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COATING PROCESS

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This invention relates to the treatment of textile fabrics to form an impervious coating thereon, and relates more particularly to the coating of textile fabrics having a basis of yarns of continuous filaments, which are employed to cover airplane surfaces.

An object of my invention is the application of an impervious and weather-proof coating having a basis of a cellulose derivative to textile fabrics having a basis of yarns of continuous filaments and employed for covering airplane wing, fuselage and control surfaces.

Another object of my invention is the application of an impervious and weather-proof coating to cellulose derivative textile fabrics, which coating will be permanently adherent to the fabric.

Other objects of my invention will appear from the following detailed description.

In the construction many types of airplanes wherein the wing load is light, cloth is extensively employed for covering wing, fuselage, tail, and other surfaces of the airplane. To be satisfactory such cloth must possess great strength. Generally, such cloth is woven in a tight compact weave from yarns of high tenacity so as to form a fabric capable of resisting the various stresses and strains placed upon it. In order to weather-proof the fabrics and also to cause them to be stretched tightly over the frame or structure of the airplane after they are attached thereto, the fabrics are usually coated with a coating composition comprising solutions of a cellulose derivative in a suitable solvent. The effect of this coating composition is two-fold. Upon drying it not only forms a smooth, impervious weather-proof coating but it also shrinks, thus causing the fabric to which it is applied to become taut and to stretch tightly across the airplane structure. Where a fabric woven from yarns spun of relatively short, staple fibers such as, for example, cotton is employed, the coating becomes anchored to the fabric by means of the many individual short fiber ends projecting from the surface of the fabric. Before the coated fabric is ready for service, however, it is essential that every projecting fiber be completely covered by the coating composition. To this end the coated fabrics are normally sanded down to remove any projecting fibers and the fabrics are then coated again. This process of sanding and recoating is repeated until all projecting fibers are covered. In most cases, to accomplish this, it is necessary to repeat the procedure eight to ten times. Should any individual fibers be permitted to remain incompletely covered and thus exposed to the elements, the exposed fibers act as wicks and by capillary action draw moisture down into the fabric below the protective coating, thus overcoming the effectiveness of the weather-proof coating and seriously impairing the life of the fabric.

The above disadvantage which is inherent in the use of fabrics woven of yarns of staple fibers may in some degree be overcome by employing fabrics woven of continuous filament yarns. By using such fabrics, sufficient coating material may be applied to the fabric with relatively few coats since there are no individual fibers projecting from the surface of the fabric and it is unnecessary to sand the coated material. The use of such fabrics, however, has a serious drawback since the coating material does not adhere with a satisfactory degree of strength to the smooth surface of the yarns or filaments comprising the fabric. This inherent lack of cohesion between the coating material and the fabric is due to the absence of projecting fibers, and in time permits the coating to separate from the fabric forming blisters and peeling after a relatively short period of service.

I have now discovered that coating compositions comprising solutions of cellulose derivatives may be caused to adhere tenaciously to fabrics woven of yarns having a basis of continuous filaments. In accordance with my invention I treat fabrics woven of continuous filament yarns with a material which acts as a plasticizer for the cellulose derivative comprising the coating composition, and the coating composition is applied thereto. I have found that the coating composition adheres to the structure of fabric containing the plasticizing material to a markedly greater extent than when the plasticizer is absent and that the bond between the fabric and the coating composition is of considerably increased strength and tenacity. The coating composition may be satisfactorily applied with relatively few individual coats and even after hard service the coated fabric remains free of blisters, and peeling and cracking are wholly eliminated.

The continuous filament yarns which may be employed in the weaving of fabrics to be treated in accordance with my invention are preferably yarns of regenerated cellulose. Such yarns may be obtained by the wet spinning of viscose solutions in a manner well known to the art. Suitable continuous filament yarns of regenerated cellulose having an unusual degree of strength may be obtained by the saponification of dry-spun, stretched yarns having a basis of an organic derivative of cellulose. Preferably, I employ the latter due to the fact that they may be produced so as to possess unusual strength and thus are highly satisfactory for the production of fabrics which are capable of bearing a substantial degree of stress.

Any suitable plasticizer or mixture of plasticizers may be incorporated with the fabrics to

produce the desired strong bond between the fabric and the coating composition when the latter is applied thereto. Among the suitable plasticizers which may be employed are, for example, the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glycol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate. The plasticizers may be applied to the fabrics after they are woven as by passing the fabric through a suitable bath containing the plasticizer, for example, a solution of the plasticizer in a volatile solvent therefor such as ethyl alcohol, by padding the plasticizer or solution of plasticizer on to the fabric and then removing the excess by means of squeeze rolls, or the plasticizers may be applied to the fabric in any other suitable manner. Furthermore, the plasticizer alone or in a suitable solution may be applied to the yarns before weaving as by means of wicks, rollers, or other suitable furnishing devices and the fabric may then be woven from the plasticized yarn. Where yarns having a basis of a saponified organic derivative of cellulose are employed, the plasticizer may, if desired, be incorporated into the solutions of the organic derivative of cellulose from which the yarns are spun, the regeneration of the cellulose by saponification of the yarns being carried out in such a manner that the plasticizer is retained in the body of the individual filaments comprising the yarn whereby a uniform distribution of the plasticizer is achieved throughout the fabric, thus ensuring a uniform bonding effect when the fabric is subsequently coated. I have found that excellent adhesion of the coating composition may be obtained when from 2 to 10% of plasticizer, based on the weight of the fabric, is incorporated in or applied to the fabric by any of the means described. Preferably, however, I employ from 3 to 5%, based on the weight of the fabric, of plasticizer.

The coating compositions which may be applied to produce an impervious and weatherproof coatings are well known to the art and preferably comprise solutions of a cellulose derivative in a suitable volatile solvent or mixture or solvents. Examples of derivatives of cellulose which may be employed to form the bases of the coating compositions are organic esters of cellulose such as cellulose acetate, cellulose propionate and cellulose butyrate, mixed esters such as cellulose acetate-propionate and cellulose acetate-butyrate, inorganic esters such as cellulose nitrate and cellulose ethers such as ethyl cellulose and benzyl cellulose.

Various volatile solvents and mixtures of volatile solvents may be employed in formulating the coating compositions. Suitable volatile solvents which may be employed, depending upon the particular cellulose derivative which it is desired to dissolve, are, for example, ethyl alcohol, acetone, butyl alcohol, ethyl acetate, butyl acetate, butyl propionate, ethyl lactate, diacetone alcohol, and ethylene dichloride. In order to modify the drying and other characteristics of the coating compositions such as flow, for example, non-solvents for the cellulose derivatives such as benzol, toluol, xylol, solvent naphtha and benzine may be added to the coating composition. For increased flexibility in the coating upon evaporation of the volatile solvents and non-solvents, plasticizers such as those incorporated with the fabric may, if desired, be added to the coating composition.

Natural or synthetic resins may also be included in the coating composition to improve the strength of the resulting coating. Among the suitable synthetic resins are those obtainable by the condensation of phenols with aldehydes or ketones, those obtainable by the condensation of urea with aldehydes, such as formaldehyde, the condensation products of phthalic anhydride or other dibasic acid anhydride with polyhydric alcohols such as glycerol, and many others. Natural resins such as kauri copal, manila copal and congo copal, and gums such as gum elemi are also suitable.

In order further to illustrate my invention, the following example is given:

Example I

A fabric having a warp of 100 ends per inch and a weft of 100 picks per inch and comprising 60 denier continuous filament yarn prepared by saponifying stretched continuous filaments having a basis of cellulose acetate is immersed in a solution consisting of 10 parts by weight of the dimethyl ether of ethylene glycol phthalate and 90 parts by weight of ethyl alcohol. The treated fabric is then subjected to a centrifuging operation, and upon evaporation of residual alcohol there is incorporated in the fabric 4% of the plasticizer on the weight of the fabric. The fabric is then cut and sewn to shape and attached in the form of a tightly fitting slip cover to a portion of the frame of an airplane structure. The fabric is then coated with a coating composition made up as follows:

	Parts by weight
Nitrocellulose	0.5
Ethyl acetate	3.25
Amyl acetate	1.59
Ethyl alcohol	0.134
Benzol	2.35

After the first coat has dried a second coat is applied and permitted to dry. After the second coat has dried the fabric has shrunk to fit, stretchnig tautly across the airplane structure. The resulting coating adheres tenaciously to the fabric and even after long exposure to the action of the elements remains free of blisters and resistant to cracking and peeling.

Example II

A fabric woven of regenerated cellulose yarns as described in Example I is padded with a solution of tricresyl phosphate in acetone so as to incorporate therein 5% of tricresyl phosphate on the weight of the fabric. This treated fabric is then cut and sewn and then placed on the frame of an airplane structure. The fabric is then coated with a coating composition made up as follows:

	Parts by weight
Cellulose acetate	75.0
Acetone	396.0
Methyl ethyl ketone	67.1
Ethyl alcohol	92.0
Benzol	102.5
Benzyl alcohol	17.5
Triphenyl phosphate	15.0

Several coats are applied and permitted to dry thoroughly between applications. The coating composition shrinks the fabric and stretches it tautly on the frame of the airplane structure. The coating adheres to the plasticizer-containing

fabric most tenaciously and is highly resistant to the action of the elements. The coating remains free of blisters and is resistant to cracking and peeling.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that 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. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of a film-forming derivative of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns and containing a plasticizer for the derivative of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glyco, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

2. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of an ester of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns and containing a plasticizer for the ester of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glycol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyi phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

3. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of a film-forming derivative of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of an organic ester of cellulose, and containing a plasticizer for the derivative of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glycol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphat , tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

4. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of an ester of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of an organic ester of cellulose, and containing a plasticizer for the ester of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycolate, triethylene gylcol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

5. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of a film-forming derivative of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of cellulose acetate, and containing a plasticizer for the derivative of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glycol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

6. Process for preparing a fabric having a strongly adherent coating thereon, which comprises applying a coating composition having a basis of an ester of cellulose to a fabric prepared from continuous filament regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of cellulose acetate, and containing a plasticizer for the ester of cellulose of said coating composition, selected from the group consisting of the dimethyl ether of ethylene glycol phthalate, dimethyl phthalate, ethyl phthalyl ethyl glycollate, triethylene glycol, triacetin, tripropionin, mono-ethyl-p-toluene sulfonamide, triphenyl phosphate, tricresyl phosphate, diethyl phthalate, dimethoxy ethyl phthalate, dibutyl tartrate, camphor and dibutyl phthalate, said coating composition shrinking upon drying to cause a shrinkage of said fabric.

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