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METHOD OF MAKING PREDOPED FABRIC

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This invention relates to the manufacture of fabrics for use particularly as coverings for those portions of airplanes where it is desired to present a smooth, taut surface presenting the minimum of resistance to the flow of air currents.

It is common practice to coat such fabrics with a so-called "dope" containing cellulosic material and ingredients which will evaporate to cause shrinking of the fabric after it is secured in place, so that the fabric will become taut, smooth and impervious to air. The dope may be applied to the fabric in a suitable coating machine, and the doped fabric dried while held against more than limited shrinking. The dried doped fabric may later be secured in place on the frame, and treated with a solvent for the dope or with further dope, and permitted to dry and shrink and become taut in place. It is important that the predoped and dried fabric be supple and somewhat stretchable, so that it can be readily secured in a smooth condition on the frame of the airplane and in various compound curves, and it is important that the fabric be shrinkable to a substantial extent after being applied and during the later drying step or steps.

One object of my invention is to provide a pre-doping procedure which will produce a fabric which is softer and more pliable, and therefore more easily applied and secured in position. Such softness and pliability are obtained by preventing the dope from locking together the warp and filler threads at the points of crossing, so that they are free for individual relative movement.

A further object of my invention is to provide a predoping proceeding which will cause the minute fibers on the nap on the cloth to become anchored down on the individual threads and parallel with the plane of the cloth fabric, so that a smoother final surface is obtained, and the need for sanding of subsequent coats is greatly reduced or eliminated.

I am aware that it has been proposed to wet the fabric with water and then coat it with a cellulose composition emulsified in water. The water is preferably in the external phase. Normal shrinkage is allowed to take place during the drying and the fabric is then subjected to a stretching operation, in the filler direction, by means of the tenter-frame. The net result of this operation is to produce fine, discrete checks in the film. It has been disclosed that this process produces a product having poor film anchorage and there is a tendency for the film to "crock off." If the water-wetted fabric is coated with a cellulosic material on a tenter-frame, the precipitation of the film of dope is not sufficient to produce a softness and pliability equivalent to that produced when an emulsion of water and naphtha is used.

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I first discovered that practically complete precipitation of the solids can be brought about if a volatile liquid hydrocarbon which is a non-solvent for the solids, such as naphtha, is used, instead of water to pre-wet the fabric. While this gives the desired degree of softness and pliability of the coated fabric, the anchorage of the film is poor, and the coating material "crocks off" with very little abrasion. Also, where the film has "crocked off," the nap fibers are no longer embedded in the dope film but are free to protrude above the surface of the surrounding area. This results in a surface which is relatively rough and which requires a sanding operation which defeats the purpose of coating the fabric.

I finally discovered that by wetting the cloth with a water emulsion of a volatile liquid hydrocarbon, such as naphtha, the precipitation of the cellulosic material of the applied dope will be confined almost entirely to the interfacial area between the dope and the cloth, the coating will be well anchored, will substantially fill the interstices between the threads with little or no impregnation of them or interlocking of them together, and will present a substantially continuous, smooth coating on the exterior face of the fabric.

The following is an example of one way in which my improved process may be carried out.

Any fabric suitable for the desired purpose may be employed, such for instance as one having 90 two-ply warp threads and 90 two-ply filler threads per inch, the fabric weighing four ounces per square yard. This is passed through a trough containing an emulsion of water and naphtha, and then passed between rollers to squeeze out excess liquid. The dope is applied to the upper surface of a horizontal run of the wetted fabric, and the fabric is drawn between a supporting bar and a superposed doctor blade which spreads the dope as a thin uniform coating or layer. The doped sheet is then passed through a heated chamber where the solvent materials are driven off and recovered, by a process common to the industry. It is then rerolled and finally subjected to a calendering operation.

An example of an emulsion of water and volatile liquid hydrocarbon which may be used, in parts by weight, is:

	Parts
Aliphatic hydrocarbon with a distillation range of 210° F. to 250° F. (This is known to the trade as "Troluoil")	48
Emulsifying agent, sorbitan monooleate polyoxyalkylene derivative	2
Water	50

An example of a predoping material which may be applied to the wetted fabric, and which in-

cludes a cellulosic derivative, a plasticizer and a volatile solvent, in parts by weight, is:

	Parts
Nitrocellulose of 30 to 40 seconds viscosity, wet with 20% alcohol	10
Dibutyl phthalate	2
Raw castor oil	2
Ethyl acetate	45
Alcohol	35
Troluoil	20

The final product, after calendering, is a soft, pliable fabric which can be readily tailored and made to conform to any of the compound curvatures found on aircraft. The coated surface is very smooth. The fabric interstices are filled and the normal nap is completely laid and covered with a film of the coating composition. Excellent results have been obtained where this product has been used to cover aircraft surfaces.

There is no difficulty in hand sewing, machine sewing, or attaching the fabric at rib sections of the airplane.

The examples contained herein do not constitute a limitation on the type of material that can be selected for emulsification or for the coating composition. Both the cellulose esters and the cellulose ethers may be used in the coating composition. The plasticizer percentage is not a limiting factor, as greater or lesser percentages can be used with equal satisfaction.

In the example given an emulsion of water and Troluoil is used. The solvent blend in the nitrocellulose composition consists of ethyl acetate, ethyl alcohol and Troluoil. The evaporation rate of the ethyl acetate, which is the only active solvent used, is more rapid than the evaporation rate of the water-Troluoil mixture. The water and Troluoil mixture is a precipitant for the nitrocellulose, and being present after the evaporation of the solvent, produces the interfacially precipitated condition of the film. If an emulsion of an aliphatic hydrocarbon of a slower evaporation rate than that of Troluoil is used, the solvent blend in the coating composition is modified, so that the active solvents evaporate from the film just prior to the water-hydrocarbon mixture. The selection of hydrocarbons of different evaporation rates will depend upon the conditions in drying and the speeds of the coating operations. Naturally, with the more rapidly evaporating solvents being used, higher coating speeds can be maintained. For this reason it will be obvious that the more rapidly evaporating solvents will be most generally used.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The process of preparing a predoped fabric for use in covering airplane frames and the like, which includes saturating cloth with an emulsion of water and a volatile liquid hydrocarbon, applying to the wetted cloth a solution of a cellulose derivative and a plasticizer in a volatile solvent, said solvent having a higher rate of evaporation than said liquid hydrocarbon-water mixture, and evaporating said solvent, liquid hydrocarbon and water.

2. The process of preparing a dry, flexible, stretchable coated fabric for use on airplanes and other structures, which includes wetting cloth with an emulsion of water and a volatile liquid hydrocarbon, and applying to the so wetted cloth a water-insoluble coating composition containing a cellulose derivative, a plasticizer and a volatile solvent, said liquid hydrocarbon, water and solvent evaporating as a mixture, and the rate of evaporation of the solvent being more rapid than that of the mixture of liquid hydrocarbon and water.

3. The process of preparing a dry, flexible, stretchable coated fabric for use on airplanes and other structures, which includes wetting cloth with an emulsion of water and a volatile liquid hydrocarbon, applying to the so wetted cloth a water-insoluble coating composition containing a cellulose derivative, a plasticizer and a volatile solvent, and heating the coated fabric to remove said solvent, said liquid hydrocarbon and said water, substantially in the order named.

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