This invention relates to methods of finishing textiles, primarily effected for the purpose of imparting wrinkle-proof properties, and also relates to the wrinkle-proofed textiles themselves as articles of manufacture.

An objectionable quality of materials woven from artificial silk, cotton, linen and as well certain fabrics of real silk, is their inclination to become badly creased or wrinkled when folds of the same are compressed. Heretofore, attempts have been made to overcome this property by impregnating the textile with a solution of artificial resin and then drying at a high temperature, but such procedure is not satisfactory, for consistently good results cannot be obtained, nor can the cause of the frequent failures be ascertained at the present time.

An object of the invention herein described is to provide woven goods or fabrics of artificial silk, cotton, linen and real silk which possess absolute stability against creasing and wrinkling and even retain such quality after washing with soap and water. Another object is to provide a process of accomplishing such result by the use of cheap, well known chemical reagents through a simple procedure consistently leading to uniformly good results.

Still another object of the invention is to provide wrinkle-proofed textiles composed wholly of artificial silk fibers or threads or partly of such fibers in admixture with various natural fibers which textiles also possess water repellant qualities leading to more effective and uniform processing.

According to one preferred embodiment of the invention, woven goods or fabrics of artificial silk, cotton, linen, or certain badly wrinkling fabrics of natural silk are treated with an aldehyde, preferably formaldehyde, in the presence of an acid compound in a quantity sufficient to produce the necessary hydrogen ion concentration, after which the treated fabric is subjected to a heat treatment at a temperature adapted to cause the desired reactions to occur without injuring the material. These temperatures are above those normally used for drying in the textile industry.

Instead of formaldehyde, other active aldehydes may be used, for example, acetaldehyde and lower molecular aliphatic aldehydes; also furfural, parahydroxyl, polymerization and addition products of lower molecular aldehydes, and other compounds which react like aldehydes, such as, for example, ammonium aldehyde and aldehyde bisulfite compounds. Generally, the effect obtained by the use of formaldehyde is superior to that resulting from the use of other aldehyde compounds.

The acid compounds suitable for use in the practice of the present invention include strong organic acids and as well mineral acids. Of the former group, the lower aliphatic carboxylic acids are preferred, such as, for example, glacial acetic acid, formic acid, propionic acid and lactic acid. Other organic acids suitable in the process include dibasic aliphatic and aromatic acids, as succinic acid, tartaric acid, oxalic acid, adipic acid, phthalic acid; and also, organic sulfonic acids. Of the latter group, i.e., mineral acids, sulfuric acid and hydrochloric acid may be mentioned, such acids being employed in correspondingly smaller quantities. Alternatively, ordinary or other acid reacting mineral salts may be used.

In order to impart other or special properties to the woven goods or fabrics treated as above described, additional substances having fiber protecting qualities are previously, simultaneously or subsequently, employed. Particularly suitable are, for example, the albuminous decomposition products of the nature of glue and gelatin. Also, the carbohydrates used for finishing textiles, especially sugars of the nature of glucose, manose and the like, and soluble cellulose derivatives of the nature of methyl cellulose may be employed. When such compounds are applied simultaneously with the aldehyde and acid, unusually good results are obtained.

The woven goods treated as herein described, with or without the addition of fiber protecting substances, are heated after such treatment at a temperature between about 130° C. and 170° C., the time of heating depending, of course, upon the particular temperature used and as well upon the particular constituents employed. At temperatures below 130° C., the best obtainable wrinkle-proofing qualities are not obtained, whereas, above about 170° C. there is a danger of injuring the fiber.

In accordance with a second embodiment of the present invention, the above mentioned woven goods or fabrics are treated with a wax-like substance or resin and with an aldehyde and a strong organic acid, after which the treated materials are dried at the hereinbefore described elevated temperatures.

The wax-like substance employed may be a wax, a wax-like compound or a resin. Among such products which are satisfactory, there may be mentioned vegetable and animal waxes, such as spermaceti, hardened sperm oil, carnauba.
wax, candellila wax, beeswax; also, mineral waxes such as Montan wax, paraffin, ceresin and other similar higher molecular hydrocarbons.

In accordance with a third embodiment of the present invention, woolen goods, threads or fabrics composed wholly of regenerated cellulose or cellulose esters or ethers, or partly of such fibers, in admixture with vegetable or animal fibers are treated with a solution or emulsion of a wax-like compound and a soluble soap or a fatty acid, said soap and acid being referred to herenafter collectively as insoluble-soap-forming bases, and are then treated with an aldehyde (preferably formaldehyde), a lower aliphatic carboxylic acid (acetic acid, for example), and a soluble salt of a metal capable of forming water insoluble soaps with the soluble soap or fatty acid employed. The said aldehyde, acid and salt may be employed in separate baths or in a single bath, the latter procedure being preferred because of its simplicity. After this treatment, the materials are heated in accordance with the procedure heretofore mentioned. Materials treated in this manner, although originally possessing wrinkling properties, are entirely free from such tendency and besides possess slight water repellent or waterproof qualities. Dyes may be very easily applied to materials treated in this manner. Their fitness for other treatments commonly used in finishing is very good.

The order in which the various treatments are effected may be altered considerably, for the formaldehyde treatment may be carried out first and the wax and soap treatment last. Furthermore, if a wax-like compound and soap are employed they may be used either in the form of an emulsion or solution and if a wax-like compound and fatty acid is to be applied, they may be used in the form of a solution or dissolved in a hydrocarbon chloride.

Treatment in accordance with this third embodiment of the invention imparts new and valuable properties to the treated fibers for it will be found that they possess a considerably less tendency to wrinkle and, furthermore, possess water repellent properties sufficient to cause water poured on to the material initially to run off in the form of drops without penetrating and moistening the fabric. This embodiment is of particular advantage in the treatment of mixtures of artificial silk with cotton, linen or other staple fibers for the reason that the treatment lessens the water absorption and swelling of the artificial silk, therefore producing a product which may be processed with uniform results in subsequent finishing operations. This quality is very important in the manufacture of a large number of mixed spun goods containing artificial silk fibers because during finishing the principal difficulty of the finishing operation is the uneven absorption of the water and consequently the uneven swelling and stretching of the artificial fibers as compared with the natural fibers and also the substantial decrease of tensile strength of the artificial fibers.

Textile materials which ordinarily wrinkle quite badly can be made absolutely stable against creasing by the treatments heretofore described. This effect is not lost through washing for the wrinkle-proofing effect is not removed by washing with customary detergents at temperatures of 70° C. The herein described processes have the distinct advantage of requiring the use only of simple well known chemical substances. Furthermore, the processes produce results which can be easily repeated.

In a number of the examples set out below which illustrate the nature of the present invention, certain angular values are given which serve as the measure of the comparative wrinkle-proofing effect obtained by the various treatment methods. These angular values are determined by cutting strips of woven material or fabric of equal size and creasing them in the warp direction in the center and pressing the folded strip together for a period of one hour under a load of 1,000 grams. The creased strips thereafter are unfolded and one fold of the material is attached to a disk in a vertical plane, the crease of the strip being fastened at the center of the disk. The disk is provided with a scale and is capable of being rotated upon a horizontal axis. Through rotation of the disk, the angle formed by the two folds of the material after a period of ten minutes is measured by reading the scale upon the disk. Repeated rotation of the folds in a vertical position the influences of the force of gravity are equalized and accurate comparative measurements obtained.

Example 1

Piece goods of viscose silk are treated for a period of two minutes at a temperature of 30° C, with a solution of 5 grams of tartaric acid, 30 grams of formaldehyde and 5 grams of calcium chloride dissolved in one liter of water. The excess solution, if any, is squeezed out and the material is then dried for a period of about 20 minutes at 130° C. After being washed for 15 minutes at 80° C, in a solution of Marseille or casile soap in the proportion of one gram of soap per liter of water, the material is rinsed and dried. The treated material possesses an angular value as determined by the foregoing apparatus of 150°. If a solution of glycine in water in the proportions of 20 grams per liter is added to the initial treating solution the fiber is protected against possible excessive injury and possesses wrinkle-proof qualities substantially as great as those obtained without glycine.

Example 2

Woven material of viscose silk is treated according to the method of Example 1 with the exception, however, that 5 grams of formic acid per liter of water are used instead of the tartaric acid and 150 grams of formaldehyde per liter are employed. The wrinkle-proof test on this material shows an angular value of 145°.

Example 3

A fabric of artificial silk is treated according to the process of Example 1 but with a solution of 2.5 grams of oxalic acid instead of the tartaric acid. The angular value of the material obtained is 145°. If methyl cellulose is added to the treatment bath in the proportion of 10 grams per liter a greater fiber hardness is obtained and the wrinkle-proof qualities are equal as good or even better than when methyl cellulose is not employed.

Example 4

Serge for lining is treated according to the process of Example 1 with 1.5 grams of tartaric acid, 100 grams of formaldehyde and 20 grams of glycine in a liter of water and is dried for a period of 10 minutes at 150° C. The treated material possesses an angular value of 150°.
**Example 5**

A material is treated in accordance with the process of Example 4 but with the use of 2.5 grams of oxalic acid instead of the tartaric acid. The angular value of the treated material is 145°. If 10 grams of methyl cellulose are added to the treatment bath, the stability of the product against wrinkling is further considerably increased.

**Example 6**

Artificial silk crepe of viscose silk is treated several minutes at 30° C. with a solution of 100 grams of formamide, 5 grams of tartaric acid and 50 grams of glucose in 845 grams of water. The excess solution is separated as by centrifuging and the silk then dried for 20 minutes at a temperature of 150° C. Although this crepe wrinkled badly prior to the treatment, it possessed an excellent stability against creasing after the treatment even subsequent to washing.

**Example 7**

A fabric of viscose artificial silk is soaked in a solution of colophony dissolved in tetrahydrofurfuralcohol in the proportions of one of the former to 20 of the latter. Any excess of the solution is wrung out after which the material is inserted into a second bath containing a 5% solution of formaldehyde and 5 cc. per liter of glacial acetic acid. After soaking for a while, the material is wrung out and dried for 20 minutes at a temperature of 150° C.

**Example 8**

A viscose artificial silk fabric is soaked for a period of 5 minutes in a solution of hardened sperm oil in trichloroethylene in the proportions of 1:20. The fabric is then compressed to remove any excess liquid and is inserted into a second bath containing a 5% aqueous formaldehyde solution and 5 cc. per liter of glacial acetic acid. After a period of 2 minutes, the material is removed, wrung out and dried 20 minutes at 150° C.

**Example 9**

A woven goods composed of viscose artificial silk fibers is saturated with a solution of sperm oil and benzol in a 1:20 proportion. It is compressed to remove excess liquid and then is treated with a 4% formaldehyde solution containing 6 cc. per liter of formaldehyde 5% strength. The excess liquid is removed and the material is dried for a period of 15 minutes at a temperature of 150° C.

**Example 10**

Knitted dress goods of copper silk are soaked in a solution of sperm oil in perchloroethylene in proportions of 1:20. The excess solution is squeezed off and the material is next treated with a 10% solution of formaldehyde containing glacial acetic acid in the proportion of 5 cc. per liter. The material is then compressed to remove excess liquid and thereafter dried for a period of 20 minutes at 145° C.

**Example 11**

A mixed fabric of cotton and linen having a tendency to wrinkle very badly is soaked for a period of 5 minutes in a solution of paraffin (melting point 63° C.) in trichloroethylene in proportions of 1:20. The material thus treated is then removed for excess liquid and then introduced into a second bath consisting of a 5% aqueous solution of formaldehyde containing 10 cc. per liter of glacial acetic acid. The excess liquid is removed and the material dried for 20 minutes at 150° C.

**Example 12**

A fabric of viscose silk is saturated with a solution of beeswax in trichloroethylene in the proportions of 1:10. The excess solution is removed and the material thereafter treated with a 10% aqueous solution of formaldehyde containing 6 cc. per liter of formic acid of 85% strength. The excess liquid is removed and the material is dried for 20 minutes at a temperature of 150° C.

**Example 13**

A viscose silk fabric is soaked in a solution of hard paraffin in trichloroethylene in the proportions of 1:20 and thereafter treated with a 10% aqueous solution of paraformaldehyde containing an addition of 5 cc. per liter of glacial acetic acid. Any excess liquid is removed and the material is dried for 20 minutes at a temperature of 150° C.

**Example 14**

Linen batiste is soaked in a solution of high melting paraffin in perchloroethylene in the proportions of 1:20. The saturated material is then centrifuged and next treated in a second bath consisting of a 10% aqueous solution of furfural in methyl alcohol containing 5 cc. per liter of formic acid of 85% strength. After a second centrifuging, the material is dried for a period of 20 minutes at 135° C.

**Example 15**

A viscose artificial silk fabric is treated for a period of 5 minutes at room temperature in a 5% solution of formaldehyde containing an addition of 5 cc. per liter of glacial acetic acid. Any excess liquid is squeezed off and the material is then impregnated with a 5% solution of sperm oil in trichloroethylene by soaking for a period of 5 minutes. The excess liquid is removed and the material is dried for 20 minutes at a temperature of 150° C.

**Example 16**

Knitted material of viscose artificial silk is treated for 5 minutes at room temperature in a 5% solution of sperm oil in trichloroethylene containing 5% formaldehyde. The excess liquid is removed and the material is then heated and dried at 150° C. for a period of 20 minutes.

**Example 17**

A fabric of viscose artificial silk is treated at 60° C. with an emulsion of 50 grams of hardened sperm oil, 10 grams of Marseille or castile soap and 10 grams of hide glue in one liter of water. The excess liquid is squeezed off and the material treated in a second solution consisting of 5% formaldehyde, 5% glacial acetic acid and 5% alum. The excess liquid is removed and the material is dried for 20 minutes at 150° C.

The emulsion employed in this last example may be satisfactorily produced in the following manner: The glue is added to four times its weight of water and permitted to soak for 12 hours, after which the solution is brought to a boil. To this solution there is added a separately prepared soap solution, and also additional water to bring the total quantity of water to one liter. The mixture is then put through a suitable homogenizer or homogenization machine. When the mass cools a paste is obtained which is capable
of being cut into pieces. When this paste is put in water it yields a uniform and stable emulsion. In the foregoing examples, although the soaking in the solutions of aldehyde, and other substances may very satisfactorily be carried out at ordinary or room temperatures, heat may be applied to the baths or during the treatments if so desired to accelerate the treatment or enhance the beneficial effects when the time saved or the improved results warrant the additional expense.

It should be understood that the present invention is not limited to the particular materials herein disclosed, for it includes all equivalent materials and conditions coming within the scope of the appended claims.

Instead of the organic acids mentioned hereinbefore mineral acids can be used with similar effect. It is essential to employ treating liquids containing acid enough to make the treated fabrics wrinkle-proof, but not enough to cause a deleterious effect on the strength of the fibres. The most advantageous pH range is between pH=2.5 and pH=3.5.

We claim:

1. A method for wrinkle-proofing artificial and natural silk, cotton, linen and mixtures of the same which comprises treating such material with a solution containing formaldehyde and an effective amount of a strong acid and heating the treated material at a temperature above about 130° C but insufficient to injure the material until the desired reaction is complete.

2. The process of decreasing the tendency of textile materials to wrinkle which comprises soaking such material in a bath containing formaldehyde and an effective amount of a strong acid and methyl cellulose, removing any excess of liquid and drying at a temperature of about 130° to 170° C and for a period adapted to cause reaction without appreciable injury to the material.

3. In the finishing of textile materials, the process of lessening their tendency to wrinkle which comprises treating such material with a solution of a wax-like substance selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cereoses and therefrom with formaldehyde and a strong acid in effective amounts in an insufficient quantity to injure the material, and heating the treated material at a temperature of from 130° to 170° C to cause the wrinkle-proofing action to become complete.

4. The process of imparting non-wrinkling qualities to artificial and natural silk, cotton, linen and mixtures of the same comprising soaking such material in a bath containing a wax-like substance selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cereoses and therefrom with formaldehyde, and finally heating the material to a temperature above about 130° C but insufficiently high to injure the material.

5. The process of imparting non-wrinkling qualities to textiles comprising treating such material with formaldehyde and a lower aliphatic carboxylic acid and then with a wax-like compound, finally heating the treated material to a temperature between about 130° and 170° C until the reaction is complete.

6. For wrinkle-proofing fabrics, the combination of steps comprising, treating the fabric with a wax, formaldehyde and a lower aliphatic carboxylic acid, and then heating the treated fabric to a temperature of about 130° to 170° C to cause the reaction forming wrinkle-proofing to be imparted to the fabric.

7. For wrinkle-proofing textiles, the combination of steps comprising soaking the textile in a bath containing both a wax-like compound and formaldehyde and heating to a temperature above about 130° to 170° C.

8. For wrinkle-proofing textiles, the combination of steps comprising soaking the textile in a bath containing a wax, an active aldehyde and a strong organic acid, and after any excess liquid is removed then heating to a temperature at which the reaction forming wrinkle-proofing compounds occurs, such temperature being above about 130° C but insufficiently high to injure the textile.

9. In the finishing of textile materials containing artificial silk fibers, the process which comprises treating such material with a wax-like compound selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cereoses, an insoluble-soap-forming base, an active aldehyde, a strong organic acid and a metal salt capable of reacting with said base to form a water insoluble soap, and heating the treated textile to a temperature above about 130° C but insufficiently high to injure the textile.

10. In the finishing of textile materials containing artificial silk fibers, the process which comprises treating such material with a bath containing a wax-like compound and an insoluble-soap-forming base and also with an active aldehyde, a lower aliphatic carboxylic acid and a metal salt capable of reacting with said base to form a water insoluble soap, and heating the treated textile to a temperature above about 130° C but insufficiently high to injure the textile.

11. In the finishing of textile materials containing artificial silk fibers, the process which comprises treating such material with a bath containing a finely divided wax-like compound and an insoluble-soap-forming base, and with a bath containing spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cereoses and an insoluble-soap-forming base, thereafter treating the material with an aldehyde selected from the group consisting of formaldehyde, acetaldehyde, furfural and compounds which decompose and form said aldehydes, a lower aliphatic carboxylic acid, and a metal salt capable of forming with said soap-forming base water insoluble soap, and drying the resulting material at an elevated temperature and a low humidity, is insufficient to injure the fibers of said material.

12. A method for finishing textile materials containing wholly or in part fibers of regenerated cellulose, or of cellulose esters or esters comprising soaking such material in a bath containing a dispersion of a wax-like compound selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cereoses and an insoluble-soap-forming base, therefor treating the material with an aldehyde selected from the group consisting of formaldehyde, acetaldehyde, furfural and compounds which decompose and form said aldehydes, a lower aliphatic carboxylic acid, and a metal salt capable of forming with said soap-forming base water insoluble soap, and drying the resulting material at an elevated temperature and a low humidity, is insufficient to injure the fibers of said material.

13. A wrinkle-proofed textile material produced by treatment with an active aldehyde under acidic conditions and heating to a temperature between about 130° to 170° C.

14. A wrinkle-proofed textile material possesses...
ing a reaction product of a wax-like substance selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cerasin, an active aldehyde and a strong organic acid with the surface of the fibers of said material, said treated textile having been heated to a temperature between about 130° to 170° C.

15. A wrinkle-proofed textile material containing artificial silk fibers and finished by treatment with a wax-like compound selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cerasin, an insoluble-soap-forming base, an active aldehyde, a strong organic acid and a metal salt capable of reacting with said base to form a water insoluble soap, and drying at a temperature between about 130° to 170° C, adapted to cause reaction of such reagents.

16. A method of treating textile material which comprises treating the same with a bath consisting of an aldehyde selected from the group consisting of formaldehyde, acetaldehyde and furfural and an acid sufficient to provide an effective acidity and heating the textiles to a temperature of about 130° to 170° C, for about 15 to 20 minutes.

17. A method for finishing textile materials containing wholly or in part fibers of regenerated cellulose or of cellulose esters or ethers comprising soaking such material in a bath containing a dispersion of wax-like material selected from the group consisting of spermaceti, hardened sperm oil, carnauba wax, candelilla wax, beeswax, Montan wax, paraffin and cerasin and an insoluble soap-forming base, thereafter treating the material with an aldehyde selected from the group consisting of formaldehyde, acetaldehyde, and furfural, a lower aliphatic carboxylic acid and a metal salt capable of forming with the soap-forming base water insoluble soap and heating the resulting material at a temperature of about 130° to 170° C, for about 15 to 20 minutes.

18. A method for wrinkle-proofing artificial and natural silk, cotton, linen and mixtures of the same which comprises treating such material with a solution containing an aldehyde selected from the group consisting of formaldehyde, acetaldehyde and furfural and an acid of the group consisting of acetic, formic, propionic, lactic, succinic, tartaric, oxalic, adipic, phthalic, sulfuric, hydrochloric, and organic sulfonic acids present in a strength to produce an acidity of about pH = 2.5 to 3.5, and heating the treated material at a temperature of about 130° to 170° C, for about 15 to 20 minutes to react the aldehyde with the fibre to produce a wrinkle-proofing effect.

19. The process of decreasing the tendency of artificial and natural silk, cotton, linen, and mixtures of such material to wrinkle, which comprises treating such material with a solution of an active aldehyde and an effective amount of a strong acid and heating the treated material to a temperature between about 130° to 170° C.

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