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METHOD OF PRODUCING METALLIC COATINGS ON A CELLULOSE ESTER BASE

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The invention relates to a method of or process of producing metallic coatings on a base material of cellulose ester or the like.

An object of the invention is to provide a novel process by which a highly reflective coating of metal, such as silver, may be produced on a base formed of a cellulose ester.

Another object is to provide a novel process for producing a brilliantly reflective silver coating on cellulose nitrate or acetate as a base material, which process may be readily employed to coat articles manufactured from the cellulose material or thin flexible sheets of the material.

A further object is to provide a novel article of manufacture embodying a relatively thin, very flexible sheet of a cellulose ester having a highly reflective silver coating thereon, which material is inherently suitable for many uses.

The new process includes the steps of first preparing the cellulose ester base to receive the metallic coating, then depositing the coating on the base, preferably by precipitation from solution, and then treating the resulting product as required according to the intended use thereof.

In describing the steps of the process in detail, it will be considered, merely for the purposes of illustration, that a silver coating is to be produced on a base consisting of a thin sheet of cellulose nitrate.

A sheet of the cellulose nitrate, which sheets are commercially well known, is preliminarily treated by placing the sheet in a bath of rather concentrated sulphuric acid and potassium dichromate. The concentration of this solution should be controlled to insure a proper action thereof on the sheet without destroying or impairing the sheet. A completely saturated solution of potassium dichromate in sulphuric acid having specific gravity of from 60° to 70° Baumé and preferably 66° Baumé may be employed although better results are obtained if the reaction is slightly retarded by adding a relatively small amount of distilled water thereto. The proper proportion is about one part water to four parts acid. A soluion made according to the following formula has been found eminently satisfactory:

Sulphuric acid 66° Baumé	cc	100
Potassium dichromate to completely saturate about	grams	15
Water	cc	25 to 30

When the sheet has been thus preliminarily treated, it being understood of course that the sheet is removed from the bath before the solution can do more than superficially attack the surface thereof, the sheet is well rinsed preferably with distilled water and then briefly immersed in a basic solution. The basic solution may, for example, be one of sodium carbonate or bicarbonate, or sodium hydroxide. It has been found that immersion of the sheet, at this point in the process, in a solution of a tin salt, such as stannous chloride, improves the results obtained from the subsequent steps.

The sheet is again thoroughly rinsed or cleansed to remove possible residues of the acidic and basic solutions and the coating of silver immediately produced thereon. Preferably the silver coating is precipitated onto the sheet by the reduction of metallic silver from a silvering solution. While any suitable silvering solution formula may be employed, the following has been found satisfactory:

First solution

Silver nitrate	grams	4
Water	cc	100

Second solution

Ammonium hydroxide (specific gravity 0.88 to 0.9)	cc	8.3
Water	cc	100

Third solution

Potassium hydroxide	grams	4
Water	cc	100

Fourth solution

Rock candy	grams	3.5
Alcohol (Alcorub)	cc	12
Nitric acid (specific gravity 1.42)	drops	10
Water	cc	200

(In preparation, the fourth solution should be boiled for approximately ten minutes and after cooling diluted with water to replace one-half of the solution loss caused by boiling. An additional 10 drops of nitric acid is added.)

In use, equal volumes of the four solutions are thoroughly mixed together and the resulting solution at once poured over the material.

The sheet is placed in a clean receptacle and the silvering solution poured thereover, resulting in the deposition of silver on the sheet. Obviously, if only one side of the sheet, or if only one surface of a manufactured article, is to be coated, only that surface need be processed as above set forth.

When practically all of the silver has been de-

posited on the sheet, the sheet is dried. It will be found desirable in most instances to protect the coating in some manner from becoming tarnished, corroded or otherwise injured. As a suitable means for affording such protection, a thin film of a flexible and moisture-proof material may be applied to the coating. Clear or opaque lacquers and varnishes, shellac, turpentine enamel, either alone or in successive coats give satisfactory results. The base material may, if desired, be tinted or a film of tinted lacquer may be applied thereover whereby to produce a colored reflective surface of pleasing appearance.

It has been found that the natural and inherent yellowish tinge of a deposited silver coating may be substantially eliminated, with a resulting improvement in the color and reflecting properties of the coating, by effecting a combination or amalgamation of a minute quantity of mercury with the coating. To this end, the material, immediately after the silver coating has been deposited thereon and the material rinsed or cleansed, is immersed in a solution containing a mercury salt. A mercuric double salt, such as potassium mercuric cyanide, is preferred and a satisfactory solution may be prepared according to the following formula:

Potassium cyanide	grams	1.25
Mercuric cyanide	do	1.25
Dissolved in water to make	cc	50
Potassium cyanide	grams	1.25
Dilute the resulting solution to	cc	6500

Immersion of the silver coating in a mercuric double salt solution of this strength for approximately five seconds produces the desired improvement in color of the coating.

Cellulose acetate may be processed as has been described but the resulting film is apt to have a pronounced yellowish tinge due possibly to the formation of silver acetate during precipitation of the coating. This difficulty has been entirely avoided by applying a thin film of cellulose nitrate to the surface of the cellulose acetate which is to be treated before subjecting the material to the first step in the process. The nitrate coated cellulose acetate may then be processed as has been described without affecting the color of the silver coat.

From the foregoing, it will be evident that a novel process has been produced by which a new article of manufacture may be easily and cheaply obtained. The article has a brilliant reflective surface, may if desired be in the form of a very flexible sheet, and may serve many purposes. The silver film adheres firmly to the base material so that it may be flexed or otherwise roughly handled in subsequent operations without causing separation of the film from the base. The article or sheet may be embossed to produce various optical effects, may be printed or similarly processed, may be heated substantially to the point of destruction of the base, and in short may be subjected to many manufacturing processes without impairing or harming the new material.

While the invention is susceptible of various modifications and changes, I have herein described in detail the preferred embodiment, but it is to be understood that I have not thereby intended to limit the invention to the specific form disclosed, but intend to cover all modifications falling within the spirit and scope of the invention as expressed in the appended claims.

I claim as my invention:

1. The process of producing a silver coating on cellulose nitrate which consists in treating the surface to be coated with a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of approximately 66° Baumé and diluted in the approximate ratio of one part water to four parts acid, rinsing the surface to remove acid, neutralizing the surface with a basic solution and including a solution of a tin salt, precipitating a coating of silver on the surface from a silvering solution, subsequently drying the resulting material, and applying a transparent protective film to the exposed surface of the silver coating.

2. The process of producing a silver coating on cellulose nitrate which consists in treating the surface to be coated with a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of 66° Baumé and diluted in the approximate ratio of one part water to four parts acid, rinsing the surface to remove acid, neutralizing the surface with a basic solution and including a solution of a tin salt, precipitating a coating of silver on the surface from a silvering solution, subsequently drying the resulting material, applying a thin protecting coating to the exposed surface of the deposited silver, and applying a film of a substantially clear pigmented substance to the exposed surface of the cellulose nitrate.

3. The process of producing a silver coating on cellulose nitrate which consists in treating the surface to be coated with a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of 66° Baumé and diluted in the approximate ratio of one part water to four parts acid, rinsing the surface to remove acid, neutralizing the surface with a basic solution and including a solution of a tin salt, precipitating a coating of silver on the surface from a silvering solution, and subsequently drying the resulting material.

4. The process of producing a silver coating on a body of cellulose ester which consists in subjecting the surface to be processed to the action of a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of from 60° to 70° Baumé, neutralizing the surface so treated, and depositing a metallic silver coating from a silvering solution on the surface.

5. The process of producing a silver coating on a body of cellulose ester which consists in subjecting the surface to be processed to the action of a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of from 60° to 70° Baumé, neutralizing the surface so treated, depositing a metallic silver coating from a silvering solution on the surface, and effecting an amalgamation with the silver coating of a minute quantity of mercury from a solution of a mercury salt.

6. The process of producing a silver coating on a body of cellulose ester which consists in subjecting the surface to be processed to the action of a saturated solution of potassium dichromate in sulphuric acid having a specific gravity of from 60° to 70° Baumé, treating the surface with a solution of a tin salt, rinsing the surface to remove excess of the tin salt solution, and depositing a metallic silver coating from a silvering solution on the surface.

7. The process of preparing a cellulose ester to receive a metallic coating which includes the step of subjecting the cellulose ester to the action of a solution containing substantially four parts of

sulphuric acid, having a specific gravity of approximately 66° Baumé, one part of water and sufficient potassium dichromate to saturate the solution.

8. The process of preparing a cellulose ester to receive a metallic coating which includes the step of subjecting the cellulose ester to the action of a solution containing a dichromate salt dissolved to saturation in sulphuric acid having a specific gravity of from 60° to 70° Baumé.

9. The process of preparing a cellulose ester to receive a metallic coating which includes the step of subjecting the cellulose ester to the action of a solution of potassium dichromate in sulphuric acid, said solution having a strength which superficially attacks the cellulose ester.

10. The process of applying a coating of metallic silver to cellulose acetate which includes the steps of coating the surface to be treated with cellulose nitrate, and depositing by chemical precipitation a metallic silver coating on the nitrate coating.

11. The process of applying a coating of metallic silver to cellulose acetate which includes the steps of coating the surface to be treated with cellulose nitrate, subjecting the nitrate coating to the action of a solution of potassium dichromate in sulphuric acid, and subsequently depositing a coating of silver on the nitrate coating.

12. The process of applying a metallic coating to a cellulose ester material which includes the steps of subjecting the material to the action of potassium dichromate in sulphuric acid for a period of time and in such concentration as will attack but not destroy said material, cleansing the material to remove possible residues, and depositing a metallic coating thereon, said steps being continuously performed without intermediately allowing the material to dry.

13. The process of coating a cellulose ester which includes the steps of subjecting the cellulose ester to the action of a solution of potassium dichromate in sulphuric acid, said solution having a strength which superficially attacks the surface of the cellulose ester, and depositing by chemical precipitation a metallic coating on said surface.

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