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HIGH TENACITY FILAMENTARY MATERIALS

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This invention relates to improvements in processes for the production, by stretching operations, of high tenacity yarns and filaments having a basis of an organic ester of cellulose, and relates more particularly to the pretreatment of said organic ester of cellulose yarns and filaments prior to stretching. This invention also relates to improvements in the conditioning of regenerated cellulose yarns and filaments of high tenacity, prepared by the saponification of stretched organic ester of cellulose yarns and filaments, whereby said high tenacity regenerated cellulose materials are rendered more amenable to textile operations such as knitting and weaving.

An object of this invention is to provide a process for the pretreatment of organic ester of cellulose yarns and filaments whereby said yarns and filaments may be subjected to textile operations at very high linear speeds.

Another object of this invention is the production of improved high tenacity organic ester of cellulose yarns and filaments by subjecting said pretreated organic ester of cellulose yarns and filaments to high speed stretching operations. Still another object of this invention is a process for the preparation of high tenacity yarns and filaments having a basis of an organic ester of cellulose which are of improved quality.

A further object of this invention is the conditioning of high tenacity regenerated cellulose yarns and filaments prepared by the saponification of high tenacity organic ester of cellulose yarns and filaments whereby knitted and woven regenerated cellulose fabrics of improved quality may be produced from said conditioned regenerated cellulose yarns and filaments.

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

Yarns of high tenacity have been produced by stretching yarns having a basis of cellulose acetate, or other organic ester of cellulose, and prepared by dry spinning operations. The stretching is effected by exerting a tension on the yarns, which are usually of a relatively high denier, i. e. 450 to 1500, prior to stretching, while they are under the influence of a softening agent such as steam, hot water, or a liquid containing an organic solvent or softening agent for the organic ester of cellulose material. During the stretching operation the length of the yarns may be increased to the extent of 200, 300, 500, or even 1000 or 2000% of their original length, and their denier is, of course, correspondingly decreased. The increase in tenacity achieved by the stretching operation is retained and is even enhanced when such stretched organic ester of cellulose yarns are subjected to the action of saponifying baths and converted to regenerated cellulose yarns. The stretching operation is most economically effected with the yarns travelling at high

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speeds. The stretching operation not only requires precise control to effect a uniform degree of stretch through the entire length of the yarn, but, due to the speed at which the yarns are moving and to their relatively high denier, the latter must be lubricated properly while moving toward the stretching apparatus to minimize friction and to avoid the application of an excessive or uneven degree of tension on the yarns. Excessive tension results in broken filaments and the formation of slubs, while any unevenness in the tension applied adversely affects the strength or tenacity of the yarns. The lack of uniformity in the stretched organic ester of cellulose yarns produced is not only carried over to the yarns after they are saponified but also to the fabrics into which they are woven.

While some yarn lubricants are satisfactory from the point of view of supplying a sufficient degree of lubrication to the rapidly moving relatively high denier yarns so that broken filaments and the formation of slubs are avoided, these lubricants are difficult to remove in the relatively short period of time elapsing before the running yarns are actually subjected to the softening and stretching operation. Furthermore, the presence of these lubricants on the yarns prevents the removal of any residual solvent remaining in the organic ester of cellulose yarns when said yarns are wet out prior to stretching. The yarn lubricants heretofore employed possessed these disadvantages and resulted in decreased operating efficiency and yarns of unsatisfactory quality.

We have now discovered that the above and other disadvantages encountered in the preparation of high tenacity organic ester of cellulose yarns may be entirely avoided by employing a novel yarn lubricant on the yarns prior to the stretching operation. Furthermore, we have also discovered that improved textile materials made of or containing high tenacity regenerated cellulose yarns may be obtained by employing said yarn lubricating composition on the regenerated cellulose yarns produced by saponification of the high tenacity stretched organic ester of cellulose yarns. In accordance with our invention these advantageous results may be achieved by employing as a yarn lubricant a composition comprising mineral oil, a yarn softening agent, an anti-static agent, an emulsifying agent and a blending agent. Suitable yarn softening agents are sulfonated olive oil or other sulfonated vegetable oil, or a cellulose ester wetting agent which acts as a softener, e. g. sulfonated mineral oil, while anti-static agents which are satisfactory are, for example, mineral salts or soaps, or sulfonated vegetable oils, which, in addition to their yarn softening action, are also effective as anti-static agents. As emulsifying agents we may

employ the safts of higher fatty acids with hydroxyalkyl amines, e. g. triethanolamine oleate, or sulfonated vegetable or mineral oil, which also function as emulsifiers. Suitable blending agents have been found to be sperm oil, oleyl alcohol or alkylated phenols, such as diamyl phenol. The lubricant composition preferably comprises from 50 to 85% by weight of mineral oil, most advantageously of a viscosity of 50 to 125 seconds (Saybolt Universal at 100° F.), 2.5 to 20% of yarn softening agent, e. g. sulfonated vegetable or mineral oil, from 5 to 30% of emulsifying agent and from 1 to 10% of blending agent.

The application of this novel lubricating composition in the conditioning of organic ester of cellulose yarns and filaments employed for the production of high tenacity organic ester of cellulose yarns by stretching operations substantially improves the uniformity and quality of the high tenacity stretched organic ester of cellulose yarns obtained. Not only does it contribute greatly to the ease with which the yarns may be wound and twisted, but the lubricant also renders the organic ester of cellulose yarns anti-static. This novel composition has another and very important characteristic since it may be completely removed both easily and quickly by passing the yarn through a wetting bath prior to stretching. The complete removal of the conditioning composition permits all of the residual solvent which may be present in the yarns to be removed in the wetting bath prior to stretching which enables the yarns and filaments to be stretched with a very high degree of uniformity. In addition to these advantages, and as heretofore indicated, the lubricating composition also yields very valuable results when applied to the high tenacity regenerated cellulose yarns which are obtained by saponifying the high tenacity organic ester of cellulose yarns.

The lubricating fluid may be applied to the yarns or filaments in any convenient manner. Thus, the fluid may be applied by means of wicks, rollers, discs or any other suitable furnishing device. The fluid may be applied to the organic ester of cellulose yarns directly as they leave the spinning cabinet where they may be formed by dry-spinning operations or the lubricating fluid may be applied to the yarns or filaments at any subsequent winding and twisting operation designed to put the yarns in the desired condition for the stretching operation. The conditioning fluid may also be applied to the stretched yarns after saponification and prior to weaving, twisting, doubling, braiding or any other textile operation whereby the yarns are fabricated into product form.

Thus, as a continuous operation, yarns, coming from the metier or spinning cabinet and moving at high speed, are passed over a suitable furnishing device where the conditioning fluid is applied and the conditioned yarns are then doubled, wound, twisted or subjected to other textile operations at high speed so that they will be in a satisfactory condition for stretching. The conditioning fluid is removed from the running yarns employing a wetting bath and the wetted yarns are then stretched, saponified, dried, lubricated and then put up in packages or fabricated directly.

The yarns which are treated prior to stretching may have a basis of any organic ester of cellulose. Examples of suitable organic esters of cellulose are cellulose acetate, cellulose propionate, cellulose butyrate and mixed esters of cellulose such as cellulose aceto-propionate and cellulose aceto-butyrate.

The stretched organic ester of cellulose yarns may be saponified conveniently to yield high tenacity regenerated cellulose yarns employing batch processes, with the stretched yarns wound on bobbins, or continuous processes may be employed. Thus, the stretched organic ester of cellulose yarns may be led directly into a saponifying bath, the path through the saponifying bath being of sufficient length so that the yarn is completely saponified before leaving the bath. After saponification the yarn is washed free of the saponifying agent, dried and wound into packages of convenient size.

The saponification may be carried out by means of any suitable basic agent. The saponifying agent may be inorganic in nature such as, for example, sodium hydroxide, potassium hydroxide, sodium silicate, ammonium hydroxide, sodium carbonate, or other inorganic basic agent. Organic saponifying agents may also be employed such as, for example, methyl amine, ethylene diamine, triethanolamine or other organic bases. The saponifying agents may be employed in varying concentrations in aqueous, alcoholic or aqueous-alcoholic solutions. The saponifying bath may be at a temperature of 20 to 100° C. For example, when aqueous solutions of sodium hydroxide are employed, they may be of concentration of 0.1 to 5% by weight and saponification may be effected in from 5 to 180 minutes with the solution at 30 to 90° C. When employing aqueous solutions of sodium hydroxide as the saponifying medium, it is preferable to include a salt such as sodium chloride or sodium acetate in said solution.

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

Example I

A yarn conditioning fluid or lubricant of the following composition is prepared:

	Parts by weight
White mineral oil (50 to 125 visc.)	77.5
Sulfonated olive oil	5.0
Sperm oil (raw)	2.5
Triethanolamine oleate	15.0

This lubricant is applied to a dry spun cellulose acetate yarn of 480 denier containing 40 filaments, and the yarn is given the desired degree of twist. The twisted yarn is then passed through a hot water bath wherein the lubricant and residual spinning solvent are removed and the yarn is then given a substantial degree of stretch, i. e. about 10 times its original length, after being sufficiently softened with a suitable softening agent. The stretched yarns are then saponified, dried and lubricated with the above fluid composition before being processed further.

Example II

The following yarn conditioning or lubricating fluid may also be employed as described above:

	Parts by weight
Mineral oil	50
Sulphonated mineral oil	30
Triethanolamine oleate	15
Diamyl phenol	5

This composition gives between 65 and 70% free mineral oil. It may be advantageously em-

ployed in the preparation of high tenacity stretched, saponified yarns as described in Example I.

The stretched saponified yarns are found to be more uniform along their length than yarns treated with other types of lubricating fluids and to possess increased overall strength. Due to the greater uniformity and strength the lubricated regenerated cellulose yarns may be warped with far greater efficiency enabling increased warping production to be achieved. Furthermore, when weaving certain types of cloth where a specific degree of porosity must be maintained it has been observed that, when employing stretched, saponified organic ester of cellulose yarns treated with our improved lubricating fluid during their preparation, the desired porosity may be maintained with a substantially reduced degree of twist in the regenerated cellulose yarns.

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 our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising mineral oil, a yarn softening agent, an anti-static agent, an emulsifying agent and a blending agent to an organic ester of cellulose yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, and stretching the yarn in the presence of a softening medium for said yarn.

2. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising mineral oil, a yarn softening agent, an anti-static agent, an emulsifying agent and a blending agent to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, and stretching the yarn in the presence of a softening medium for said yarn.

3. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising mineral oil, a yarn softening agent, an anti-static agent, an emulsifying agent and a blending agent to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn, and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

4. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising from 50 to 85% of mineral oil, from 2.5 to 20% of a yarn softening agent comprising a sulfonated oil, from 5 to 30% of an emulsifying agent and from 1 to 10% of a blending agent to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn, and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

5. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising mineral oil, sulfonated olive oil, sperm oil and triethanolamine oleate to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

6. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising mineral oil, sulfonated mineral oil, triethanolamine oleate and diamyl phenol to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

7. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising 77.5% by weight of mineral oil, 5% of sulfonated olive oil, 2.5% of raw sperm oil, and 15% of triethanolamine oleate to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn, and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

8. In a process for the production of improved high tenacity cellulosic yarns, the steps which comprise applying a lubricating fluid comprising 50% by weight of mineral oil, 30% of sulfonated mineral oil, 15% of triethanolamine oleate and 5% of diamyl phenol to a cellulose acetate yarn prior to subjecting the yarn to winding and twisting operations, winding and twisting the yarn, passing the lubricated yarn through a hot aqueous bath whereby the lubricant is removed, stretching the yarn in the presence of a softening medium for the yarn, and saponifying the stretched cellulose acetate yarn whereby a regenerated cellulose yarn is obtained.

9. Yarn having improved textile characteristics and quality comprising an organic ester of cellulose having applied thereto a lubricating fluid comprising mineral oil, a sulfonated oil, an animal oil lubricant, a hydroxyalkyl amine salt of a long chain fatty acid and a blending agent.

10. Yarn having improved textile characteristics and quality comprising cellulose acetate having applied thereto a lubricating fluid comprising mineral oil, a sulfonated vegetable oil, an animal oil lubricant, the hydroxyalkyl amine salt of a long chain fatty acid and a blending agent.

11. Yarn having improved textile characteristics and quality comprising cellulose acetate having applied thereto a lubricating fluid comprising mineral oil, sulfonated olive oil, sperm oil and triethanolamine oleate.

12. Yarn having improved textile characteristics and quality comprising cellulose acetate

having applied thereto a lubricating fluid comprising mineral oil, sulfonated mineral oil, triethanolamine oleate and diamyl phenol.

13. Yarn having improved textile characteristics and quality comprising cellulose acetate having applied thereto a lubricating fluid comprising 77.5% by weight of mineral oil, 5% of sulfonated olive oil, 2.5% of raw sperm oil, and 15% of triethanolamine oleate.

14. Yarn having improved textile characteristics and quality comprising cellulose acetate having applied thereto a lubricating fluid comprising 50% by weight of mineral oil, 30% of sulfonated mineral oil, 15% of triethanolamine oleate and 5% of diamyl phenol.

15. High tenacity regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of cellulose acetate and having applied thereto a lubricating fluid comprising mineral oil, a sulfonated oil, an animal oil lubricant, a hydroxyalkyl amine salt of a long chain fatty acid.

16. High tenacity regenerated cellulose yarns prepared by the saponification of stretched yarns having a basis of cellulose acetate and having applied thereto a lubricating fluid comprising mineral oil, sulfonated olive oil, sperm oil and triethanolamine oleate.

17. High tenacity regenerated cellulose yarns

prepared by the saponification of stretched yarns having a basis of cellulose acetate and having applied thereto a lubricating fluid comprising mineral oil, sulfonated mineral oil, triethanolamine oleate and diamyl phenol.

18. A yarn lubricating fluid for application to regenerated cellulose yarns prepared by the saponification of yarns having a basis of a cellulose ester consisting of 50 to 85% by weight of mineral oil, 2.5 to 20% of a sulfonated oil, 5 to 30% of triethanolamine oleate and 1 to 10% of a blending agent capable of forming a homogenous mixture with the other ingredients of the lubricating fluid.

19. A yarn lubricating fluid for application to regenerated cellulose yarns prepared by the saponification of yarns having a basis of a cellulose ester consisting of 77.5% by weight of mineral oil, 5% of sulfonated olive oil, 2.5% of raw sperm oil, and 15% of triethanolamine oleate.

20. A yarn lubricating fluid for application to regenerated cellulose yarns prepared by the saponification of yarns having a basis of a cellulose ester consisting of 50% by weight of mineral oil, 30% of sulfonated mineral oil, 15% of triethanolamine oleate and 5% of diamyl phenol.

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