

1

2

3,477,805

PROCESS FOR MODIFYING KERATIN FIBERS
Dmitry M. Gagarine and Emile E. Habib, Spartanburg,
and Kermit S. La Fleur, Clemson, S.C., assignors to
Deering Milliken Research Corporation, Spartanburg,
S.C., a corporation of Delaware

No Drawing. Continuation of application Ser. No.

111,447, May 22, 1961. This application Aug. 6,

1965, Ser. No. 477,958

Int. Cl. D06m 3/06, 3/08, 3/12

U.S. Cl. 8-128

12 Claims

This invention relates to a novel process for modifying the characteristics of wool fabrics and, more particularly, to a process for imparting to wool fabrics a propensity for a permanent finish and/or pleat.

This application is a continuation of application Ser. No. 111,447, filed May 22, 1961, now abandoned.

Methods of improving the finish of wool fabrics have been the subject of considerable research efforts in recent years. The luster, hand and texture of wool fabrics is normally enhanced by either one or two methods, that is, by adding up to about 25% by weight of mohair to the wool fabric and decating the fabric or by a process known as London shrinking (or paper pressing), which involves relaxing the fabric in water and then pressing for protracted periods of time. Both methods provide fabrics having satisfactory luster, hand, and texture, though at increased cost. Unfortunately, however, these desirable characteristics are not permanent and are removed by the garment manufacturer during his sponging operation, during which the fabric is relaxed in water prior to cutting.

To date, therefore, no satisfactory process has been developed for providing, at the mill level, a wool fabric having a lustrous finish permanent to subsequent treatments by the garment manufacturer.

Many procedures are available for imparting to wool fabrics a crease which is fairly resistant to distortion even after considerable wear and wetting. All of these procedures, however, have proven sufficiently unsatisfactory as to have attained only limited success. For example, one such process involves spraying the finished garment, for example, a pair of trousers, with a solution of a reducing agent immediately before pressing. It is necessary in this process that the amount of water applied to the fabric be at least 40% by weight of the fabric. This process necessarily involves spray equipment, manual labor and a multiplicity of discontinuous steps and manipulations. In addition, this process is applicable only to the finished garment, since there are short and limiting time factors in the process between application of the reducing agent and press-finishing of the cloth.

These problems have been partially overcome by a process wherein the reducing agent is applied at the mill level followed by drying at temperatures necessarily below 50° C. so as to inhibit the activity of the reducing agent on the wool fibers. This low temperature drying, however, is highly objectionable in a mill operation in that this procedure requires far more space and time than is economically desirable. Furthermore, even though the reducing agent is applied at the mill level, the consumer must moisten the fabric to a moisture content of at least about 40% by weight prior to pressing, again adding materially to the equipment and labor involved in producing the fabric.

In still another process, monoethanolamine bisulfite is applied to the fabric at the mill level and dried in the conventional manner. However, in order for the consumer to obtain any permanent shaping of this fabric, it is necessary to steam the fabric for 20 minutes under high pressure prior to pressing. This, of course, is time consuming and expensive and is objected to by the consumer.

There has been developed to date, therefore, no satisfactory and economical process, which may be done at the mill level, for imparting to a fabric a propensity for permanent creasing, thereby reducing costs and hazards involved in subsequent treatments by the consumer.

The difficulties inherent in the processes of the prior art are obviated in accordance with this invention which comprises treating the fabric with a reducing agent and from about 3 to about 50%, by weight of the fabric, of a swelling agent. The fabric so treated may then be shipped to garment manufacturers, processed into garments and pressed under lower moisture levels than hitherto considered possible to obtain pleats permanent to subsequent manipulation and wetting. For example, garments prepared from the novel fabric of this invention may be pressed on a Hoffman press (30 seconds' steam-pressing, 30 seconds' dry-pressing), without additional treatment such as wetting to high moisture levels of about 40% by weight, to obtain permanent pleats. Preferably, the fabric is shipped at moisture levels of less than about 30% by weight and pressed under the same initial conditions. Particularly in instances where the fabric contains relatively small amounts of moisture, e.g., about 3 to 10% by weight, additional moisture may be absorbed from the steam during the preferred steaming procedure, so that actual moisture levels in the fabric during pressing will be slightly higher than at the outset of pressing. This moisture increase is accomplished, however, without cumbersome, uneconomical spraying techniques as are normally required.

If desired, the luster of the fabric so treated may be improved prior to shipping in a press-finishing operation involving contacting at least one surface of the fabric with a pressing element under conditions sufficient only to provide a lustrous fabric surface.

A highly lustrous fabric may be obtained by semi-decating or full-decating the chemically modified fabric particularly when the decating procedure is combined with the press-finishing operation, although these decating procedures substantially remove the propensity in the fabric for subsequent permanent pleating.

To impart only a permanent finish to the fabric while retaining in the fabric its propensity for permanent pleating, it is essential that the finishing step be carefully controlled so that the fibers at or near the surface of the fabric are affected by the treatment so as to provide a permanent finish, while a sufficient number of the remaining fibers throughout the fabric are not sufficiently affected so as to destroy their propensity for accepting a permanent pleat. Generally, the desired condition is provided by controlling the temperature and pressure of the pressing element and the time of exposure of the fabric to the element. Generally, these conditions vary with the amount of reagents and water remaining in the fabric. For example, if unreacted reducing agent is present in the fabric at the time of press-finishing, the total period of exposure of the fabric to the pressing conditions should be more limited. Since the temperature of the preferred finishing means, a conventional rotary press, is maintained at about 260° F., the period of exposure may be decreased by increasing the feed rate of the fabric through the press, e.g., in excess of about 30 yards per minute. In instances where the unreacted reducing agent has been removed by washing, reduced feed rates are suitable, for example, about 20 yards per minute.

Obviously, a sufficient number of passes must be made to insure that the desired fabric properties are produced, although one pass is generally sufficient once the desired conditions have been established. The pressure on these rolls may be increased so that higher luster may be obtained, although care must be taken to insure retention of

the fabric's propensity for subsequent permanent pleating by the garment maker.

The press-finishing operation is improved by steaming the fabric briefly, prior to or concurrently with, the pressing operation. This steaming operation is particularly desirable where the treated fabric is essentially dry, i.e., containing less than about 5% moisture by weight prior to press-finishing. The period of exposure of the fabric to the steam depends to a large extent on the steam pressure and feed rate of the fabric. Pretreatment of a fabric traveling at a rate of about 25 yards per minute with steam at about 10 pounds per square inch, for example, is entirely suitable. Steaming for extended periods of time, for example, in excess of about 15 seconds is wholly unnecessary for optimum operation of this invention.

Selection of the press-finishing element depends largely on the type finish desired. For example, finishes approaching a shine may be obtained by using a pressing element having a solid planar surface. More lustrous finishes are obtained when the pressing element surface is moderately irregular, as in a slightly knurled surface. For purposes of the present invention, this latter surface is preferred. Textured finishes are provided when fabric-faced pressing elements are utilized, while embossed finishes may be obtained by using embossing rolls of the desired construction.

Furthermore, the decating procedures described herein-after are entirely satisfactory in themselves for the production of highly desirable finishes.

If the permanent pleating propensity is not particularly desired by the consumer, it may be readily removed by a decating process which, coincidentally, considerably improves the luster and hand of the fabric over that obtained after rotary pressing. This procedure is preferably conducted by wrapping the finished fabric with a smooth surfaced material, such as a cotton or rayon fabric, in such a manner that the smooth surface contacts the treated fabric at its finished surface. If a nonlustrous or matte finish is desired, the liner used in the decating should have a coarse textured surface. The resulting wrap is decated by treatment in an autoclave for at least about 2 minutes with steam at a pressure of at least about 20 pounds per square inch. After this treatment, the fabric is cooled and dried by vacuum in the conventional manner. This decating process removes the propensity of the fabric for permanent pleating to a substantial degree and should not be used where permanent pleating is desired by the consumer.

On the other hand, if the optimum permanent pleating propensity is desired, the press-finishing operation may be eliminated or at least conducted under mild conditions, e.g., short periods of time at relatively low temperatures, such as with the rotary press rolls at about room temperature. The fabric so produced may be pressed, preferably in the presence of steam, by the garment manufacturer under the normal low moisture levels available with standard pressing equipment. Obviously, the garment manufacturer may press at a higher moisture level, e.g., in excess of 40% by weight, and obtain permanent pleats, but an advantage of this invention is that this uneconomical procedure is eliminated.

The reducing agent and swelling agent may be applied to the fabric in any desired amount, depending upon the degree of reducing desired. In general, optimum results are obtained when from about 0.01 to about 10% by weight of the reducing agent and from about 3 to about 50% by weight of the swelling agent are applied to the fabric. Most preferably, from about 1 to about 3% by weight of the reducing agent and from about 7.5 to about 15% by weight of the swelling agent are applied to the fabric.

While the effect of the reducing agent may be subject to some speculation amongst wool experts, it is generally considered that the reducing agent ruptures a plurality of the cystine disulfide linkages present in the wool fibers.

The concentration of the reducing agent and the period of exposure of the wool fabric to the reducing agent should be controlled so that excessive ruptures of these linkages, resulting in excessive degradation of the fabric, is not permitted to occur. Generally, it is believed that excessive degradation occurs when an excessive number of the cystine disulfide linkages of the wool fiber are ruptured. Extreme cases of degradation may be checked visually, in that the wool fiber appears to become gelatinous in nature when an extremely excessive number of the cystine disulfide linkages are ruptured. In any case, the degree of degradation may be detected by physical tests.

A satisfactory level of disulfide linkage reduction is indicated when the fabric treated with the reducing agent satisfactorily passes the following test:

(1) Remove reducing agent in fabric by washing in water 75° F. and squeeze to a wet pickup of 80%;

(2) Fold the fabric upon itself and press the folded area with a hand iron set at 370° F. for 1 minute under a pressure of four pounds per square inch; and

(3) Immerse the dry, pressed fabric in water at 170° F. for 30 minutes. After removal from this water and drying, a fairly sharp pleat should be retained.

Any reducing agent capable of rupturing the desired level of the disulfide linkages is suitable for use in accordance with this invention. Among the suitable reducing agents there are included metallic formaldehyde sulfoxylates, such as zinc formaldehyde sulfoxylate, the alkali metal sulfoxylates, such as sodium formaldehyde sulfoxylate; alkali metal borohydrides, such as sodium borohydride, potassium borohydride and sodium potassium borohydride; alkali metal sulfites, such as sodium or potassium bisulfite, sulfite, metabisulfite, or hydrosulfite, ammonium bisulfite, sodium sulfide, sodium hydrosulfide, cystine hydrochloride, sodium hypophosphite; sodium thiosulfate; sodium dithionate; titanous chloride; sulfurous acid; mercaptan acids, such as thioglycolic acid and its water-soluble salts, such as sodium, potassium or ammonium thioglycolate; mercaptans, such as hydrogen sulfide, and sodium or potassium hydrosulfide; alkyl mercaptans, such as butyl or ethyl mercaptans and mercaptan glycols, such as β -mercapto ethanol; and mixtures of these reducing agents.

Of these reducing agents, those containing sodium bisulfite, particularly the sodium bisulfite-sodium sulfite (50/50) combinations, are most highly desired for optimum rupturing of the disulfide linkages within a short period of time at minimal cost.

While it is known that the swelling agents for the wool swell the wool fibers and possibly assist in the reduction of the disulfide linkages, there appears to be no ready explanation for why this swelling action provides the advantages that occur in its use. For example, when a reducing agent is utilized alone, it is necessary to dry the fabric at low temperatures for extended periods of time to avoid destroying the propensity of the treated fabric to be permanently pleated. When the same fabric, however, is treated with a reducing agent in combination with a swelling agent, it is possible to dry the fabric at a much higher temperature and to a greater degree without destroying this propensity, thereby greatly facilitating the mill drying operation. For example, the fabric treated in this manner may be dried at temperatures approaching 200° F. to moisture contents as low as 3%, whereas a similar treatment would remove a substantial amount of the permanent pleating propensities of a fabric treated only with a reducing agent.

Similarly, there is no obvious explanation for the fact that a fabric treated with both a reducing agent and a swelling agent may be pressed at low moisture levels (for example, less than about 20% moisture) to obtain a permanent pleat, even after extended aging periods, as opposed to conventional procedures which require prolonged presteaming (e.g., about 20 minutes) or spraying

to obtain a water content of at least 40% by weight in the fabric prior to pressing.

Urea constitutes the most readily available and desirable swelling agent, although any other material which will swell wool fibers in an aqueous medium is suitable. For example, guanidine compounds such as the hydrochloride; formamide, N,N-dimethyl formamide, acetamide, thiourea, phenol, lithium salts, such as the chloride, bromide, and iodide and the like are similarly useful.

The reducing agent and swelling agent may be added to the fabric in any desired sequence, but in a preferred embodiment, the reagents are added to the fabric by impregnating with an aqueous solution containing both reducing agent and swelling agent in the desired proportions. The fabric may then be immediately removed from the solution, squeezed to the desired wet pick-up and allowed to age for an appropriate time before further processing, in accordance with this invention. Generally, no advantage is obtained by aging the impregnated fabric for more than two hours, although aging times in excess of 24 hours have been utilized with success. Alternatively, the fabric may be aged while immersed in the reagent bath.

Good results may be obtained by treating with reducing agent-swelling agent solutions at a pH between about 3 and about 10, although optimum results are obtained at pH levels between about 4.5 and about 7.0.

In addition, the temperature of the treating solutions may be adjusted to any desired level. For example, room temperature solutions are entirely satisfactory, although these solutions may be heated where it is desired to limit the exposure time of the fabric to the solution or where it is desired to utilize low concentrations of the reactants, for example, the fabric need not be exposed to a heated solution of the reducing agent and swelling agent for more than about 2 minutes to obtain optimum results, while longer periods of exposure, e.g., at least about 15 minutes, are preferred when the fabric is padded with the treating solution at room temperature.

Permanent luster and/or pleats are most easily attained when the press-finishing procedure at the mill level and/or pressing by the garment manufacturer is conducted while the fabric still contains the reducing agent and swelling agent.

Long periods of exposure to the wide variety of conditions that a fabric in storage is subjected to, however, may make it desirable to reduce the level of leachable reagents in the fabric, particularly with respect to the reducing agent. Consequently, it is preferred to treat the fabric with the reducing agent, wash the fabric and then apply the swelling agent. A fabric treated in this manner can withstand more rigorous storage conditions while retaining the highly desirable propensity for subsequent permanent pleating by the garment manufacturer. In this regard, it appears critical that at least 3% by weight of the swelling agent must be present in the fabric at the time of pressing in order to obtain permanent pleats at the desired low moisture levels.

In a particularly preferred embodiment of this invention, the fabric is impregnated with an aqueous solution containing the reducing agent, aged for an appropriate time, e.g., from about 30 minutes to about 2 hours, after which the fabric is passed through water, preferably at about 75° F. This treated fabric is then impregnated with an aqueous solution of the swelling agent, dried and prepared for shipment to garment manufacturers, in the desired condition, i.e., with or without treatment for permanent luster.

The mill level drying prior to press-finishing, as for example on a rotary press, may be effected at room temperature if desired, but one advantage of this invention is that the treated fabric may be dried at elevated temperatures, i.e., up to about 200° F., without destroying the fabric's ability to accept subsequently a permanent finish

and pleat. Normal mill drying temperatures of 170° to about 180° F. are, therefore, entirely suitable for this drying operation, thereby presenting a distinct advantage over prior art procedures which require low temperature drying in order to retain in the fabric a propensity for subsequent permanent finishing and pleating.

While the process of this invention is particularly adapted to fabrics composed essentially of keratin fibers, particularly those composed entirely of wool fibers, it is also applicable to fabrics wherein synthetic or natural fibers are blended with the wool components and to blends of keratin fibers, such as mohair, alpaca, cashmere, vicuna, guanaco, camel's hair, silk, llama and the like. The preferred synthetic fibers include polyamides, such as polyhexamethylene adipamide; polyesters, such as polyethylene terephthalate; and acrylic fibers, such as acrylonitrile homopolymers or copolymers containing at least about 85% combined acrylonitrile, such as acrylonitrile/methacrylate (85/15), and cellulose acetate and viscose rayon. Of the natural fibers which may be blended with the keratin fibers, cotton is preferred.

The process of this invention may be performed on woven, non-woven, or knitted fabrics of any type, dyed or undyed provided, of course, that the dyes are stable to the reagents. The low temperature treatments with the reducing agent are particularly adapted to the treatment of dyed goods. Conversely, the high temperature treatments may not be entirely suitable for treatment of dyed goods since, at these elevated temperatures, the reducing agent may, in some instances, strip some dyes from the fabric.

The following examples illustrate preferred embodiments of the present invention:

EXAMPLE I

A wool fabric, composed of 55 ends of 2 ply 40 worsted count yarn (Z16 and S15 twist in the plies), and 46 picks of 2 ply 40 worsted count yarn (Z16 and S15 twist in the plies) is padded with a solution in water at 100° F. (pH of 4.4) containing 2% sodium bisulfite and 10% urea with 0.02% of the nonionic wetting agent Surfonic N-95. The fabric is squeezed out to obtain a 100% wet pickup of the solution on the fabric. The fabric is then laid out on a pallet, folded over upon itself, covered with a film of polyethylene and aged for 30 minutes at room temperature. After washing in water at about 75° F. for about ½ minute, the fabric is then dried down to about 5% moisture at a temperature of about 175° F.

The fabric is then passed through a jet of steam into a David Gessner Co. rotary press model No. 20 (Serial PD506) at about 25-30 yards per minute, the press rolls being heated to a temperature of about 275° F.

To illustrate the permanence of the luster obtained, a swatch of the fabric so treated and an untreated control fabric which has been similarly rotary pressed are immersed in water containing 0.05% by weight of Synowet HR (an anionic wetting agent) at 110° F. for 10 minutes. The finish and luster of the treated fabric is substantially equivalent to the excellent qualities obtained at the rotary press, while the untreated fabric loses substantially all its finish and luster.

A second swatch of the treated fabric and an untreated fabric swatch are folded over and steam pressed for 30 seconds and dry pressed for an additional 30 seconds in a standard Hoffman press. After boiling in water containing 0.05% by weight of Surfonic N-95, the treated fabric retains substantially its pleated configuration while the untreated swatch loses its pleat completely.

EXAMPLE II

The procedure of Example I is followed except that after passing through the rotary press, the fabric is wrapped in a smooth cotton liner and treated with steam at 20 pounds per square inch pressure for 2 minutes in an

autoclave, after which the steaming is terminated and the fabric is dried under vacuum for about 8 minutes. The resulting fabric has a more lustrous finish and better hand than the fabric of Example I, but is not characterized by a propensity for substantially permanent pleating.

EXAMPLE III

The procedure of Example I is followed except that the fabric is aged for 2 hours at room temperature after padding with the bisulfite-urea solution. A similarly lustrous fabric is provided after passing the fabric so aged through a rotary press at a rate of 25 yards per minute. The finish and pleats obtained by this procedure are similar to the results of Example I.

EXAMPLE IV

The fabric of Example I is padded with a solution in water of 2% sodium bisulfite and 10% urea at 100° F. (pH of 4.4) with a wet pickup of about 100%. The fabric is then folded onto a pallet under substantially tensionless conditions and covered with a sheet of polyethylene to inhibit drying. The fabric is permitted to stand in this condition at room temperature (about 80° F.) for 100 minutes. The aged fabric is then crabbed by passing at a rate of about 10 yards per minute through 4 tanks of water at a temperature of about 75° F. The fabric is then dried to about 3.5% moisture content in a dryer containing hot air at a temperature of 172° F. The fabric is press-finished as in Example I to obtain a similarly permanent finish. The fabric is then shelf-aged for 7 days at room temperature. Similarly shelf-permanent pleats are formed in this fabric by pressing as in Example I.

EXAMPLE V

The procedure of Example IV is repeated except that the washing procedure is conducted after the fabric is passed through the rotary press. A similarly permanent finish is imparted to the fabric when it is passed through the rotary press at about 5 yards per minute. After washing, the fabric is dried again as in Example IV to a moisture content of about 4% by weight and pressed in a Hoffman press, whereby similarly permanent pleats are obtained.

EXAMPLE VI

The procedure of Example IV is repeated except that the fabric is wrapped in a smooth cotton liner after it is passed through the rotary press and the wrapped fabric is decated for 2 minutes at 20 pounds per square inch pressure of steam in an autoclave after which it is vacuum dried for 8 minutes. The crease obtained under the Hoffman press is not permanent when the fabric is decated in this manner, although the lustrous fabric finish is retained throughout all of these operations.

EXAMPLE VII

The procedure of Example IV is repeated except that the treating solution is replaced with the following solutions:

- (1) $\text{NaHSO}_3/\text{Na}_2\text{SO}_3$ (0.5%/0.5%) plus 20% urea, at a pH of 6.35
- (2) $\text{Na}_2\text{S}_2\text{O}_5$ (1%) plus 20% urea, at a pH of 4.7
- (3) $\text{Na}_2\text{S}_2\text{O}_4$ (1%) plus 20% urea, at a pH of 3.95
- (4) $\text{Na}_2\text{S}_2\text{O}_3$ (1%) plus 20% urea, at a pH of 6.55
- (5) Na_2SO_3 (1%) plus 20% urea, at a pH of 8.8
- (6) Ammonium thioglycolate (1%) plus 10% urea, at a pH of 6.0
- (7) Sodium borohydride (1%) plus 10% urea, at a pH of 6.4, and
- (8) Sodium bisulfite (2%) plus 40% urea, at a pH of 7.1

Good results are obtained as in Example IV with each of these solutions, although slightly better results are obtained with the $\text{NaHSO}_3/\text{Na}_2\text{SO}_3$ combinations.

EXAMPLE VIII

The procedure of Example VII is repeated except that instead of impregnating the fabric swatches with the treating solution by padding them through the solutions and aging, the fabrics are kept immersed in the various solutions for periods of 15 minutes, 30 minutes, 1, 2 and 4 hours and not aged after removal. Each of the solutions is maintained at room temperature. Similarly permanent finishes are obtained in each of the treated fabrics by passing them through the rotary press at higher rates proportional to the period of contact of the fabric with the solution.

EXAMPLE IX

The fabric of Example I is impregnated with a 2% by weight solution of sodium bisulfite, squeezed to a wet pickup of 100%, laid out on a pallet and aged, under a film of polyethylene, for 30 minutes at room temperature. After washing with water at 75° F., the fabric is passed three times through a 12% aqueous solution of urea to pick up 10% by weight of the urea on the fabric. The fabric is then passed through a tenter frame and dried in the conventional manner. This fabric is shipped to a garment manufacturer, who prepares from the fabric several pairs of men's trousers. The pleats formed in these fabrics by standard Hoffman pressing procedures (30 seconds steaming, 30 seconds dry-pressing) are retained after immersion in water at 170° F. for 30 minutes.

That which is claimed is:

1. A process for modifying the characteristics of a fabric comprising keratin fibers including the steps of (1) treating said fabric with a reducing agent capable of rupturing the cystine disulfide linkages in the keratin fibers and from about 3 to about 50% by weight of a swelling agent; (2) drying said fabric at an elevated temperature to a moisture level of less than about 30% by weight, said swelling agent being substantially retained in said fabric; and (3) pressing said fabric at a moisture level of less than about 30% by weight, to set a configuration therein which is substantially durable to subsequent wear and wetting.

2. A process for modifying the characteristics of a fabric comprising keratin fibers including the steps of (1) adding to said fabric a reducing agent capable of rupturing the cystine disulfide linkages in the keratin fibers and from about 3 to about 50% by weight of a swelling agent; (2) drying said fabric at an elevated temperature to a moisture level of less than about 30% by weight, said swelling agent being substantially retained in said fabric; and (3) preparing a garment from said fabric and pressing said garment at a moisture level of less than about 30% by weight to impart thereto a pleat capable of withstanding subsequent wear and wetting without substantial loss of said crease.

3. A process for modifying the characteristics of a fabric comprising keratin fibers including the steps of (1) adding to said fabric a reducing agent capable of rupturing the cystine disulfide linkages in the keratin fibers; (2) washing said fabric after permitting a sufficient time for the reducing agent to react with the keratin fibers; (3) adding to said washed fabric from about 3 to about 50% by weight of a swelling agent; (4) drying said fabric at a temperature between 122° and 200° F. to a moisture level of less than about 30% by weight, said swelling agent being substantially retained in said fabric and preparing a garment therefrom; (5) pressing said garment at a moisture level of less than about 30% by weight to impart thereto a pleat capable of withstanding subsequent wear and wetting without substantial loss of said crease.

4. The process of claim 3 wherein the garment is steamed and pressed at a moisture level of less than about 30% by weight.

5. A process for modifying the characteristics of a fabric keratin fibers including the steps of (1) treating

said fabric with from about 0.01 to about 10% by weight of a reducing agent capable of rupturing the cystine disulfide linkages in the keratin fibers and from about 3 to about 50% by weight of a swelling agent; (2) drying said fabric at an elevated temperature to a moisture content of less than about 30% by weight, said swelling agent being substantially retained in said fabric; (3) contacting at least one surface of said fabric at a moisture level of less than about 30% by weight with a pressing element under conditions whereby the fibers at or near the surface of said fabric are durably set in a pressed configuration while a sufficient number of the remaining fibers throughout the fabric are not sufficiently set as to destroy their propensity for subsequent durable setting to provide a lustrous fabric surface capable of withstanding manipulation and wetting without substantial loss of said luster, said fabric being characterized by a propensity for subsequent permanent pleating.

6. A process for modifying the characteristics of a fabric composed essentially of keratin fibers comprising the steps of (1) impregnating said fabric with an aqueous solution containing from about 0.01 to about 10% by weight of a reducing agent capable of rupturing the cystine disulfide linkages in the keratin fibers and from about 3 to about 50% by weight of a swelling agent; (2) drying the fabric to a moisture content below at least about 20% by weight, said swelling agent being substantially retained in said fabric; (3) contacting at least one surface of said fabric with a pressing element under conditions sufficient to provide a lustrous fabric capable of withstanding manipulation and wetting without substantial loss of said luster; (4) washing said fabric with an aqueous medium; (5) wrapping said fabric with a porous, flexible material; (6) heating said wrapped fabric and flexible material in the presence of steam at a pressure of at least about 10 pounds per square inch; and (7) after terminating the steaming, drying said fabric under vacuum to provide a fabric finish capable of withstanding manipulation and wetting without substantial loss thereof.

7. A process for modifying the characteristics of a

fabric composed essentially of wool fibers comprising the steps of (1) impregnating said fabric with an aqueous solution containing from about 1 to about 5% by weight of sodium bisulfite; (2) aging said impregnated fabric for a period from about 30 minutes to about 2 hours; (3) washing said fabric in an aqueous medium; (4) impregnating said fabric with an aqueous medium containing from about 3 to about 50% by weight of urea; and (5) drying said fabric at a temperature between 122 degrees and 200 degrees F., said fabric thereby being characterized by a propensity for subsequent durable setting.

8. A wool fabric treated in accordance with claim 5.

9. A wool fabric treated in accordance with claim 7.

10. The process of claim 1 wherein said fabric is dried at a temperature between about 122 and about 200° F.

11. The process of claim 3 wherein the drying procedure of step 4 is conducted at an elevated temperature.

12. The process of claim 1 wherein the fabric is pressed without the addition of moisture in excess of the regain level prior to pressing.

UNITED STATES PATENTS

References Cited

2,672,397	3/1954	Lundgren	8—128
2,983,569	5/1961	Charle	8—127.5
3,098,694	7/1963	Reider	8—128

FOREIGN PATENTS

443,359	2/1936	Great Britain
---------	--------	---------------

OTHER REFERENCES

Speakman, Journal of the Textile Institute, pp. T627-T628 (1958).

Wolfgram et al., Journal of the Society of Dyers & Colorists, vol. 76, 169-173, March 1960.

MAYER WEINBLATT, Primary Examiner

U.S. Cl. X.R.

8—127.6; 38—144; 117—141

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,477,805 Dated November 11, 1969

Inventor(s) Dmitry M. Gagarine, Emile E. Habib and Kermit S. LaFleur

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 1, line 21, delete "or" and substitute therefor --of--.

In Column 6, line 9, "wood" should read --wool--; line 27, "treament" should read --treatment--.

In Column 8, line 75, after "fabric" insert --comprising--.

SIGNED AND
SEALED
FEB 24 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents