

UNITED STATES PATENT OFFICE

2,269,479

METHOD OF MAKING FABRICS

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No Drawing. Application February 5, 1937,
Serial No. 124,235

7 Claims. (Cl. 154—33)

This invention relates to fabrics, pads and similar materials made of fibers, including both cloth-like sheet materials which can be used for many of the same purposes as textile fabrics while still having distinct and individual characteristics, and also thicker, more bulky fibrous bodies.

The fibrous structures above referred to are produced without using any of the common fabricating processes such as spinning, weaving, knitting, felting, or the like.

In my copending application Serial No. 30,022, filed July 5, 1935, I have described a novel fibrous product and a process for making the same which involves distributing a waterproof binder substantially throughout a body of loosely intermingled fibers where it serves to unite both kinds of the fibers into a highly porous unified structure. In a preferred form of the invention cotton fibers are mixed with cellulose acetate fibers while the latter fibers are in a dry and non-adhesive condition. Subsequently this mixture is treated with a solvent for the binder or by heat, if the binder is of a thermo-plastic nature, either procedure serving to develop the normally latent adhesive properties of the fibers and thus to make them bond to, or unite with, other fibers with which they are in contact. While the fibers are in this condition the mixture may be compressed more or less, if desired, to produce a more intimate contact of each fiber with its neighbors. After the solvent has evaporated, or the mass has cooled, depending upon the method employed to develop the adhesive characteristics of the binder elements, the fibers will be left securely bonded to each other in a unified mass. In such products the binder may or may not be in a fiber form.

It will be observed that in these products the bond or union of one fiber to another, upon which the strength and integrity of the structure fundamentally depends, is an adhesive union created by the binder. Consequently, while these products find a wide range of utility, they nevertheless have limitations not found in fabrics made by the usual textile operations, and such limitations have compelled the adoption of restrictive expedients in manufacturing them. For example, in making a bleached or absorbent cotton fabric or pad, it has been necessary to kier boil and bleach the fiber prior to making up the fibrous body. This is an expensive operation because of the extremely bulky nature of the cotton in a fibrous form, and the difficulty of handling it in this condition. Moreover, the nature of bleached cotton fibers is such that they act very differently in the beating, carding, calendaring, and other operations required in working them into the desired condition, and they do not handle as well nor produce as satisfactory a product as do raw or unscoured cotton fibers.

In addition, the fact that the bonds or points of coalescence which hold the fibers together are thermo-plastic and soluble in many of the common organic solvents, some of which are used in dry cleansing operations, necessarily restricts somewhat their field of operation.

I have now made the surprising discovery that these fabrics, and like products, can be kier boiled and bleached in the usual way without disintegrating. This is an astonishing result considering the nature of the bonds which unite the fibers to each other and the fact that it is well known that the caustic solutions used in kier boiling and the common bleaching agents attack the bonding materials. Not only is the integrity of the structure maintained through such a treatment, but when the binders consist of cellulose acetate, or other cellulose esters, they are regenerated into cellulose and the bonds in the final product thus are neither thermo-plastic nor sensitive to the common solvents. On the contrary, they are approximately as resistant and stable as is the cotton fiber itself, assuming that the original mixture consists of cotton and cellulose acetate fibers. Such a product thus consists of cellulose fibers unified by a coalescence of the fibers or, in other words, by cellulose bonds.

Thus the present discovery completely eliminates all of the objectionable characteristics above described in applicant's earlier product. If the conversion or regeneration of the binder is complete, then the entire fibrous body is converted into an integral homogeneous structure. The degree of conversion during the kier boil is intimately related to the alkaline solution used, the temperatures applied, and the length of time occupied by the process. For example, typical conditions maintained in a kier boil are to use a 1% solution of sodium hydroxide at a temperature of approximately 250° F. for a period of, say, ten hours. Such a treatment produces a fairly complete conversion of the cellulose acetate binder fibers to a relatively pure cellulose form. If, however, this time is reduced, the temperature is lowered, or the caustic concentration is decreased, then the degree of conversion will be lessened. This treatment also scours the cotton fibers, removing the normal waxes and oils from them, and reduces them to an approximately pure cellulose form. Both the fibers so treated and also the regenerated cellulose fibers are water absorbent. The bleaching operation effects a further purification of the cotton fibers, improves their color, and increases their absorbency. Usually a bleaching solution includes sodium hypochlorite; and this constituent also has a regenerating action on cellulose esters. While it is preferable to regenerate the cellulose by kier boiling or bleaching, or both, since this treatment produces highly desirable

changes in the fibers, such regeneration can, if desired, be produced by treatment with other aqueous alkaline solutions, when kier boiling or bleaching is not desirable.

It should be observed that in this process the binder performs an essential structural function in the production of the initial fibrous body, and that its subsequent regeneration changes it into a form which eliminates its characteristics that are objectionable in the final product, and replaces them with properties that are useful and desirable. And this transformation takes place while still maintaining the union of the fibers to each other substantially undiminished in strength. So far as I am aware, this result has never been produced heretofore.

For convenience the bond, union, or similar relationship of the fibers to each other produced by the various methods above described, and which is relied upon mainly to give the fibrous body its strength and stability, is frequently herein designated as a "coalescence," or by some similar term, whether or not these terms are used in their strict or technically accurate sense.

It is a common practice to incorporate a plasticizer in the cellulose ester binders, particularly those in fiber form, and it is desirable to remove these constituents because they are normally complex organic compounds which are frequently toxic. I have discovered that the kier boiling operation accomplishes this result in addition to effecting the conversion above described. For example, a preferred plasticized acetate composition may contain as much as 50% of a plasticizer known as para toluene ethyl sulfonamide. This plasticizer is readily removed in the manner above described, and notwithstanding the fact that it originally constituted a high proportion of the mass of the fiber, its removal leaves the fibers securely bonded to each other. Residual solvents and other impurities also are removed by this process.

An important advantage of this invention in the production of fabrics or other fibrous bodies in which cotton is a predominating or important constituent, is that it permits the initial preparation of the fibrous structure from raw cotton, which is a far more satisfactory material to handle in such machines as pickers, cards, garnets, and the like, than is bleached cotton, and the body so produced then can be kier boiled and bleached exactly as in the case of any cotton fabric. This also permits the economical handling of the fabrics by those methods commonly used with woven, felted, knitted, and like products, as against the far more expensive and cumbersome method of bleaching the cotton fiber in bulk prior to making up the fabric structure. In addition, the appearance of a fibrous web prepared with raw cotton is much better than one made up from bleached cotton.

As described in my earlier application above referred to, the development of the coalescing properties of the binder fibers during the unifying step may, if desired, be carried to such a point that the fiber form of the binder will be destroyed and this constituent of the mixture will be left distributed throughout the product in the form of small individual droplets or irregularly shaped bodies adhering to the cotton fibers in such a manner as to bind them together into a coherent mass. If such a product is subjected to the regenerating treatment above described, these droplets or other binder elements will be converted into cellulose, as in the case

of the product in which the binder is left in a fiber form. The conversion treatment neither changes the position nor the shape of the binder elements.

5 In referring to a regeneration or conversion of cellulose ester binder material in the specification and claims hereof, I mean a conversion of that material into one of a higher cellulose content while maintaining its solid form, as distinguished from the meaning of the term "regeneration" as used in the viscose and cuprammonium processes in the rayon industry wherein cellulose is precipitated from solution to solid form.

10 While in making the products above described it is of great advantage to use a binder of fiber form, this is not always necessary. For example, in making some products satisfactory results are produced by spraying a solution, emulsion, or other dispersion of one of the binders herein mentioned on a fibrous web, or impregnating the web with such a material. Subsequently the solvent, or other medium in which the binder is dispersed, is evaporated, thus leaving the fibers united to each other by the residual binder. The proportion of binder added to the fiber should be such that the product resulting from this procedure will be a highly porous reticulated structure with abundant interstitial spaces entirely open and free. Since all of these binders are waterproof, such a process as that just described would produce a highly non-absorbent product which would be objectionable if an absorbent body were desired. However, by regenerating the binder into cellulose or an equivalent absorbent form, this objection can be obviated. Whether the binder is in a fiber form or in some other form, such as those just mentioned, the conversion of it into cellulose is highly advantageous in making pads, surgical sponges, absorbent gauzes, and other bodies used primarily because of their ability to absorb water, blood, or other liquids.

The product initially produced and subjected to the regenerating process, as above described, may be made from any of the materials disclosed in my application above referred to, and with any of the binders or variations in processes there described. While the invention probably is of greatest practical utility in connection with the manufacture of cotton products or those in which cotton forms a predominating constituent, nevertheless it is equally useful in the manufacture of articles made from other textile fibers such as wool, silk, and rayon of the regenerated cellulose type. Also, while cellulose acetate is the binder at present preferred, other forms of binders may be used, particularly other cellulose esters.

60 In this connection it may also be pointed out that the purification of the product, particularly by the elimination of plasticizers and similar objectionable constituents from the binder, is of advantage regardless of any other effect on the binder. Plasticizers are primarily used to lower the melting point of the binder or to change its characteristics in some manner adapted to facilitate the subsequent step of developing the normally latent adhesive properties of the binder and bonding these elements to the cotton or non-binder fibers. After this step has been performed, the presence of the plasticizer is a disadvantage both for the reasons above pointed out and also because it makes the binder more sensitive to the action of heat, solvents, and the

like. Consequently, the mere fact of eliminating these constituents improves the product since it converts the binder into a more stable form in which it is less likely to be destroyed or adversely affected. As above pointed out, the binder may be so modified that it is no longer affected materially by the agent originally used in performing the unifying step.

It should also be understood that in making these fibrous products from different kinds of fibers and in using different binders, some variation or modification of the process may be necessary to suit the requirements of these different materials. For example, when the product is made of wool fiber it will customarily be subjected to a scouring operation with an alkaline solution which will regenerate binders made of cellulose derivatives such as those above mentioned. Such a scouring operation, therefore, is the equivalent of the kier boiling and bleaching processes used on cotton, but the wool scouring process is carried on at a lower temperature and usually for a different period of time from that used in kier boiling. Consequently, while I have herein disclosed typical embodiments of my invention, it will be understood that the invention may be embodied in other forms without departing from the spirit or scope thereof.

The claims in this application are limited to applicant's method of making fabrics in which fibers are united by discrete particles of a cellulose ester binder which is regenerated into a binder constituent of a higher cellulose content. The product disclosed in this application is claimed in a pending application Ser. No. 405,623, filed August 6, 1941, which is a division of the instant application.

Having thus described my invention, what I desire to claim as new is:

1. That improvement in methods of making fabrics and similar fibrous structures which consists in dry-mixing textile fibers with cellulose acetate binder fibers having normally latent adhesive properties, performing said mixing operation while the adhesive properties of the binder fibers are in a latent condition, then unifying the mixture so produced by softening said binder fibers and causing them to bond with each other, and finally subjecting the unified fibrous body to an aqueous alkaline treatment and thereby converting said cellulose acetate fibers into fibers of higher cellulose content while preserving the textile fibers in their original fibrous form and maintaining the unified fibrous body and the bonds thereof substantially unimpaired.

2. A method according to preceding claim 1, in which said aqueous alkaline treatment is conducted under the influence of heat and pressure.

3. That improvement in methods of making fabrics and similar fibrous structures which consists in dry-mixing raw cotton textile fibers with cellulose acetate binder fibers, performing said mixing operation while the adhesive properties of said binder fibers are in a latent condition, then subjecting the mixture so produced to a coalescing operation which bonds said cotton and binder fibers together at intersecting points into a highly porous unified structure, and subsequently kier boiling the structure so produced and thereby scouring said cotton fibers and converting said cellulose acetate fibers into fibers of higher cellulose content while preserving the textile fibers in their original fibrous form and

maintaining the bonds of the unified structure substantially unimpaired.

4. That improvement in methods of making fabrics and similar fibrous structures which consists in dry-mixing textile fibers with cellulose acetate binder fibers having normally latent adhesive properties, performing said mixing operation while the adhesive properties of the binder fibers are in a latent condition, the cellulose acetate fibers containing a substantial proportion of a plasticizer, unifying the mixture so produced by softening said cellulose acetate fibers through the influence of heat and causing them to coalesce with other fibers at points of intersection therewith, and finally subjecting the unified fibrous body of fibers to an aqueous alkaline treatment serving to convert said cellulose acetate fibers into fibers of higher cellulose content while preserving the textile fibers in their original fibrous form and maintaining the unified fibrous body and the bonds thereof substantially unimpaired.

5. That improvement in methods of making fabrics and similar fibrous structures, which consists in dry-mixing textile fibers with binder fibers having normally latent adhesive properties and consisting essentially of a cellulose ester, continuing said mixing operation until the binder fibers are distributed substantially throughout the entire fibrous mass, unifying the mixture so produced by softening said binder fibers and thereby causing them to bond the fibers of the mass together into a unified structure by coalescence of the fibers at intersecting points, and subsequently subjecting said unified structure to an aqueous alkaline treatment which converts said cellulose ester fibers into fibers of higher cellulose content while preserving the textile fibers in their original fibrous form and maintaining the bonds of the unified structure substantially unimpaired.

6. That improvement in methods of making fabrics and similar fibrous structures, which consists in dry-mixing raw cotton textile fibers with binder fibers having normally latent adhesive properties and consisting essentially of a cellulose ester, continuing said mixing operation until the binder fibers are distributed substantially throughout the entire fibrous mass, unifying the mixture so produced by softening said binder fibers and thereby causing them to coalesce with the other fibers at spaced points of contact therewith and thereby to unite the fibers of said body into a highly porous unified structure, and subsequently kier boiling the structure so formed and thereby scouring the raw cotton fibers and converting said cellulose ester fibers into fibers of a higher cellulose content while preserving the textile fibers in their original fibrous form and maintaining the bonds of the unified structure substantially unimpaired.

7. That improvement in methods of making fabrics and other fibrous structures of the type consisting essentially of a unified fibrous body of intermingled, unorganized, dry-assembled raw cotton textile fibers bonded together by discrete particles of a binder consisting essentially of a cellulose ester, which consists in subjecting said mass to an aqueous alkaline treatment which converts said cellulose ester into a binder constituent of a higher cellulose content while preserving the textile fibers in their original fibrous form and maintaining the unified fibrous body and the bonds thereof substantially unimpaired.

RAYMOND E. REED.