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COMPOSITE FABRIC AND METHOD OF MAKING THE SAME

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This invention relates to the preparation of stiffened fabrics and also to wearing apparel or other technical or commercial articles formed in whole or in part of such stiffened fabrics.

This application is a continuation-in-part of my copending application S. No. 743,835 filed September 13, 1934.

An object of my invention is to prepare fabrics of any desired degree of increased stiffness and in a simple and expeditious manner. A further object of my invention is to prepare wearing apparel and other technical or industrial articles consisting of or containing such stiffened fabric. Other objects of the invention will appear from the following detailed description.

In the making of stiffened fabrics by causing cellulose acetate or other organic derivative of cellulose or other thermoplastic yarns to melt or coalesce by operations involving the application of heat and pressure, it has previously been considered necessary to have present during this operation acetone or other volatile organic solvent for the derivative of cellulose. In the preparation of laminated fabric, such volatile solvent has been applied to the assembly of fabrics, one or more of which contains the organic derivative of cellulose yarn. However, if an assembly of fabrics is to be laminated, in which the outer layer of fabric contains organic derivative of cellulose yarn, upon the application of heat and pressure in the presence of the solvent, the organic derivative of cellulose yarn coalesces, with the result that the original appearance of such outer fabric is destroyed, due to the partial or complete coalescence of the organic derivative of cellulose yarn therein.

I have found that if plasticizers for the cellulose acetate or organic derivative of cellulose or other thermoplastic material are present only in such fabric or fabrics containing organic derivative of cellulose yarn which is to be coalesced, and not present in such fabric containing the organic derivative of cellulose yarn, say the outer fabric, which is not to be coalesced, good stiffening effects and firm adhesion may be obtained by the application of heat and pressure, particularly if water or moisture is present during the pressing. However the organic derivative of cellulose yarn in the fabric in which no plasticizer is present or has been applied, suffers little if any coalescence or change in appearance. In this manner it is possible to make laminated fabric in which the outer layer of fabric contains organic derivative of cellulose yarn and which retains substantially its original appearance.

The products formed by this invention may be used for any purpose where a stiffened and/or relatively impermeable fabric is desired. An important application of such products is wearing apparel which may be formed in whole or in part of fabrics made or prepared in accordance with this invention. Thus collars or cuffs may be formed entirely of the product of this invention. Alternatively, shirts may be made wherein the attached collars, neckbands, cuffs, fronts or bosoms are made of such products. Hats or parts of hats may likewise be formed of such material, as may also be the inner or sweat bands of hats, visors for caps, cuffs of gauntlets, inner linings for cravats, stiffening material used in the inner portions of garments such as coats, to help retain the shape thereof, etc. The fabrics of this invention may be used for a variety of other purposes, and indeed may be used for any industrial or technical purpose where fabric of increased stiffness and/or impermeability is required.

In order that the desired degree of stiffening and adhesion be attained upon the hot pressing in the presence of water, it is of importance that there also be present in the assembly being treated a plasticizer or relatively high boiling or non-volatile solvent for the cellulose acetate. This plasticizer may be caused to be present in any manner. Thus it may be incorporated with the cellulose acetate yarns or filaments, either by way of the dope or spinning solution from which it is formed, or by spraying, dipping or otherwise treating the cellulose acetate yarns or filaments, or the fabric containing the same, with the plasticizer or a mixture or solution of the plasticizer with a volatile solvent such as benzol or preferably ethyl or methyl alcohol or other swelling or penetrating agent for the derivative of cellulose, and permitting the solvent to evaporate.

Any suitable plasticizer may be employed, which plasticizer may or may not be soluble in water. Examples of suitable relatively water insoluble plasticizers for cellulose acetate are dimethyl phthalate, diethyl phthalate and di-methoxyethyl phthalate, $(C_6H_4(COOCH_2.CH_2OCH_3)_2$; while examples of relatively water soluble plasticizers are diethyl tartrate, dimethyl tartrate, monoacetin, diacetin, triacetin, etc. A mixture of two or more of these plasticizers may be used. In some cases it is advantageous to employ a mixture of water soluble and water insoluble plasticizers, so that upon subsequent laundering the whole or part of the water soluble plasticizer is removed. The amount of plasticizer present is preferably substantial, and is on the order of from less than 25% to 150% or more of the weight of the cellulose acetate present.

In one form of this invention the assembly of fabrics comprising cellulose acetate yarns or filaments employed as starting material may first be cut, sewn or otherwise shaped. After the desired articles, such as collars, cuffs or other wearing apparel or parts thereof are formed, plasticizer being present therein, they may then be treated with water and then subjected to heat

and pressure to impart the desired stiffness and/or impermeability.

Products of this invention have any desired degree of stiffness, which is relatively permanent, so that they may be subjected to repeated laundering without substantially losing their stiffness. In this manner the use of starch or other extraneous stiffening materials during laundering may be avoided.

The assembly to be treated should comprise at least two layers of fabric, which either consists wholly of cellulose acetate yarn or which is a mixed fabric containing yarn of cellulose acetate alternating either in the warp or in the weft or both, in any desired degree of alternation, with yarns of other non-thermoplastic fibres such as cotton, regenerated cellulose, linen, wool or natural silk. This alternation may be for instance 1, 2, 3 or more cellulose acetate yarns with 1, 2, 3 or more yarns of cotton or other nonthermoplastic fibres. For convenience the warp may be made with such alternation of cellulose acetate yarn and yarn of other fibres, while the weft may consist wholly of such cellulose acetate yarn or wholly of yarn of other fibres. However the weft may consist of an alternation of such cellulose acetate yarns and non-thermoplastic yarns of other fibres, in which case, if the fabric is made in ordinary looms, the alternations will be preferably in two's or multiples of two's. If desired a fabric may be used in which either the warp or the weft consists wholly of cellulose acetate yarn while the other component consists of non-thermoplastic yarn.

Instead of employing a woven fabric, a knitted or netted fabric may be employed. Also a fabric containing mixed yarn containing both filaments of cellulose acetate and fibres of cotton or other non-thermoplastic material may be employed.

Two, three, four or more of such fabrics may be assembled and these fabrics may be of the same or different construction. In order that the layer of fabric that is to be exposed to view should retain its fabric structure and appearance by avoiding coalescence of the cellulose acetate yarn therein, it is important that no plasticizer be present in this layer, the plasticizer being present only in such layers of fabric in which the cellulose acetate yarn is to be caused to coalesce. The assembly of the 2, 3 or more of such fabrics is preferably treated with water, and in the presence of a plasticizer, heat and pressure is applied to the whole surface to form a composite fabric that is united throughout, or only in local areas by application of heat and pressure only at the desired local areas.

In order to increase the opacity of the final product or to impart special color effects thereto, finely divided white pigments such as titanium dioxide or antimony trioxide or colored pigments such as lamp black may be incorporated with the cellulose acetate yarn.

As instances of the manner that the various fabrics may be assembled, the following are given. In the case of collars, cuffs, etc. where an exterior appearance of ordinary textile fabric is desired, a layer of fabric consisting wholly of or containing cellulose acetate yarn, as above described, and to which plasticizer has been applied, may be interposed between two layers of a mixed fabric consisting of cotton, linen or other non-thermoplastic fibres and yarns of cellulose acetate, of any desired construction and to which no plasticizer has been applied.

To obtain good adhesion, water should preferably be present during the application of heat and pressure in accordance with this invention. The water or aqueous liquid may be applied to the assembly of fabrics having an intermediate layer containing cellulose acetate yarn and plasticizer in any suitable manner, such as by dipping, spraying or brushing. A convenient manmanner of wetting the assembly is by padding the same with water. Both sides of the assembly should be wetted with the water, as it is desirable that all of the layers of the fabric present be wetted therewith when heat and pressure is applied.

The so wetted assembly of fabrics is then subjected to heat and pressure. This may be done by any suitable device, for instance by hot ironing or by passing between pressure rolls, one or both of which are heated, or between a heated roller and a heated or cold plate or surface, or between a heated pressing iron or plate and a cold board or surface. The heating device may be heated to the desired temperatures for instance 80 to 180° C. or more and the pressure applied may be any desired pressures, for instance from 10 to 600 pounds per square inch.

If heated devices that have desired designs, such as stripes, dots, rectangles or other geometric, floral or other designs, embossed thereon are employed, novel effects are obtained, since only those portions that come in contact with the embossed portions of the heated device become united, while the other portions retain the properties of the original fabrics. This local application of heat and pressure may be done by manually operated means if desired. By locally applying or having present the plasticizer only in those places that are to be united, the union of other portions upon subsequent laundering is avoided.

By this method there is produced a laminated fabric in which the cellulose acetate yarn in the fabric not containing the plasticizer has not been coalesced at least on the outer or visible side of the fabric, while the cellulose acetate yarn in the fabric containing such plasticizer has coalesced or melted to form a firm union. In this manner a laminated product having an outer layer of fabric containing cellulose acetate yarn may be produced which has substantially the original appearance of such fabric.

In order further to illustrate my invention but without being limited thereto, the following detailed examples are given.

Example I

A fabric having a warp of 120 ends per inch comprising one end of acetone soluble cellulose acetate yarn of 150 denier alternating with one end of bleached cotton yarn of 40/1 count and a weft of 76 picks per inch of bleached cotton yarn of 40/1 count, has applied thereto by spraying, dipping or padding the following mixture:

	Parts by weight
Di-methoxyethyl phthalate	50
Triacetin	20
Ethyl alcohol	30

The amount of di-methoxyethyl phthalate and triacetin applied is 45% of the weight of the fabric.

For making fabrics to be used for making a desired article, there is employed an assembly of two layers of fabric consisting of a weft of cellulose acetate yarn and a warp of cotton or linen with an interposed layer of the fabric containing both

acetone soluble cellulose acetate filaments and the plasticizer.

The assembly is then wetted on both sides with water. Thereupon the assembly is pressed with a hot iron or calender to form a stiffened material in which the fabrics are united. Preferably the heating and pressing is done on both sides of the assembly. By way of example, in the making of collars a pressure of 90 lbs. per square inch on the press and a temperature corresponding to 75 lbs. per inch steam pressure may be used. By controlling the degree of heat and pressure and/or selection of the type of fabrics employed and the amount of cellulose acetate present, and/or the amount of plasticizer present the degree of stiffness may be controlled. Generally a semi-stiff fabric is formed, which retains its stiffness after repeated laundering so that the use of starch or like material is not required.

The outer fabrics of the laminated product retain substantially the original appearance of such fabrics despite the fact that they contain cellulose acetate yarn, since owing to the absence of plasticizer in such outer layers of fabric, substantially no coalescence or melting of the cellulose acetate yarn at least on the outer surface has taken place.

Example II

The method of Example I is carried out with the exception that the amount of the di-methoxyethyl phthalate, triacetin and alcohol mixture applied is such that the amount of di-methoxyethyl phthalate and triacetin applied is only 25% of the weight of the fabric, and instead of employing a mixed fabric containing cotton and cellulose acetate yarn as the two outer layers of the assembly, a woven fabric consisting wholly of cellulose acetate yarn is employed.

A well stuck laminated product is produced in which the outer surfaces retain the appearance of the textile fabric, substantially no coalescence or melting of the cellulose acetate having taken place on at least the outer surface.

If collars or cuffs or bosoms or other articles which are to be sewn onto shirts or other articles of apparel are to be formed, it is advantageous to cut the assembly of fabrics to the desired shape or form and sew it to form the article prior to the application of the water and the heat and pressure so that the assembly is stiffened and united by wetting with water and application of heat and pressure only after the article is completed.

The fabrics and articles obtained by this invention may be made more or less stiff as desired by controlling the amount of cellulose acetate present in the layer containing the plasticizer in the assembly of fabrics being treated; the more cellulose acetate present, the stiffer the resultant products. Likewise the softness may be controlled by the amount of plasticizer present, the larger the amount of plasticizer the softer the product.

While this invention has been described particularly in connection with cellulose acetate, such cellulose acetate may be replaced in whole or in part by other derivatives of cellulose such as cellulose nitrate, or cellulose formate, cellulose propionate, cellulose butyrate, or other organic esters of cellulose, or methyl cellulose, ethyl cellulose and benzyl cellulose or other cellulose ethers or other thermoplastic materials. In each case a suitable plasticizer for the particular derivative of cellulose will be chosen.

The term "plasticizer" as herein employed is intended to include relative nonvolatile substances having a plasticizing, softening or solvent action upon the derivative of cellulose or other thermoplastic material or any other material that facilitates the coalescence.

It is to be understood that the foregoing detailed 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 by invention, what I desire to secure by Letters Patent is:

1. Wearing apparel or other industrial or technical articles comprising a plurality of fabrics containing both non-thermoplastic fibres and thermoplastic cellulose derivative yarns or filaments, said articles having an increased stiffness due to the presence between two of said fabrics of an intermediate layer of cellulose derivative yarns or filaments which have been subjected to heat and pressure in the presence, in said layer only, of a plasticizer for the cellulose derivative, the derivative of cellulose yarns or filaments in the fabrics free of plasticizer retaining their original appearance.

2. Collars, cuffs and like articles comprising an assembly of fabrics of which at least one of the outer layers is a fabric containing both cellulose acetate yarns or filaments and non-thermoplastic fibres, said articles having an increased stiffness due to the presence between two of said fabrics of an intermediate layer of cellulose acetate yarns or filaments which have been subjected to heat and pressure in the presence of water and a plasticizer for the cellulose acetate, the cellulose acetate yarns or filaments in the outer layers of the fabric retaining their original appearance.

3. A product of increased stiffness in at least a part thereof, or wearing apparel or other industrial or technical articles containing the same, comprising a plurality of fabrics containing both non-thermoplastic fibres and thermoplastic organic derivative of cellulose yarns or filaments, which fabrics are united by means of an intermediate layer of organic derivative of cellulose yarns or filaments that have been subjected to heat and pressure in the presence of water and a plasticizer for the organic derivative of cellulose, the organic derivative of cellulose yarns or filaments in at least one of the outer fabrics of the assembly retaining their original appearance.

4. A product of increased stiffness in at least a part thereof, or wearing apparel or other industrial or technical articles containing the same, comprising a plurality of fabrics containing both non-thermoplastic fibres and cellulose acetate yarns or filaments, which fabrics are united by means of an intermediate layer of cellulose acetate yarns or filaments that have been subjected to heat and pressure in the presence of water and a plasticizer for the cellulose acetate, the cellulose acetate yarns or filaments in at least one of the outer fabrics of the assembly retaining their original appearance.

5. The method of preparing a stiffened laminated fabric comprising applying heat and pressure at least locally to an assembly of fabrics containing thermoplastic cellulose derivative yarns or filaments, there being present plasticizer for the cellulose derivative in at least one of said fabrics which is between two of said fabrics and at least one of the outer fabrics of the assembly being free of plasticizer for the cellulose derivative, the cellulose derivative yarns or filaments in the fabric free from plasticizer retain-

ing their original appearance in the finished product.

6. The method of preparing a stiffened laminated fabric comprising applying heat and pressure in the presence of water at least locally to an assembly of fabrics containing thermoplastic derivative of cellulose yarns or filaments, there being present plasticizer for the derivative of cellulose in at least one of said fabrics which is between two of said fabrics and at least one of the outer fabrics of the assembly being free of plasticizer for the cellulose derivative, the cellulose derivative yarns or filaments in the fabric free from plasticizer retaining their original appearance in the finished product.

7. The method of preparing a stiffened laminated fabric comprising applying heat and pressure in the presence of water at least locally to an assembly of fabrics containing cellulose acetate yarns or filaments, there being present plasticizer for the cellulose acetate in at least one of said fabrics which is between two of said fabrics and at least one of the outer fabrics of the assembly being free of plasticizer for cellulose acetate, the cellulose acetate yarns or filaments in the fabric free from plasticizer retaining their original appearance in the finished product.

8. The method of preparing a stiffened laminated fabric comprising applying heat and pressure at least locally in the presence of water and a plasticizer for a thermoplastic derivative of cellulose to a plurality of fabrics each containing derivative of cellulose yarns or filaments, under such conditions that the derivative of cellulose yarns or filaments of at least one of the surface layers of the fabric are free of plasticizer and retain their original appearance in the finished product.

9. The method of preparing a stiffened laminated fabric comprising applying heat and pressure at least locally in the presence of water and a plasticizer for the cellulose acetate to a plurality of fabrics each containing cellulose acetate yarns or filaments, under such conditions that the cellulose acetate yarns or filaments in at least one of the surface layers of fabric are free of plasticizer and retain their original appearance in the finished product.

10. The method of preparing a stiffened laminated fabric comprising applying heat and pressure at least locally in the presence of water and a mixture of water soluble and water insoluble plasticizers for a thermoplastic derivative of cellulose to a plurality of fabrics each containing derivative of cellulose yarns or filaments.

11. The method of preparing a stiffened laminated fabric comprising applying heat and pressure at least locally in the presence of water and a mixture of water soluble and water insoluble plasticizers for the cellulose acetate to a plurality of fabrics each containing cellulose acetate yarns or filaments.

12. In the method of preparing a stiffened laminated product by the application of heat and pressure at least locally to an assembly of fabrics, an intermediate fabric between two of said fabrics containing thermoplastic derivative of cellulose yarns or filaments, the steps of applying to the fabric containing the derivative of cellulose yarns or filaments that are to be coalesced, a mixture comprising a plasticizer and a volatile solvent therefor that is a swelling or penetrating agent for the derivative of cellulose and uniting the assembly of fabrics under such conditions that the yarns or filaments in at least one surface layer of fabric retain their original appearance in the finished product.

13. In the method of preparing a stiffened laminated product by the application of heat and pressure at least locally to an assembly of fabrics, an intermediate fabric between two of said fabrics containing cellulose acetate yarns or filaments, the steps of applying to the fabric containing the cellulose acetate yarns or filaments that are to be coalesced, a mixture comprising a plasticizer and a volatile solvent therefor that is a swelling or penetrating agent for the cellulose acetate and uniting the assembly of fabrics under such conditions that the yarns or filaments in at least one surface layer of fabric retain their original appearance in the finished product.

14. In the method of preparing a stiffened laminated product by the application of heat and pressure at least locally to an assembly of fabrics, at least one of which contains cellulose acetate yarns or filaments, the step of applying to the fabric containing the cellulose acetate yarns or filaments that are to be coalesced, a mixture comprising a water soluble and a water insoluble plasticizer therefor.

15. In the method of preparing a stiffened laminated product by the application of heat and pressure at least locally to an assembly of fabrics, at least one of which contains cellulose acetate yarns or filaments, the step of applying to the fabric containing the cellulose acetate yarns or filaments that are to be coalesced, a mixture comprising triacetin, di-methoxyethyl phthalate and ethyl alcohol.

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