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YARN TREATING PROCESS

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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.

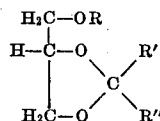
As is well-known in the manufacture of yarns, particularly those composed of or containing cellulose organic derivatives, it is necessary to treat the yarn in order to reduce the tendency toward breakage of the individual filaments or fibers when they are subjected to various mechanical strains and to 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," "laddering," "pin holes," 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 formulas, generally in connection with mineral, animal or vegetable oils. It has been found, however, that most of the known softening agents and the various formulas 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 formulas. 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 yarn 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 formulas 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. Another object is to provide a new class of hitherto unknown chemical compounds. Still another object is to provide new chemical compounds having the structure and properties discussed below. Other objects will appear hereinafter.

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



where R is alkyl, alkoxyalkyl, alkaryl, cycloalkyl or heterocyclic group; and R' is hydrogen, alkyl, or aryl group and R'' is hydrogen, alkyl, alkaryl, cycloalkyl or heterocyclic group, may be used as yarn conditioning agents and particularly as softening agents with or without the addition of animal, mineral, vegetable oils in the treatment of yarns composed of or containing organic derivatives of cellulose. 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 formulas 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 purposes of illustration and not as a limitation thereof.

Typical examples of compounds which we have found exceptionally valuable as yarn conditioning agents are the following:

Compound	B. P.
	<i>Millimeters</i>
Acetone glycerol methyl ether (not new).....	57-58°/15.
Acetone glycerol β -ethoxy ethyl ether.....	98-102°/8.
Ethylidene glycerol propyl ether.....	45-47°/10.
Ethylidene glycerol β -ethoxyethyl ether.....	98-102°/10.
Ethylidene glycerol β' -butoxy- β -ethoxyethyl ether.....	165-70°/8.
Ethylidene glycerol tetrahydrofurfuryl ether.....	123-127°/9.
Butylidene glycerol methyl ether.....	65-70°/11.
Propylidene glycerol methyl ether.....	45-50°/15.
Furfural glycerol methyl ether.....	116-119°/15.
Tetrahydrofurfural glycerol methyl ether.....	110-115°/7.
Furfural glycerol butyl ether.....	120-125°/8.
Tetrahydrofurfural glycerol butyl ether.....	130-5°/10.
Furfural glycerol tetrahydrofurfuryl ether.....	173-180°/9.
Furfural glycerol β -ethoxy ethyl ether.....	157-160°/14.
Tetrahydrofurfural glycerol β -ethoxyethyl ether.....	157-161°/7.
Tetrahydrofurfural glycerol tetrahydrofurfuryl ether.....	180-7°/10.
Amylidene glycerol ethoxy ethyl ether.....	125-130°/10.

Illustrative examples of the preparation of these new compounds are given below.

Ethylidene glycerol tetrahydrofurfuryl ether.—Glycerol tetrahydrofurfuryl ether (350 parts), 130 parts of paraldehyde, 5 parts of concentrated sulfuric acid are refluxed together for 10 hrs. The solution is then treated with excess solid sodium carbonate, filtered, and fractionally distilled. 320 parts of the ethylidene ether are obtained, B. P. 122-8°/9 mm.

Preparation of furfuryl glycerol ethoxy ethyl ether.—Ten parts of glycerol ethoxy ethyl ether, 7 parts of furfural, 20 parts of benzene, and 5 gm. of a dehydration catalyst (such as ferric chloride, p-toluene sulfonic acid, sulfuric acid, etc.) are distilled in such a way that the benzene is returned to the reaction. The heating is discontinued when the theoretical quantity of water has been collected. The product is washed once with water, separated and fractionated. Ten parts of the ether acetal are obtained, B. P. 157-60°/14 mm.

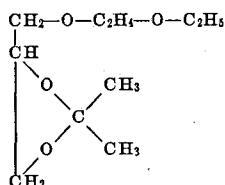
Our invention will be more readily understood by reference to the following examples in which typical applications of the invention are set forth:

Example I

A 20% solution of cellulose acetate in acetone in which is incorporated 1-25% by weight of acetone glycerol methyl ether is extruded through fine orifices into an evaporative atmosphere. The filaments thus produced are wound or twisted and wound. Yarns produced from filaments thus prepared are pliable and suitable for knitting.

Example II

Yarn composed of cellulose acetate and designed for knitting is treated by applying thereto acetone glycerol β -ethoxyethyl ether



by means of an applicator roll. The amount of the conditioning liquid may run from 4-25% by weight of the untreated yarn. If the yarn is intended primarily for weaving, the same procedure may be followed except that the amount

of conditioning agent added to the yarn is only about 1-5%.

Example III

A yarn conditioning composition is made up by mixing the following ingredients in the indicated proportions:

	Parts
Ethylidene glycerol β -ethoxy ethyl ether.....	70
Olive oil.....	30

This composition is applied to a cellulose acetate yarn intended for knitting in an amount representing 4-25% by weight of the untreated yarn. The filaments or fibers treated as described above are quite soft and pliable and give excellent results in textile operations, especially knitting.

Other examples of yarn conditioning compositions which may be applied to various types of yarns, particularly those composed of or containing cellulose acetate, cellulose acetate propionate and similar cellulose organic derivative yarns in accordance with our invention and which render such yarns soft and pliable and well-adapted for various textile operations, particularly knitting, are the following:

Example IV

	Parts
Ethylidene glycerol β' -butoxy- β -ethoxy ethyl ether.....	60
Blown olive oil.....	40

Example V

	Parts
Ethylidene glycerol tetrahydrofurfuryl ethyl ether.....	70
Neat's-foot oil.....	30

Example VI

	Parts
Butylidene glycerol methyl ether.....	70
Blown neat's-foot oil.....	30

Example VII

	Parts
Tetrahydrofurfuryl glycerol tetrahydrofurfuryl ether.....	70
Light mineral oil.....	30

Example VIII

	Parts
Tetrahydrofurfuryl glycerol-ethoxy ethyl ether.....	50
Sperm oil.....	50

Example IX

	Parts
Ethylidene glycerol cyclohexyl ether.....	70
Blown sperm oil.....	30

Example X

	Parts
Formylidene glycerol β' -ethoxy- β -ethoxy ethyl ether.....	10
Water.....	80
Water soluble cellulose ester.....	5
Blown olive oil.....	5

Example XI

	Parts
Blown teaseed oil.....	25
Acetone glycerol ethyl ether.....	75

Example XII

	Parts
Blown neat's-foot oil.....	25
Oleic acid.....	25
Sulfonated castor oil.....	30
Acetone glycerol β -ethoxyethyl ether.....	20

Example XIII

	Parts
Blown teaseed oil.....	25
Cetyl sulfate ammonium salt.....	4
Oleic acid.....	26
Mineral oil.....	20
Glycerol acetone cetyl ether.....	25

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 satisfactory, while if the yarn is intended for weaving, the amount may vary between about 1 and 5%.

Of the above compositions, we have found that those of Examples XII and XIII, characterized by the presence therein of acetone glycerol β -ethoxyethyl ether and glycerol acetone cetyl ether respectively, are unique in their ability to reduce or eliminate accumulations of static electricity on yarns of the type herein referred to, particularly when such yarns are employed for the manufacture of cut staple fibers. It is therefore one of the specific features of our invention to employ these compositions as anti-static agents generally, and specifically for the manufacture of cut staple yarns. In producing cut staple fibers, the selected composition may be deposited on the fiber after the cutting operation in any convenient manner, as by a conventional type of applicator, by spray, immersion or the like. Cut staple fibers treated in this manner display a very marked reduction in their tendency to accumulate charges of static electricity and in many cases this tendency is substantially or completely eliminated.

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 formulas of varying composition.

The yarn conditioning 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 satis-

factory 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.

As indicated above, the acetals described above are hitherto unknown chemical compounds. So far as we are aware, the preparation of these compounds has never been described in the literature and, of course, their usefulness as yarn conditioning agents or their other properties have never been referred to.

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

1. The process of conditioning yarn composed 15

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 as its essential lubricating and softening component acetone glycerol β -ethoxyethyl ether.

2. Textile yarns composed of or containing cellulose acetate amenable to textile operations including knitting, weaving, spinning, and the like, impregnated with a lubricant comprising acetone glycerol β -ethoxyethyl ether.

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