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CONDITIONING OF YARN

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This invention relates to the conditioning of textile yarns and more particularly to the conditioning of filaments and yarns composed of organic derivatives of cellulose such as cellulose acetate, cellulose acetate propionate, cellulose acetate butyrate, etc., to render them more amenable to textile operations such as knitting and the like.

As is well-known, in the manufacture of yarns, particularly those composed of or containing cellulose organic derivatives, it is necessary to treat the yarn in order to reduce the tendency toward breakage of the individual filaments or fibers when they are subjected to various mechanical strains and to lubricate the yarn in order to facilitate handling in such operations as spinning, twisting, winding and reeling. In addition, it is necessary to treat yarn to adapt it for use as warp or filling or for the manufacture of various types of knitted fabrics. In knitting, it is particularly important that the yarn be soft and pliable in order that it may conform readily to the contour of the needles and thus produce a closely knit fabric free from such defects as "stitch distortion", "pinholes", "laddering", and the like.

Heretofore it has been proposed to employ softening agents such as polyhydric alcohols and similar agents as ingredients of yarn conditioning or lubricating formulae, generally in connection with mineral, animal or vegetable oils. It has been found, however, that most of the known softening agents and the various formulae containing them have certain drawbacks, one of the most serious of which is high vapor pressure, and in some cases too drastic a solvent action on the yarn. Many of such agents possess slight or insufficient solvent power for the lubricants with which they are used and it is accordingly necessary to employ blending agents or emulsifying agents in order to obtain operable yarn treating formulae. In addition, many of the known softening and lubricating agents are insufficiently soluble in water to permit satisfactory removal by aqueous scour baths.

This invention has as its principal object to provide an entirely new class of yarn conditioning agents which are particularly adapted for the treatment of yarns composed of or containing organic derivatives of cellulose and capable of lubricating, softening and rendering such yarns more amenable to knitting and other textile operations. A further and specific object is to provide a class of conditioning agents which augment or assist the lubricating action of various lubricants when applied to such yarns. A still further object is to provide yarn softening and lubricating formulae which can be readily removed from the yarns by the usual scour baths. A still further object is to provide an improved method for the conditioning of yarns, particularly those composed of or containing organic derivatives of cellulose such as cellulose acetate, whereby the yarn is rendered soft and pliable and capable of employment in a variety of textile operations where complicated designs or stitches are employed. Other objects will appear hereinafter.

These objects are accomplished by the following invention which in its broader aspects comprises the discovery that polyketones having the general formula:

$$R-(\overset{O}{\overset{\|}{C}})_{2,3,\text{ etc.}}-R'$$

where R and R' are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms, typical examples of which ketones and their method of preparation are as follows: 3,4-Dimethylhexanedione-2,5,—Bull. Soc. Chim. (3) 6, 809; Nonanedione-2,4- and nonanedione-2,8,—J. Chem. Soc. 55, 335; 2-Methyloctanedione, 3-5,—Bull. Soc. Chim. (3) 27, 1094; Decanedione-2,4,—Rec. Trav. Chim. 16, 120; Pentanedione,-2,3,—Ber. 21, 1412; Hexanedione,-2,3,—Ber. 22, 2119; Hexanedione-2,4,—Ber. 22, 1014; Hexanedione-3,4,—J. Prakt. Chem. (2) 55, 196; Heptanedione-2,4,—Ber. 22, 1010; Heptanetrione-2,4,6,—Ann. 257, 276; Triacetylmethane,—A. Chem. Phys. (7) 26, 345; and similar compounds.

We have found that these compounds have a slight solvent and/or softening action on cellulose organic derivative yarns which renders such yarns soft and pliable without at the same time having too drastic a solvent action thereon.

In accordance with the invention these compounds may be applied directly to the yarn during or after spinning, or may be added to the spinning solution itself. We have found that these compounds have exceptional solvent powers which enable them to dissolve mineral oils and blown and unblown, drying and semi-drying, vegetable and animal oils and accordingly they may be, and preferably are, employed as ingredients of yarn conditioning or lubricating formulae in conjunction with agents which function wholly or partially as lubricants.

In the following examples and description, we have set forth several of the preferred embodiments of our invention, but they are included merely for the purposes of illustration and not as a limitation thereof.

Our invention will be more readily understood by reference to the following examples in which typical applications of the invention are set forth:

Example I.—A yarn conditioning composition consisting of 3,4-dimethylhexanedione-2,5 is deposited on cellulose acetate yarn intended for knitting as it passes from the spinning cabinet, application being by means of a conventional applicator roll dipping in a bath of the agent. The conditioning agent is deposited in an amount representing anywhere from 4–25% of the dry weight of the yarn. The yarn thus treated is characterized by a high degree of softness and pliability without harmful loss of strength and is in excellent condition for use in knitting.

Example II.—A yarn conditioning composition consisting of 3,4-dimethylhexanedione-2,5 is deposited on cellulose acetate yarn intended for weaving as it passes from the spinning cabinet, application being by means of a conventional applicator roll dipping in a bath of the agent. The conditioning agent is deposited in an amount representing anywhere from 1–5% of the dry weight of the yarn. The yarn thus treated is characterized by a high degree of softness and pliability without harmful loss of strength and is in excellent condition for use in knitting. As in Example I, the yarn is found to be in excellent condition for knitting by reason of its softness and pliability.

Example III—A conditioning liquid of the following composition:

	Percent
Acetonyl acetone	70
Olive oil	30

is applied in an amount representing about 1–5% of the dry weight of the yarn to cellulose acetate yarn intended for knitting purposes. The yarn thus treated is found to be quite soft and pliable and gives improved results in the knitting operation.

Other yarn conditioning compositions having a softening and lubricating effect on various types of yarns including those composed of or containing cellulose organic derivatives such as cellulose acetate, as well as viscose, natural silk and others which may be used in accordance with our invention are the following:

Example IV

	Percent
Heptanetrione 2,4,6	60
Blown olive oil	40

Example V

	Percent
Triacetylmethane	70
Blown sperm oil	30

Example VI

	Percent
Hexanedione-3,4	70
Light mineral oil	30

Example VII

	Percent
Pentanedione-2,3	30
Sperm oil	70

Example VIII

	Percent
Decanedione-2,3	20
Blown neat's-foot	30
Sulf. olive oil	20
White mineral oil	10
Oleic acid	10
Ethanolamine	3
Water	7

Example IX

	Percent
Acetyl acetone	20
Sperm oil	60
Laurol	20

Example X

	Percent
Nonanedione-2,8	50
Blown sperm oil	30
Sulf. castor oil	20

Example XI.—A 20% solution of cellulose acetate in acetone in which is incorporated 1–25% of the weight of the cellulose acetate of nonanedione-2,4 is extruded through fine orifices into an evaporative atmosphere. The filaments thus produced are wound or twisted and wound. Yarns produced from filaments thus treated are soft and pliable and especially well suited for knitting operations.

Still other compositions which may be employed for the conditioning of yarns in accordance with our invention are the following:

Example XII

	Percent
Water	80
Gelatin	5
Acetonyl acetone	10
Sulfonated olive oil	5

Example XIII

	Percent
Water	80
Water soluble cell. ester	5
Hexanedione 2,4	10
Diethylene glycol	5

Example XIV

	Percent
2,4 octane dione	20
Mineral oil	30
Blown olive oil	50

Example XV

	Percent
2,4,6 decane trione	18
Mineral oil	20
Blown olive oil	20
Oleic acid	15
Sodium sulfate	2
Sulfonated olive oil	20
Sodium cetyl sulfate	5

Example XVI

	Percent
Acetonyl acetone	10
Butyl oleate	30
Blown neat's-foot oil	60

As will be apparent from the above examples and description the conditioning agents of our invention may be applied by a wide variety of methods. For example, we may employ the agent as an ingredient of the spinning dope from which the filaments are formed, the amount of the agent so employed depending upon a number of factors, such as the particular cellulose derivative used

in making the yarn, the solvent or solvent combination used in making up the spinning solution, and the degree of softness or pliability desired in the yarn, etc.

If the conditioning agent is to be applied to the yarn after spinning, this may be done by bringing the yarn in contact with a wick, roll, or felt wet therewith or the liquid may be applied by immersion, spray, or otherwise. The particular point at which the liquid is applied may vary. It may, for example, be applied to the yarn inside or outside the spinning cabinet, between the guide and godet roll, between the godet or other roll or guide and the point of winding and/or twisting. In some cases, the liquid may even be applied to the yarn after winding onto cones, spools, bobbins, or the like or by the so-called "bobbin to bobbin" method. In the case of staple fiber manufacture, the liquid may be applied to the yarn prior to, or after cutting into staple lengths.

The amount of the agent so employed will vary widely depending upon the results desired, the specific nature of the material to which the agent is applied, the use to which the yarn is eventually to be put and other factors. For example, in a given case where a cellulose organic acid ester yarn such as a yarn composed of cellulose acetate, is intended for knitting, about 4 to 25% or more by weight, based on the weight of the dry yarn, may be sasisfactory, while if the yarn is intended for weaving, the amount may vary between about 1 and 5%.

Although in the above examples we have referred primarily to yarn treating compositions containing only the conditioning agent and an oil, other ingredients such as solvents, nonsolvents, emulsifying agents, blending agents and the like, may be added within the scope of our invention. Likewise, various dyes or other coloring matter may be included in case it is desired to permanently or fugitively tint or dye the material undergoing treatment.

Although we have found it convenient to illustrate our invention by reference to compositions containing specific percentages of the various ingredients, these percentages may vary widely depending upon the particular purpose for which the composition is intended. For example, if it is desired to control the solvent or softening action of the conditioning agent, the amount of the agent may be adjusted as, for example, by reducing the amount of the agent and correspondingly increasing the amount of oil or other ingredient.

While we have described our invention with particular reference to the treatment of yarns composed of organic derivatives of cellulose such as cellulose acetate, the conditioning agents and formulas described herein are applicable to the conditioning of many other types of cellulose derivative yarns such as those composed of or containing cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, ethyl cellulose, methyl cellulose, benzyl cellulose and others, as well as to the conditioning of silk, wool, cotton, viscose and other natural or artificial materials.

The term "yarn" as used herein and in the claims is to be understood as including a single filament, a plurality of filaments associated into the form of a thread, either of high or low twist, single or multiple threads associated or twisted together, composite threads composed of a mixture of natural and artificial filaments or a composite thread formed by twisting together individual strands of natural or artificial materials, as well as cut staple fibers produced from natural and/or artificial filaments or threads and spun yarn produced from such staple fibers.

As indicated above, the yarn conditioning agents of our invention are exceptionally good solvents for a wide variety of mineral, blown and unblown, drying and semi-drying animal and vegetable oils such as cottonseed, olive, castor, neat's-foot, sperm and other oils. This enables them to be used with any of such oils in making up a variety of yarn treating formulae of varying composition.

The yarn condtioning method and compositions of our invention possess many outstanding advantages. The fundamental and outstanding characteristic of the agents employed in accordance with the invention is their ability to soften yarns, especially those composed of or containing organic derivatives of cellulose such as cellulose acetate and render them soft and pliable and amenable to various textile operations, especially operations such as those involved in weaving and knitting where complicated designs or stitches are employed, without too drastic an action on the yarn material. Another outstanding characteristic of these compounds is their exceptional solvent power for a wide variety of mineral, animal and vegetable oils and their ability to act as lubricating assistants in conjunction with these oils when applied to such yarns. In addition, due to their solubility in water, they may be readily removed from yarns and fabrics by means of the usual aqueous scour baths. By employing the yarn conditioning agents and method of our invention as herein described, one is enabled to obtain highly satisfactory results in the manufacture of yarns and woven fabrics and especially the production from these yarns of closely knit fabrics free from defects such as pin holes, stitch distortion, laddering and the like.

What we claim and desire to secure by Letters Patent of the United States is:

1. The process of conditioning yarn to render it more amenable to textile operations including knitting, weaving, spinning and the like, which comprises applying thereto a lubricating and softening composition containing a polyketone having the general formula:

$$R-(\overset{O}{\overset{\|}{C}})_{2,\,3,\,\text{etc.}}-R'$$

where R and R' are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

2. The process of conditioning yarn composed of or containing organic derivatives of cellulose to render it more amenable to textile operations including knitting, weaving, spinning and the like, which comprises applying thereto a lubricating and softening composition containing a polyketone having the general formula:

$$R-(\overset{O}{\overset{\|}{C}})_{2,\,3,\,\text{etc.}}-R'$$

where R and R' are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

3. The process of conditioning yarn composed of or containing cellulose acetate to render it more amenable to textile operations including knitting, weaving, spinning and the like which comprises applying thereto a lubricating and soften-

ing composition containing a polyketone having the general formula:



where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

4. The process of conditioning yarn composed of or containing cellulose acetate to render it more amenable to textile operations including knitting, weaving, spinning and the like, which comprises applying thereto a lubricating and softening composition containing a polyketone having the general formula:



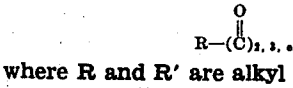
where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms, and a textile lubricant.

5. The process of conditioning yarn composed of or containing cellulose acetate to render it more amenable to textile operations including knitting, weaving, spinning and the like which comprises applying thereto a lubricating and softening composition containing pentanedione-2,3.

6. The process of conditioning yarn composed of or containing cellulose acetate to render it more amenable to textile operations including knitting, weaving, spinning and the like which comprises applying thereto a lubricating and softening composition containing hexanedione-2,4.

7. The process of conditioning yarn composed of or containing cellulose acetate to render it more amenable to textile operations including knitting, weaving, spinning and the like which comprises applying thereto a lubricating and softening composition containing heptanedione-2,4.

8. A conditioning agent for rendering yarns more amenable to textile operations, including knitting, weaving, spinning and the like, which comprises a polyketone having the general formula:



where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

9. A conditioning agent for rendering textile yarns composed of or containing organic derivatives of cellulose more amenable to textile operations, including knitting, weaving, spinning and the like, which comprises a polyketone having the general formula:



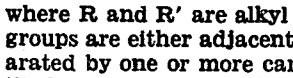
where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

10. A conditioning agent for rendering yarns composed of or containing cellulose acetate more amenable to textile operations including knitting, weaving, spinning and the like containing pentanedione-2,3.

11. A conditioning agent for rendering yarns composed of or containing cellulose acetate more amenable to textile operations including knitting, weaving, spinning and the like containing hexanedione-2,4.

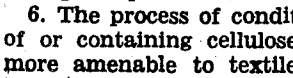
12. A conditioning agent for rendering yarns composed of or containing cellulose acetate more amenable to textile operations including knitting, weaving, spinning and the like containing heptanedione-2,4.

13. Textile yarn amenable to textile operations including knitting, weaving, spinning and the like impregnated with a lubricant containing a polyketone having the general formula:



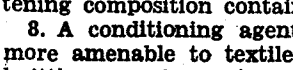
where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

14. Textile yarn composed of or containing organic derivatives of cellulose amenable to textile operations including knitting, weaving, spinning and the like impregnated with a lubricant containing a polyketone having the general formula:



where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms.

15. Textile yarn composed of or containing organic derivatives of cellulose amenable to textile operations including knitting, weaving, spinning and the like impregnated with a lubricant containing a polyketone having the general formula:



where R and R′ are alkyl groups and the ketone groups are either adjacent to one another or separated by one or more carbon atoms and a textile lubricant.

16. Textile yarns composed of or containing cellulose acetate amenable to textile operations including knitting, weaving, spinning and the like impregnated with a lubricant comprising pentanedione-2,3.

17. Textile yarns composed of or containing cellulose acetate amenable to textile operations including knitting, weaving, spinning, and the like impregnated with a lubricant comprising hexanedione-2,4.

18. Textile yarns composed of or containing cellulose acetate amenable to textile operations including knitting, weaving, spinning and the like impregnated with a lubricant comprising heptanedione-2,4.

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