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METHOD OF MAKING STIFFENED FABRICS

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12 Claims. (Cl. 154—2)

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

An object of my invention is to prepare fabrics of any desired degree of increased stiffness in a simple, economical and expeditious manner. Another object of my invention is to prepare wearing apparel consisting of or containing such stiffened fabric.

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

Articles of wearing apparel and similar articles are made by laminating two or more layers of fabric, at least one of which contains cellulose acetate or other derivatives of cellulose, by causing the cellulose acetate or other derivative of cellulose to coalesce, thus effecting an adhesion between the various layers of fabric forming the web of laminated material or articles of wearing apparel. Coalescence of the fabric containing cellulose acetate or other derivative of cellulose has heretofore been effected by dipping the assembly in a bath of volatile organic solvents or latent solvents for the derivative of cellulose, which solvents cause the derivative of cellulose to soften or melt when the assembly is subjected to elevated temperatures. In the making of stiffened fabrics by causing cellulose acetate or other derivative of cellulose filaments to at least partially coalesce, there enter many considerations that are of great importance from the point of view of expeditious manipulation and from the point of view of the properties of the final product. For example, dipping the assembly into the bath of volatile organic solvents or latent solvents is objectionable when any exposed layers of fabric are made of or contain derivatives of cellulose. In such cases the exposed layers of fabric may be altered, marred or even entirely destroyed by contact with the liquid solvent. Another disadvantage attendant upon the use of liquid solvent is that the degree of coalescence and consequent stiffening to the desired extent is difficultly controllable requiring very precise control as to time and other conditions.

I have found that by using the vapors of volatile organic solvents or latent solvents for the cellulose acetate, as an aid in effecting coalescence upon application of heat and pressure, many advantageous results are attained. I have found that by exposing the fabric assembly, wherein a fabric made of or containing a derivative of cellulose is employed, to the vapor of volatile organic solvents or latent solvents before the application of heat and pressure thereto, the derivative of cellulose fabric component is not marred, altered or in any way deleteriously affected. I have also found that by this method not only is a better adhesion of the layers of the assembly effected and a more desirable product obtained, but also that the articles are produced more easily and expeditiously.

In accordance with my invention, I prepare fabric webs and articles of increased stiffness by a method wherein an assembly of a plurality of layers of fabric, at least one of which contains a derivative of cellulose, is first exposed to the action of the vapor of an organic solvent or latent solvent and then subjected to the action of heat and pressure whereby the layers of assembly are laminated and a stiffened product obtained. By the use of the vapors of solvents I have found that the degree of coalescence of the filaments of the yarn making up the fabric may be controlled to any extent from slight closing of the interstices of the fabric to complete closing thereof. Another advantage flowing from the use of the vapors of the solvents is that the handling of the article prior to the application of heat and pressure is facilitated since the vapors do not cause the article to become unduly tacky, soggy or limp.

Contact between the vapors and the fabric web or articles may be effected in any convenient manner. For example, the volatile solvent in liquid form may be placed in the bottom of a closed vessel out of contact with the articles themselves and upon the solvent volatilizing the vapors thereof contact and impregnate the articles placed in said vessel. In order to effect the laminating process the operative takes one or more of the vapor impregnated articles from the closed vessel and applies heat and pressure to the articles by any suitable means. In order to lower the time necessary for impregnating the articles with the solvent vapors the vessel may be placed under vacuum. If desired, however, the solvent may be volatilized in one vessel and then circulated through a separate container in which the articles to be laminated are placed. Where a vessel in which the solvent is contained in the bottom thereof is employed I have found that the articles have absorbed a sufficient amount of solvent vapor usually after thirty minutes of exposure thereto. A feature of the present invention is that the fabric or articles produced are substantially free from wrinkles such as are produced when the fabrics or articles are dipped in the organic solvents or latent solvents in liquid form.

Any suitable volatile organic solvent or latent solvent may be employed in accordance with my invention. For example, I may use acetone, methyl ethyl ketone, methyl alcohol, ethyl alcohol, dichlorethylene, ethylene dichloride, tetra methylene oxide, etc., or mixtures of such solvents. I have found that a mixture of dichlorethylene and methyl alcohol or a mixture of acetone and methyl alcohol yield particularly desirable results.

In order that the desired degree of stiffness and adhesion be obtained upon the hot pressing, 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 derivative of cellulose employed. This plasticizer may be caused to be present in the materials in any manner. Thus, it may be incorporated with the derivative of cellulose in whatever form it may be present, either by way of dope or spinning solution from which the yarns of the derivative of cellulose are formed or by spraying, dipping or otherwise treating the derivative of cellulose or fabric containing the same with a solution of the plasticizer in volatile solvent or thinner 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 or mixtures of plasticizers may be employed. Examples of suitable plasticizers for cellulose acetate, for example, are dimethoxyethyl phthalate, triacetin, diacetin, diethoxyethyl phthalate, etc. The amount of plasticizer present in the fabric containing same is between 35 and 50% or more on the weight of said fabric. The preferred plasticizer employed is a mixture of dimethoxyethyl phthalate and triacetin.

Small amounts of other plasticizers, swelling agents or similar materials may also be added to the mixture of dimethoxyethyl phthalate and triacetin, such as from 5 to 20% on the weight of said mixture of tricresyl phosphate, camphor and the like.

The plasticizer or plasticizer compound may be applied to the desired fabric in any suitable manner, such as by dipping, spraying, padding, etc. It is preferable when employing the dimethoxyethyl phthalate and triacetin mixture above specified to apply the same by dipping the fabric into a solution of the plasticizer in ethyl or methyl alcohol, preferably ethyl alcohol. Other solvents and thinners for the plasticizers which also have a slight swelling action on the derivative of cellulose, i. e. cellulose acetate, may be employed. Any amount of solvent may be employed for this purpose, for instance, from 10 to 90 or more percent, based on the weight of the plasticizer, of ethyl alcohol may be employed. The fabric is dipped into this solution and passed through a pair of squeeze rollers regulated with sufficient pressure that the desired quantity of plasticizer remains on the fabric. After treating the fabric with the plasticizer in the solvent or thinner, the solvent or thinner is allowed to evaporate. The evaporation of the solvent or thinner may be hastened by the application of heat. It is preferable to have from 40 to 45% on the weight of the fabric of plasticizer whether the fabric is 100% cellulose acetate, or only 30% cellulose acetate and the remaining part cotton.

The products formed by my 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 or assembly 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, 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.

An important advantage of this invention is that the fabric or assembly of fabrics employed as starting material may first be cut, sewn or otherwise shaped quite readily, since they have the properties of and may be handled as ordinary fabrics. After the desired articles, such as collars, cuffs, or other wearing apparel or parts thereof are formed, they may be treated with the solvent vapors that aid in effecting the coalescence of the cellulose acetate fabric after exposure to elevated temperatures and then subjected to heat and pressure to impart the desired stiffness, adhesion of the various layers, and/or impermeability. In this manner, the sewing of stiff or impermeable material is avoided.

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 or adhesion. In this manner, the use of starch or other extraneous stiffening materials during laundering may be avoided.

This invention may be carried out in a large number of ways, particularly as to the nature of the fabric or number of fabrics employed, provided that cellulose acetate in any form, such as powder, film, yarns or filaments are present in the fabric if a single fabric is used, or in or near at least one of the fabrics if a plurality of fabrics are used.

If the cellulose acetate is present in the form of yarns or filaments, then there should be present in the product treated at least one layer of fabric, which either consists wholly of cellulose acetate yarn, or which is a mixed fabric containing yarn of cellulose acetate either in the warp or in the weft or both, in any desired degree of alternation, with yarns of other non-thermoplastic fibers 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 non-thermoplastic fibers. For convenience, the warp may be made with such alternation of cellulose acetate yarn and yarn of other fibers, while the weft may consist wholly of such cellulose acetate yarn or wholly of yarn of other fibers. However, the weft may consist of an alternation of such cellulose acetate yarns and non-thermoplastic yarns of other fibers, 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,

or the warp and/or the weft may be formed from yarns prepared from mixed staple fibers.

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 fibers of cotton or other non-thermoplastic material may be employed.

Only a single layer of fabric consisting wholly of cellulose acetate yarn or a single layer of any of the fabrics above described containing both cellulose acetate yarn or filaments and non-thermoplastic fibers may be treated by this invention, whereby relatively thin fabric having the desired degree of stiffness or impermeability throughout or only locally may be produced. Alternatively, 2, 3, 4 or more of such fabrics may be treated with the solvent vapor so as to cause stiffening at elevated temperature and pressure.

In another, and in some cases preferred, method of carrying out the invention, one or more fabrics consisting wholly of non-thermoplastic yarns, such as cotton, linen, reconstituted cellulose, wool or silk, is assembled with one or more fabrics consisting wholly of cellulose acetate yarn or of a mixture of cellulose acetate yarn and filaments and yarn of non-thermoplastic fibers, as above described, may be treated by this invention, whereby a composite fabric made up of a plurality of layers may be made. If a product is to be produced wherein all the layers thereof are united, it is of importance where two or more layers of fabric consisting wholly of non-thermoplastic material is used, that at least one layer of fabric consisting of or containing cellulose acetate yarn be interposed between such layers of fabric.

In another form of my invention I may employ, as the intermediate layers of the assembly, or as the sheet material which is to be coalesced to bind the other sheets together, a fabric consisting wholly of non-thermoplastic yarns and filaments which has been coated with cellulose acetate. This coating of cellulose acetate may be applied to the non-thermoplastic material by applying the same thereto in the form of a powder or as a slurry in a liquid carrier. The coating of cellulose acetate may also be applied to the non-thermoplastic fabric from a volatile solution of the cellulose acetate, which volatile solvent is permitted to evaporate prior to laminating the fabrics.

If desired, either the yarns or powder coating that contains cellulose acetate also may contain a white or colored pigment. For instance, titanium oxide, antimony oxide, lead oxide or carbonate, iron oxide, etc., may be added to the cellulose acetate. Furthermore, the cotton or cellulose acetate, or both, present in the adhesive layer may be dyed to balance with the color of the other layer or layers of fabric forming the assembly.

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 of cotton or linen is desired, a layer of fabric consisting wholly of or containing cellulose acetate yarn, as above described, may be interposed between two layers of fabric consisting of cotton, linen or other non-thermoplastic fibers. An assembly that is also useful for such purposes comprises three layers of fabric consisting wholly of such non-thermoplastic yarns, with a layer of fabric consisting of or containing cellulose acetate yarn between each of such fabrics.

Where a product is desired having an exterior of fabric made of or containing cellulose acetate, this may be done by interposing a layer of fabric consisting wholly of non-thermoplastic fibers between two layers of fabric consisting of or containing cellulose acetate filaments, or by forming an assembly of three layers of fabric containing or consisting of cellulose acetate yarn with a layer of fabric consisting of non-thermoplastic fibers interposed therebetween. In this case the fabric of non-thermoplastic material may be of the desired construction to impart to the final product such properties as may be required due to its fabric structure.

These arrangements are given only by way of example, it being obvious that other arrangements with a less or greater number or layers of fabric may be employed to obtain any desired effects.

When an assembly of two or more fabrics is used, particularly in connection with wearing apparel or parts thereof, such as collars, cuffs, shirt bosoms, mats, etc., it is advantageous to cut and sew them together to the desired form before causing coalescence of the cellulose acetate filaments, since it is much more convenient to manipulate them before the desired stiffness and/or impermeability is imparted thereto.

The application of heat and pressure to the solvent vapor impregnated fabric web or article may be done by any suitable device as, 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, 100 to 180° C. or more, and the pressure applied may be any desired pressure, for instance, from 10 to 600 pounds per square inch.

The fabric and articles obtained by this invention may be made more or less stiff as desired by controlling the amount of cellulose acetate yarns or filaments in the assembly of fabrics being treated; the more cellulose acetate present, the stiffer the resultant products. The stiffness of the fabrics and other articles may also be controlled by controlling the amount and concentration of the solvent vapors coming into contact with the materials, and the temperature, pressure and the number of times heat and pressure is applied to the assembly. Thus, stiffer products result when vapors of more active solvents are employed, when the concentration of the solvent vapor is increased, when heat and pressure is applied more than once or when the applied pressure is increased. The fabrics or other articles may be rendered softer by the incorporation of plasticizers, such as diethyl phthalate, dimethyl phthalate, dibutyl tartrate, etc. onto or in the fabrics containing the cellulose acetate filaments or yarns.

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

Example I

A fabric consisting of 20% of yarns of cellulose acetate containing a pigment and 80% of yarns of cotton has applied thereto, by dipping, a mixture of dimethoxy ethyl phthalate, triacetin and alcohol as plasticizer. After evaporation of the alcohol from the fabric, the fabric has thereon about 40%, based on the weight of the fabric,

of a mixture consisting of 13 parts of dimethoxy ethyl phthalate and 1 part of triacetin.

The above fabric is interposed as an intermediate layer between two layers of fabric consisting solely of cotton fibers and woven as a broadcloth. This assembly of fabric is cut in the form adapted to be sewn into a collar for a man's shirt. The assembly is placed in a vessel containing in the bottom thereof and out of contact with the assembly a volatile solvent mixture containing 75% by weight of acetone and 25% by weight of methyl alcohol. After being subjected to the vapors of the solvent mixture in the vessel for about thirty minutes the assembly is taken out and subjected to a temperature of from 125° to 139° C. and a pressure of from 40 to 85 pounds per square inch. The article after the application of heat and pressure is pliable, free from wrinkles and exhibits no glazed surface or paper-like feel.

Example II

A fabric consisting of 20% of yarns of cellulose acetate containing a pigment and 80% of yarns of cotton has applied thereto, by dipping, a mixture of dimethoxy ethyl phthalate, triacetin and alcohol as plasticizer. After evaporation of the alcohol from the fabric, the fabric has thereon about 40%, based on the weight of the fabric, of a mixture consisting of 13 parts of dimethoxy ethyl phthalate and 1 part of triacetin.

The above fabric is interposed as an intermediate layer between two layers of fabric consisting solely of cotton fibers and woven as a broadcloth. This assembly of fabric is cut in the form adapted to be sewn into a collar for a man's shirt. The assembly is placed in a vessel containing in the bottom thereof and out of contact with the assembly a volatile solvent mixture containing 80% by weight of dichlorethylene and 20% by weight of methyl alcohol. After being subjected to the vapors of the solvent mixture in the vessel for about thirty minutes the assembly is taken out and subjected to a temperature of from 125° to 139° C. and a pressure of from 40 to 85 pounds per square inch. The article after the application of heat and pressure is pliable, free from wrinkles and exhibits no glazed surface or paper-like feel.

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 celluose ethers.

It is preferable in the forming of collars, cuffs, etc. to have a coalescible fabric bleached and/or blued the same as the cotton outer fabrics and also to have the coalescible fabric shrunk the same as the outer fabric. For instance, if the cotton muslin, broadcloth or other shirting material is Sanforized, the coalescible fabric should also be Sanforized. While, if the outer fabric is shrunk by boiling in water, a similar shrinking should be given the coalescible fabric.

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

1. In the production of stiffened fabrics by uniting a plurality of layers of fabric at least one of which contains a derivative of cellulose, the combination of the step of rendering adhesive said derivative of cellulose, by exposure to a volatile substance selected from the class consisting of solvents and latent solvents for said derivative of cellulose, said substance being applied solely in the vapor form with the step of uniting the layers of fabric under heat and pressure immediately after the step of rendering adhesive said derivative of cellulose.

2. In the production of stiffened fabrics by uniting a plurality of layers of fabric at least one of which contains an organic derivative of cellulose, the combination of the step of rendering adhesive said organic derivative of cellulose, by exposure to a volatile substance selected from the class consisting of solvents and latent solvents for said organic derivative of cellulose, said substance being applied solely in the vapor form with the step of uniting the layers of fabric under heat and pressure immediately after the step of rendering adhesive said organic derivative of cellulose.

3. In the production of stiffened fabrics by uniting a plurality of layers of fabric at least one of which contains cellulose acetate, the combination of the step of rendering adhesive said cellulose acetate, by exposure to a volatile substance selected from the class consisting of solvents and latent solvents for said cellulose acetate, said substance being applied solely in the vapor form with the step of uniting the layers of fabric under heat and pressure immediately after the step of rendering adhesive said cellulose acetate.

4. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising a derivative of cellulose, to the action of a volatile substance selected from the class consisting of solvents and latent solvents for the cellulose derivative sufficient to render adhesive the cellulose derivative, said substance being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a plasticizer for the derivative of cellulose whereby the layers of fabric of the assembly are united and a stiffened product is produced.

5. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile substance selected from the class consisting of solvents and latent solvents for the cellulose acetate sufficient to render adhesive the cellulose acetate, said substance being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a plasticizer for the cellulose acetate whereby the layers of fabric of the assembly are united and a stiffened product is produced.

6. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of acetone and methyl alcohol sufficient to

render adhesive the cellulose acetate, the said solvent being applied solely in vapor form, and then immediately applying heat and pressure to said assembly whereby the layers of fabric of the assembly are united and a stiffened product is produced.

7. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of dichlorethylene and methyl alcohol sufficient to render adhesive the cellulose acetate, the said solvent being applied solely in vapor form, and then immediately applying heat and pressure to said assembly whereby the layers of fabric of the assembly are united and a stiffened product is produced.

8. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate to the action of a volatile substance selected from the class consisting of solvents and latent solvents for the cellulose acetate sufficient to render adhesive the cellulose acetate, said substance being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a mixture of dimethoxy ethyl phthalate and triacetin as plasticizer whereby the layers of fabric of the assembly are united and a stiffened product is produced.

9. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of acetone and methyl alcohol sufficient to render adhesive the cellulose acetate, the said solvent being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a plasticizer for the cellulose acetate whereby the layers of fabric of the assembly are united and a stiffened product is produced.

10. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of dichlorethylene and methyl alcohol sufficient to render adhesive the cellulose acetate, the said solvent being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a plasticizer for the cellulose acetate whereby the layers of fabric of the assembly are united and a stiffened product is formed.

11. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of acetone and methyl alcohol sufficient to render adhesive the cellulose acetate, the said solvent being applied solely in vapor form, and then immediately applying heat and pressure to said assembly in the presence of a mixture of dimethoxy ethyl phthalate and triacetin as plasticizer whereby the layers of fabric of the assembly are united and a stiffened product is produced.

12. Process for the production of stiffened fabrics and articles made therefrom, which comprises subjecting an assembly comprising a plurality of layers of fabric, at least one of which contains yarns comprising cellulose acetate, to the action of a volatile solvent comprising a mixture of acetone and methyl alcohol sufficient to soften the cellulose acetate, the said solvent being applied in vapor form, and then applying heat and pressure to said assembly in the presence of a mixture of dimethoxy ethyl phthalate and triacetin as plasticizer, the plasticizer being present in an amount equal to 40 to 45% based on the weight of the fabric containing the cellulose acetate, whereby the layers of fabric of the assembly are united and a stiffened product is produced.

WILLIAM WHITEHEAD.

CERTIFICATE OF CORRECTION.

Patent No. 2,281,646. May 5, 1942.

WILLIAM WHITEHEAD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 37, claim 12, for "soften" read --render adhesive--; and line 38, same claim, after "then" insert --immediately--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 14th day of July, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)