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YARN TREATING COMPOSITION AND PROCESS

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This invention relates to the manufacture and use of synthetic yarns, and more particularly to a method adapted for the lubrication of filling yarn composed of or containing organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like.

As is well known, in the manufacture of synthetic yarns, particularly those composed of or containing organic derivatives of cellulose, it is necessary to treat the yarn to reduce the tendency toward breakage of the filaments or fibers when they are subjected to various mechanical strains and to condition the yarn to adapt it for use as warp and filling, and also for various types of knitting. In order to meet the requirements of practical use, a yarn lubricant must have certain particular qualities and characteristics. It must, for example, be stable in storage, during application to the yarn and on the yarn itself. It must be sufficiently chemically inert that it will not react with the material of which the yarn is composed and must be non-corrosive in order that it will have no adverse effect on the textile machinery upon which the yarn is eventually manufactured into a fabric. It must be capable of being applied to the yarn uniformly from pound to pound and yard to yard, as well as from filament to filament. It must be capable of wetting the yarn material without having too drastic a solvent action thereon. It must have sufficient anti-friction qualities to permit of the yarn being handled and used at economical speeds. It must be capable of remaining on the yarn for comparatively long periods of time without ageing or oxidizing and should be capable of being removed in the ordinary scour baths employed in the textile industry. It should be of such a nature that it will not interfere with the uniformity of dyeing the woven or knitted material. In addition, depending upon the use to which it is put, the lubricant should have special characteristics to adapt it, respectively, for the conditioning of warp and filling yarns and for yarns intended for circular, half-hose and flat knitting, and for cut staple.

In preparing a yarn for a warping operation, the friction quality of the yarn itself, for example, cellulose acetate, should be medium to low. In commercial warping under satisfactory conditions, employing the cone-creel type, a tension of 15–20 grams is experienced with a standard type of acetate yarn at speeds of about 320 yards per minute. When warping from spools at a speed of 200–240 yards per minute, tensions of 40–50 grams are experienced. Such tensions are found to be satisfactory and the warp lubricant must be selected so as to give the desired drag or frictional resistance to the yarn. The matter of static is also very important and the lubricant must be so compounded as to reduce the accumulation of static charges to the least possible minimum. In addition, the warp yarn should have the ability to wet out quickly in a size bath such, for example, as a bath composed of an aqueous solution or dispersion of gelatin. Obviously a water repellent lubricant will resist the proper application of the size in a thin skin over the yarn filaments. Water repellent oils tend to form a non-uniform size skin which does not offer sufficient protection for the weaving operations—a defect which can be compensated for only by applying additional size which, in turn, tends to increase the cost of slashing. The soluble lubricant, on the other hand, should not be too miscible with water, as under such circumstances it tends to be leached out by the size bath.

Referring now to filling yarn lubricants, the main properties of such lubricants are anti-static and friction reducing qualities and the ability to give the yarn to which they are applied the proper stretch characteristics without an undue decrease in ultimate strength of the yarn. Filling lubricants must be able to produce sufficient drag to supply a definite tension when the yarn is handled in a normal type silk or acetate shuttle from which the yarn is withdrawn at speeds comparable to those employed in a normal weaving operation. A standard cellulose acetate yarn, for example, should have a drag sufficient to supply 30 grams tension on a full cop. A secondary reason for using a sufficiently viscous oil on the filling yarn is to prevent sloughing from the nose of the cop in the shuttle due to quick changes in speed. The filling lubricant should also be slightly tacky or sticky in order to counter-balance the repelling effect of static charges of electricity which accumulate on the yarn in the weaving operation and also the tendency of the reed, if oppositely charged, to pull the filling thread backwards during the receding motion. The lubricant should be such that, once the reed places the lubricated filling in its proper place up against the warp threads, it is sufficiently tacky to hold the yarn in place against the squeezing motion of the warp threads in the weaving operation. On the other hand, the tackiness or stickiness should not be excessive, as otherwise the yarn will be subjected to an excessive tension which stretches it beyond the yield point and interferes considerably with its dyeing qualities. A standard cellulose acetate filling yarn, for example, should have a tension not much over 30–40 grams for a full cop under weaving conditions.

The requirements of a lubricant for conditioning yarn for circular knitting purposes are somewhat different. For example, the lubricants should be of such character as to give the yarn a certain amount of stretch under a relatively

low load and should have a sufficient softening action on the yarn to give it a very high degree of flexibility during the knitting operation. This latter quality of flexibility is extremely important in a circular knitting yarn, since it is required to pass around the knitting needles at a rather sharp angle and should readily conform to the contour thereof. At the same time, the lubricant should be of such nature as to give the yarn a relatively high drag, thus supplying sufficient tension on the yarn to draw it into position around the needles. In other words, the yarn must be weak and limp for the knitting operation and should be wiry after finishing. As in the case of lubricants for conditioning yarns for other purposes, the lubricant must have, not only the ability to wet the yarn, but also must be readily removable in the scour bath.

It will thus be seen from the above discussion of yarn lubricants, that the question of determining what a satisfactory lubricant for any given purpose should contain is extremely involved and depends largely upon the use for which the yarn is intended. In fact, the production of a satisfactory lubricant is largely a matter of effecting a compromise between anti-friction characteristics on the one hand and drag-inducing characteristics on the other. In the case of lubricants for circular knitting yarns, it is a question of obtaining the proper degree of flexibility and stretch without too drastically weakening the yarn. In other words, properly conditioning a yarn, especially one composed of or containing organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like, is not merely a matter of lubricating the material with an ordinary anti-friction lubricant, but is a highly complex problem which involves a careful technical analysis of the particular requirements of the yarn to be conditioned and a careful study of the properties of various oils and other ingredients which will give the desired results. As is well known, there are many different oils, fats, and waxes which have been applied for greasing or lubricating purposes in the textile industry. For example, various animal, vegetable, and mineral oils have been applied to various textile materials such as threads and fibers composed of cotton, wool, silk, jute and various other substances. Sulfonated and unsulfonated animal and vegetable oils have been widely used with or without admixtures of mineral or other oils. However, many of the oils heretofore employed have suffered serious drawbacks. Many of the well-known animal and vegetable oils contain unsaturated bodies and are subject to oxidation, resinification, and the development of rancidity, all of which changes, occurring after the lubricant has been applied to the yarn, adversely affect its characteristics. Even relatively stable mineral oils tend to polymerize or resinify on the yarn with the production of gummy deposits. The tendency toward rancidity of various animal and vegetable oils, particularly castor oil, is especially objectionable in that it produces an odor in the yarn material on which it is used which is often difficult or impossible to completely remove.

This invention has as its principal object to provide a high speed method of and compositions for conditioning synthetic yarns, especially those composed of or containing organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate butyrate and the like to adapt them for various textile operations. A further object is to provide stable yarn conditioning compositions which are as little as possible subject to polymerization, resinification, or the development of rancidity. A still further object is to provide a method of conditioning synthetic yarns for use in warp operations. Another object is to provide a method and composition for conditioning such yarns for circular knitting purposes. A specific object is to provide a method and composition for conditioning yarns composed of or containing organic derivatives of cellulose such as cellulose acetate, to adapt it for use as a filling yarn. Other objects will appear hereinafter.

These objects are accomplished by the following invention which, in its broader aspects, comprises the compounding of a yarn treating composition from one or more oxidized animal or vegetable oils, which oils are not subject to polymerization, resinification, and the development of rancidity and which have the ability to give the yarn the desired anti-fraction, anti-static, drag, flexibility and/or stretch characteristics, and applying such compositions to the yarn, either in the form of a mixture or a solution or aqueous emulsion. We have found that certain classes of oils, especially the oxidized animal and vegetable oils and certain related wax-like bodies are especially valuable in the compounding of such yarn lubricants or lubricating compositions.

At this point we wish to emphasize the fact that the oils with which we are particularly concerned are oxidized oils as distinguished from non-oxidized oils. In other words, we have found that certain of the essential characteristics of the raw unoxidized oils such as specific gravity, iodine value, saponification value and viscosity are markedly altered by oxidation and their essential characteristics, so far as their ability to act as yarn lubricants is concerned, are profoundly altered. We have found, for example, that any oil which is capable of undergoing oxidation after deposition on the yarn is unsatisfactory from the standpoint of meeting the exacting demands made at the present day upon synthetic yarn lubricants, particularly those employed as lubricants for filling yarns.

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

Among the various oxidized oils which we have found to be especially useful as yarn conditioning agents or ingredients of such compositions, oxidized neat's-foot oil is unique and, in fact is so outstanding in its ability to condition yarns, especially those intended for use as filling, as definitely to stand in a class by itself. Taking into consideration the fact that the neat's-foot is one of the most widely employed of textile lubricants, it is indeed remarkable that the oxidized form of the oil should be found to be so exceptionally effective as compared to known lubricants in the treatment of synthetic yarns. Among other oxidized oils which we have found to be especially satisfactory as filling yarn lubricants are the oxidized non-drying vegetable oils such as olive, castor, teaseed, hazel nut, arachis (peanut), apricot kernel, olive kernel, peach kernel, grape seed, croton, and sesame. Among these oils we have found that sesame and teaseed oils are outstanding.

The oxidized non-drying animal oils may also be used in accordance with our invention and

may be divided into two main classes, namely, the non-drying terrestrial animal oils and the fish and marine animal oils. Among the oxidized non-drying terrestrial animal oils which may be employed in accordance with our invention are lard, horse foot, neat's-foot, sheep's-foot and tallow. Among the fish and marine animal oils may be mentioned seal, shark, cod liver, sardine, whale and porpoise.

In addition to the above oils certain of the oxidized non-drying liquid waxes, which may, for the purposes of the instant invention, be regarded as oils, give excellent results. Typical among such waxes or oils are those of the sperm oil group including sperm oil, dolphin oil, bottle nose oil, etc.

As indicated above the oils with which we are particularly concerned herein are the oxidized non-drying oils, particularly oxidized neat's foot oil. The production of these oxidized oils may be carried out by blowing air or oxygen into the oils under appropriate temperature and pressure in a well-known manner. In some cases it may be desirable to obtain a more or less completely oxidized oil, while in other instances the degree of oxidation may be somewhat less. As is well known, each specific oil or liquid wax has certain definite physical constants such as specific gravity, iodine value, saponification value and viscosity, each of these undergoing change during oxidation of the oil. In general it may be said that the specific gravity will increase, the iodine value will decrease, the saponification value will increase and the viscosity will increase. The extent to which oxidation is carried in preparing the oils for use in accordance with our invention will be determined in a given instance largely by the properties desired in the finished oil and the purpose for which it is to be employed. Although in some instances it may be desired to obtain a finished oxidized oil having a Saybolt viscosity up to about 3000 seconds, we have found that an oil having a viscosity from 100 to 300 seconds (at 100° C.) is generally to be preferred for most purposes.

In oxidizing the above-mentioned oils and liquid waxes it may be desirable in some instances to employ a suitable catalyst to increase the efficiency of oxidation. Furthermore, since the matter of color is rather important and since the eventual oil should, under ordinary circumstances, have as little color as possible, we find it desirable to employ an oil which has previously been bleached to eliminate organic or other coloring matter which would adversely affect the appearance and clarity of the oil.

In accordance with our invention the oxidized non-drying oils of the character above specified may be employed, either alone or in admixture with other oils, solvents, diluents, leveling agents and other ingredients. Single oils or a mixture of oils may be employed in the form of solutions or they may be emulsified by means of the usual emulsifying agents such as sulfonated bodies, soft soaps and various other agents. If applied from aqueous emulsions, the yarn should preferably be conditioned to a residual moisture content of about 6–8%, based on the dry weight of the yarn before winding and storage in order to avoid "soft packages." If desired, an appropriate dye or other coloring matter may be added to such oils or solutions or emulsions thereof, thus forming solutions or dispersions of the dye in the lubricating medium. Such compositions may be satisfactorily employed for the simultaneous lubrication and fugitive tinting of synthetic yarns. In such cases, the particular dye or tint will, of course, be selected upon the basis of the particular synthetic yarn material to which it is to be applied.

The yarn conditioning agents of our invention may be applied to the yarn in almost any convenient manner and at almost any stage of the yarn manufacturing operation. For example, they may be applied by bringing the yarn, either within or without the spinning cabinet in contact with a wick, roll, or felt wet therewith, or by immersion, spraying or otherwise. The particular point in the yarn manufacturing operation at which the compositions are applied may be accomplished is not especially critical, since lubrication may be carried out, either 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 and so on. In some cases the compositions may be applied to the yarn after winding onto cones, spools, bobbins or the like or by the so-called "bobbin to bobbin" method. In event of application to cut staple, the liquid may be applied to the yarn prior to or after cutting into staple lengths.

We wish to emphasize at this point that the specific composition of a given yarn conditioning liquid made up in accordance with our invention will vary within rather wide limits, depending upon the specific nature of the yarn material to which it is to be applied and particularly upon the specific purpose for which the yarn is intended. Therefore, no hard and fast rule can be laid down with respect to the particular ingredients entering into our compositions, except that they all are characterized by the presence therein as the essential lubricating and conditioning agent of an oxidized non-drying animal or vegetable oil or liquid wax.

In order more fully to set forth the features of our invention, the following typical yarn conditioning compositions are given:

Filling yarn conditioning compositions

1

	Per cent
Sulphonated olive oil	19.6
Mineral oil	45.0
Blown neat's-foot oil	24.6
Oleic acid	6.3
Triethanolamine	4.5

2

Sulphonated olive oil	18.5
Mineral oil	43.0
Blown olive oil	33.0
Oleic acid	3.1
Triethanolamine	2.4

Conditioning compositions for warp yarn

1

	Per cent
Mineral oil	65.0
Blown neat's-foot oil	10.0
Sulphonated olive oil	25.0

2

Mineral oil	70.0
Blown neat's-foot oil	5.0
Sulphonated olive oil	25.0

Circular knitting yarn conditioning compositions

1

	Per cent
Methoxy ethyl succinate	82.5
Blown olive oil	17.5

2

Tetrahydrofurfuryl glycolate	80.0
Blown sperm oil	20.0

3

Methoxy ethyl succinate	80.0
Blown neat's-foot oil	20.0

Treatment of cut staple yarns

1

	Per cent
Blown neat's-foot oil	85.5
Sulphonated olive oil	9.5
Triethanolamine	5.0

2

Blown neat's-foot oil	20.0
Mineral oil	58.0
Sulphonated olive oil	20.0
Triethanolamine	2.0

As an illustration of the effect which varying amounts of blown neat's-foot oil has on oil A of composition 30 parts of sulphonated oil, 30 parts of mineral oil, we have prepared the following combinations and measured the shuttle tension on full cops of acetate yarn lubricated with the various mixtures indicated.

Oil A	Blown neat's-foot oil	Shuttle tension on full cop
Parts	*Parts*	*Grams*
100		17
75	25	26
72.5	27.5	31
70	30	35
65	35	37

It is obvious from the foregoing table that increasing amounts of blown neat's-foot oil increase the amount of drag which the yarn exerts as it is removed from the package on which it is wound.

As above set forth all of the above compositions are characterized by the presence therein of an oxidized non-drying oil. We have found that these oils are particularly useful and give outstandingly satisfactory results in the conditioning of synthetic yarns, particularly those composed of or containing organic derivatives of cellulose, for example, the cellulose organic acid esters such as cellulose acetate, cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate and the like, the cellulose ethers and various other cellulose derivative materials. Although our invention finds particular application in the treatment of yarns composed of or containing cellulose derivatives, it may also be applied to yarns composed of regenerated cellulose as well as natural silk, wool, cotton and other natural or artificial materials.

As previously indicated, the results obtained in the treatment of synthetic yarns with compositions containing the oxidized non-drying oils herein described, particularly oxidized neat's-foot oil, in accordance with our invention, are outstanding and unexpected. Not only are such lubricating or conditioning compositions stable on the yarn during the various textile operations through which the yarn is required to pass, such as twisting, winding, spinning, weaving, and the like, but are also stable when the yarn is stored for long periods of time. Contrary to what would be expected from the use of known yarn conditioning agents, the compositions herein described are free of the development of rancidity, resinification or gummy deposits which adversely affect the yarn and seriously interfere with its usefulness in various textile operations. The compositions of our invention are particularly characterized by the fact that they impart to the yarn a soft feel, a good hand and excellent texture.

What we claim is:

1. The process which comprises preparing a cellulose acetate filling yarn for weaving by applying to the yarn a lubricating composition containing as its essential lubricating component oxidized neat's-foot oil, winding said filling yarn on a cop and using said cop in a shuttle, the lubricating treatment giving the yarn such frictional and drag characteristics that it can be unwound from the cop in a weaving operation smoothly and without jerking or sloughing.

2. The process of conditioning yarn composed of or containing an organic derivative of cellulose to adapt it for use as a filling yarn which comprises applying thereto a lubricating composition having the following formula:

	Per cent
Sulphonated olive oil	19.6
Mineral oil	45.0
Blown neat's-foot oil	24.6
Oleic acid	6.3
Triethanolamine	4.5

3. A yarn composed of cellulose acetate and adapted for use as filling yarn coated or impregnated with a composition having the following formula:

	Per cent
Sulphonated olive oil	19.6
Mineral oil	45.0
Blown neat's-foot oil	24.6
Oleic acid	6.3
Triethanolamine	4.5

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