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FOIL AND FILM MANUFACTURE

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The present invention relates to a process for the production of thin foils or films and more particularly to the production of thin foils or films made from or containing cellulose or cellulose derivative, the latter being organic or inorganic in nature.

Foils or films of cellulosic materials are usually made by spreading more or less viscous solutions of cellulosic derivatives on the moving surface of a flexible belt or wheel, said surface being highly polished and preferably of metal. After suitable exposure to evaporating influences the set and dried product is stripped from the surface in practically endless form. The surface upon which the dope solution is formed is subject to much wear and, due to the nature of the dope used, becomes corroded and pitted. Consequently, it is necessary to resurface or refinish the casting surfaces frequently in order to produce satisfactory foil or film. The frequent renewals of the film forming surfaces have greatly curtailed the output of the product with the consequent increase in their cost.

Another factor which contributed to lower considerably the efficiency of metal surfaced casting wheels or belts was the difficulty with which the very thin films of cellulose derivative were stripped from such surfaces. Thin films or foils containing solvents have no mechanical strength, tear easily and stick tenaciously to a metal surface even though the surface is highly polished and free from any physical imperfections.

It is accordingly an object of the present invention to provide an improved casting surface which will be free from the above mentioned and other disadvantages and which will be especially simple and inexpensive in construction and efficient in operation.

Another object of my invention is to provide a new medium for use as a film forming surface.

Still another object of the invention is the provision of a non-metallic foundation layer or substratum which is highly resistant to the deleterious action of the solvents or ingredients contained in the dope solutions and which is strongly adherent to the metal base but from which the foil or film may be readily stripped.

A further object of the present invention is to provide a film forming surface which is capable of taking a high polish and which is readily patched or repaired. Other objects and advantages of this invention will appear hereinafter in the description and claims.

I have found that improved foils or films of cellulosic materials can be produced from more or less viscous solutions of cellulose or cellulosic derivatives by brushing, spreading, pouring or spraying the dissolved cellulosic material upon a base protectively coated with a substance which is not affected or dissolved away by dope solvents or constituents.

In accordance with my invention, such a protective coat involves the use of a laminar combination consisting of a cellulosic derivative lacquer priming coat, a safety coat or intermediate layer and finally a top layer of hardened gelatin upon which the foil or film is adapted to be formed.

The following are examples of priming lacquers found suitable as first coats:

Example I

	Parts
Nitrocellulose (½ second viscosity)	100
Castor oil	12
Gum elemi	15
Ester gum	17
Dibutyl phthalate	47
Mixed alkylated toluene sulfonamids	12
Alcohols	33
Butyl acetate	18
Ethyl acetate	143
Toluol	25
Benzol	75
"Blanc fixe" (barium sulfate)	245

Example II

	Parts
Low viscosity pyroxylin	100
Blown rape seed oil	10
Soft synthetic resin (toluene sulfonamid-aldehyde condensation product)	15
"Amberol" synthetic phenol aldehyde resin)	15
Tricresyl phosphate	45–90
Mixed alkylated sulfonamids	10
Alcohols	33
Butyl acetate	20
Ethyl acetate	100
Toluol	30
Benzol	60
Ethyl ether of ethylene glycol	10
Magnesium carbonate or other suitable pigment	30–150

Example III

Pyroxylin	8 ounces
Dammar solution	½ pint
Ester gum solution	¼ pint
Elemi solution	¼ pint
Ethyl acetate	1 pint
Butyl acetate	1 pint
Butanol	½ pint
Denatured alcohol	½ pint
Benzol	2 pints
Toluol	2 pints

Example IV

Lacquer pyroxylin	6 ounces
Pyroxylin (½ second viscosity)	6 ounces
Shellac solution	½ pint
Ethyl acetate	1 pint
Butyl acetate	1 pint
Butanol	½ pint
Denatured alcohol	½ pint
Toluol	2½ pints
Tricresyl phosphate	2 ounces

This first layer acts as an adhesive to the metal to provide a good anchorage for the succeeding layer and it is to be understood that the above examples are merely illustrative, the proportions and the constituents of which may be widely varied, as is well known to those skilled in the art. Many other examples of priming lacquers could be given. These priming lacquers may have either a nitrocellulose or an organic derivative of cellulose base and are preferably those that give a matte or semi-matte finish as with lacquers having this characteristic better adhesion is secured when the second layer is applied thereon. The plasticizers may also vary but an amount must be used sufficient to obtain the desired flexibility. Vegetable oils may or may not be added to secure the desired pliability. When hard resins, such as amberol and/or ester gums are used, the addition of soft, sticky or tacky gums is necessary to obtain the proper adhesion. These gums may be of the natural variety such as gum elemi, which has the consistency of lard, or they may be any of the soft synthetic resins such as those given in Example II. It is also preferable to use a pigment or filler in the priming lacquer to improve the adhesion and to make the final coating more resistant to contraction, expansion, etc. The priming lacquer may be applied by any suitable method, such as spraying, flowing, etc. This layer which is preferably about .003'' to .008'' in thickness, should be allowed to dry about twenty-four hours before applying the second layer.

The safety or intermediate layer serves as a binder between the adhesive layer and the top layer and the following are illustrative examples of safety coats which I have found satisfactory.

Example I

	Parts
Swiss hard gelatin	100
Distilled water	200
Acetic acid	20–30
Pure methyl alcohol (photographically inert)	3000

Example II

	Parts
Swiss hard gelatin	100
Distilled water	200
Salicylic acid	40
Pure methyl alcohol (photographically inert)	3000

Other acids may of course be used besides acetic acid and salicyclic acid, such as malic acid and lactic acid. This second layer is applied to the first layer in the same manner as the latter was applied to the base and is preferably about .001'' to .005'' in thickness.

For the top coating the folowing formulae are preferable:

Example I

	Parts
Swiss hard gelatin	100
Distilled water	400–800
Glycerine	48
Potassium dichromate	1

Example II

	Parts
Swiss hard gelatin	100
Distilled water	400–800
Glycerine	48
Potassium dichromate	6

The above formulae represent gelatin solutions in which the hardening agent, potassium dichromate, is introduced in the formula. However, other soluble chromium salts, such as ammonium dichromate and chrome-alum, may be used for hardening the gelatin ammonium dichromate being particularly effective. The gelatin may also be suitably hardened by treating it with tannic acid and its derivatives. As is well known, the hardening action of these substances takes place only by exposure to sunlight or to rays from any suitable actinic source, such as a Cooper Hewitt lamp. Gelatin solutions may also be hardened by treating them with a formaldehyde solution in which case exposure to an actinic source is not necessary. It is to be understood that the gelatin in the above formulae may be replaced by other proteid substances such as casein, glue, etc., the casein being hardened with formaldehyde.

In making up the gelatin solutions I prefer to omit the dichromate salt. These solutions, which are preferably at a temperature of 40° C., are applied while warm to the wheel or flexible belt either by flowing or dipping and subsequently chilled, if found desirable. After the first coating is dried or set, a second layer of gelatine solution is applied. This process is repeated a third time, if necessary, to obtain the proper depth of coating. After the final gelatin coating has set, the coated wheel or belt is passed through a 2½% potassium or ammonium dichromate solution at room temperature in order to bring about a reaction with the gelatin. A three to ten minute immersion in the dichromate solution being usually found sufficient. After the penetration of the dichromate solution into the gelatin layer, the hardening is accomplished by exposing the treated surface to actinic rays, the exposure being prolonged for a sufficient length of time to bring about the requisite hardening or insolubilization of the gelatin. When sunlight is used as the actinic source, the duration of the exposure depends upon the intensity of the rays. Generally five to fifteen hours of exposure has been found sufficient. With a Cooper-Hewitt lamp, the time of exposure is usually lessened.

In the case of a wheel, I have found that only the top gelatin coatings applied to the surface provide a satisfactory casting surface. However, the three layer combination may be used if it is so desired. Where greater flexibility is desirable, as in the case of a belt machine, the three-layer combination is more suitable.

The term "film" as used in the specification and in the appended claims is to be construed

as including within its scope sheets and foils as well as films.

The foregoing description is given merely by way of illustration and many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I desire to secure by Letters Patent is:

1. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution, covering the surface thus formed with a layer of another gelatin solution and treating the gelatin layers with a dichromate solution and then hardening the treated surface.

2. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution, covering the surface thus formed with a layer of another gelatin solution and treating the gelatin layers with an ammonium dichromate solution and then hardening the treated surface.

3. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution containing an organic acid, covering the surface thus formed with a layer of another gelatin solution and then hardening said gelatin layers.

4. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution containing acetic acid, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with a dichromate solution and then hardening the same.

5. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution containing salicylic acid, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with a dichromate solution and then hardening the same.

6. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution containing an organic acid, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with an ammonium dichromate solution and then hardening the same.

7. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution containing acetic acid, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with an ammonium dichromate solution and then hardening the same.

8. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with a dichromate solution and then exposing the same to actinic rays to harden the surface.

9. Method of making a film forming surface which comprises coating a base with a lacquer, applying to said lacquer coating a layer of gelatin solution, covering the surface thus formed with a layer of another gelatin solution, treating the gelatin layers with an ammonium dichromate solution and then exposing the same to actinic rays to harden the surface.

10. A casting bed for the production of films, foils, sheets and the like which consists of a layer of hardened proteid substance upon another layer of proteid substance which is bonded by means of an intermediate layer of lacquer to a casting base.

11. A casting bed for the production of films, foils, sheets and the like which consists of a layer of hardened gelatin upon another layer of gelatin bonded by means of an intermediate layer of lacquer to a casting base.

12. A casting bed for the production of films, foils, sheets and the like which consists of a layer of hardened gelatin upon another layer of gelatin bonded by means of an intermediate layer of lacquer to a flexible casting base.

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