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RESILIENT FILAMENTS

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This invention relates to the preparation of artificial filaments having a basis of cellulose acetate, or other organic derivative of cellulose, which filaments are substantially permanently crimped and highly resilient, and which possess a voluminous or lofty structure.

An object of my invention is to provide a process for the treatment of artificial filaments having a basis of cellulose acetate or other organic derivative of cellulose whereby said filaments may be permanently crimped.

Another object of my invention is to provide a process for the treatment of cellulose acetate or other organic derivative of cellulose filamentary materials to render the latter more resilient and to impart thereto a voluminous structure.

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

Filaments having a basis of cellulose acetate or other organic derivative of cellulose in staple fiber form have been found to possess excellent insulating characteristics when employed in the manufacture of comforters, sleeping bags and like articles. Continuous artificial filaments having a basis of cellulose acetate or other organic derivative of cellulose differ from materials such as cotton and wool in that the artificial filaments are relatively smooth. They do not possess a crimped or crinkled structure, such as that found in naturally occurring fibers such as wool, which structure is largely responsible for the characteristic hand or fullness of said materials. Consequently, when the ordinary artificial filaments having a basis of cellulose acetate or other organic derivative of cellulose are subjected to prolonged pressure, as, for example, in a sleeping bag, they tend to become matted and upon release of the pressure do not fully return to their original voluminous state. This matting causes the dead air spaces in said artificial filamentary materials to be reduced in volume and the latter gradually lose some of their insulating properties which, of course, is a definite disadvantage which tends seriously to restrict their usefulness.

I have now discovered, however, that artificial filamentary materials having a basis of cellulose acetate or other organic derivative of cellulose, and particularly filaments in staple fiber form, may be treated so as to impart a substantially permanent crimped or crinkled structure thereto. In accordance with the novel process of my invention, filamentary materials having a basis of cellulose acetate are immersed in a liquid medium having at least a softening action on the cellulose acetate filaments, and, after the excess liquid is

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removed from the filaments, they are then immersed in water at an elevated temperature. The filaments are maintained in the water bath for a short time after which the water is removed and the treated filaments are dried with heated air. This treatment effects a marked change in the character of the filaments. In place of their originally smooth and straight structure, the filaments are now permanently crimped or crinkled and possess a full and elastic hand substantially similar to that possessed by wool. Furthermore, the filaments are far more resilient than prior to treatment and recover their original voluminous structure even after the prolonged application of pressure.

Any suitable liquid medium having a softening action on the cellulose acetate filaments may be employed. Examples of such liquids are aqueous solutions of ethyl alcohol, containing from 50 to 95.5% of the alcohol, aqueous solutions of acetone containing from 20 to 80% of acetone, and aqueous solutions of acetone containing ethyl and/or methyl alcohol, for example, those solutions containing from 10% to 40% of acetone and from 10 to 50% of ethyl and/or methyl alcohol. Solutions containing ethyl alcohol, acetone or methyl alcohol together with organic liquids which do not exert any softening or swelling action on the cellulose acetate filaments such as benzol and toluol, xylol or paraffinic hydrocarbons may also be employed. Preferably, we employ aqueous solutions of ethyl alcohol containing from 70 to 90% by volume of the alcohol as the treating medium. The alcoholic solutions may be at a temperature of from 65 to 110° F. during treatment and the filaments may be maintained therein for from 5 to 60 seconds. When employing aqueous solutions of ethyl alcohol, the temperature is preferably about 90° F. and the filaments are usually maintained therein for about 30 seconds. Following this treatment, the excess liquid is removed in any convenient manner, such as, for example, centrifuging.

The moist filaments are removed from the centrifuge after the solvent treatment and are then placed in a water bath at a temperature of 60 to 212° F., preferably about 150 to 160° F. for 1 to 5 seconds. At the end of this period the filaments are removed from the water bath, centrifuged to remove as much water as possible, and are then dried with hot air. Any convenient method of drying is suitable. The filaments may be dried, for example, by being placed upon screens or racks and entered into a chamber through which hot air is circulated, or the filaments may be

placed in a rotary drier in which they are tumbled about while hot air passes therethrough. During the drying operation, the air may be at a temperature of 68 to 300° F.

The filaments may be treated while in a continuous filamentary form but preferably they are converted into relatively short staple lengths, for example from 3 to 6 inches in length, before being treated.

The filaments may be prepared in any convenient manner well known to the art such as by dry-spinning or wet-spinning operations. Preferably, we employ filaments having a basis of an organic derivative of cellulose which are prepared by dry-spinning operations. A particularly valuable product is obtained when I employ those dry-spun filaments which are not subjected to any tension or draw-down during the spinning operation as, for example, those filaments prepared in accordance with the process of U. S. Patent No. 2,290,929. The filaments may be of any convenient denier, excellent results being achieved with filaments of 1.5 to 30 denier.

In order further to illustrate my invention but without being limited thereto, the following example is given.

Example

Cellulose acetate filaments are dry-spun without tension or draw-down employing a solution of cellulose acetate in acetone containing about 25% by weight of cellulose acetate and 75% by weight of 95/5 acetone/water. The filaments are spun so as to be approximately 6 denier per filament. The continuous filaments are then cut into staple fiber in any convenient manner in which the fibers are from 3 to 6 inches in length.

After being suitably opened and loosened up, the fibers, in the form of a bundle, are dipped into a solution containing 80% by volume of completely denatured ethanol and 20% by volume of water, maintained at 90° F., for 30 seconds. The treated fibers are removed from the solution and the excess liquid is removed by centrifuging. From the centrifuge the fibers are placed in a water bath at a temperature of 150 to 160° F. and held therein for about 5 seconds. After being removed from the water bath, the fibers are centrifuged again to remove as much water as possible, and are dried in a rotary drier with air at about 200° F. The staple fiber treated in this manner is observed to have lost the soft and typical hand of cellulose acetate fibers and now possesses a harsh, voluminous and resilient hand greatly resembling that of wool. The fibers are substantially permanently crimped and even after being subjected to an appreciable pressure for a considerable period of time, the fibers resume their original lofty character and form when the pressure is removed.

While our invention has been more particularly described in connection with the treatment of artificial filaments having a basis of cellulose acetate, it may be employed in connection with the treatment of filaments having a basis of other organic derivatives of cellulose, for example, cellulose esters such as cellulose propionate and cellulose butyrate, mixed esters such as cellulose acetate-propionate and cellulose acetate-butyrate, and cellulose ethers such as ethyl cellulose and benzyl cellulose.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made

therein without departing from the spirit of my invention.

The expression "swelling agent" as employed in the appended claims is to be construed as including within its scope substances which not only have a swelling effect on the organic derivative of cellulose but which may also have a solvent action thereon.

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

1. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of an organic derivative of cellulose and prepared from filaments spun without any tension being exerted thereon, in an aqueous liquid medium containing a water-soluble swelling agent having at least a softening action on the organic derivative of cellulose, removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F., removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

2. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, in an aqueous liquid medium containing a water-soluble swelling agent having at least a softening action on the cellulose acetate, removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F., removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

3. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, containing from 70 to 90% by volume of ethyl alcohol, removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F., removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

4. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, containing from 70 to 90% by volume of ethyl alcohol for from 5 to 60 seconds, removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F. for from 1 to 5 seconds, removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

5. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, containing from 70 to 90% by volume

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of ethyl alcohol for from 5 to 60 seconds at a temperature of 65 to 110° F., removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F. for from 1 to 5 seconds, removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

6. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, containing 80% by volume of ethyl alcohol from 5 to 60 seconds at a temperature of 65 to 110° F., removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F. for about 5 seconds, removing the water from

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the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

7. Process for the production of voluminous, permanently crimped artificial staple fibers, which comprises immersing relaxed, unstretched and unassociated dry-spun staple fibers, having a basis of cellulose acetate and prepared from filaments spun without any tension being exerted thereon, containing 80% by volume of ethyl alcohol for about 30 seconds at a temperature of 90° F., removing excess liquid from the staple fibers, immersing the staple fibers in water at a temperature of about 150 to 160° F. for about 5 seconds, removing the water from the staple fibers and drying the staple fibers, whereby voluminous, permanently crimped staple fibers are produced.

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