Patented Apr. 4, 1939 2,153,358

UNITED STATES PATENT OFFICE

2,153,358

TEXTILE MATERIAL AND METHOD OF MAKING THE SAME

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No Drawing. Application February 3, 1936, Serial No. 62,167

8 Claims. (Cl. 18—54)

This invention relates to the treatment or preparation of staple fibres to produce fibres that are more suitable for spinning or other textile operations. This application is a continuation-in-part of my co-pending application Ser. No. 611,943 filed May 17, 1932, which issued as Patent No. 2,086,590 of July 13, 1937.

An object of my invention is to prepare or treat staple fibres, particularly fibres made of organic derivatives of cellulose, with a material adapted to destroy or diminish the tendency of such fibres to develop electrostatic charges when manipulated, so that the staple fibres may be successfully associated together to form "spun" yarn.

Heretofore, the anti-static finishes have been applied to the extent of 1.5% and over, as lower amounts than this could not be caused to spread uniformly and provide a continuous more-or-less unbroken electro-conductive film on the filaments. An object of the invention is to provide a method of applying less anti-static finish yet forming this continuous film and offering the necessary anti-static properties.

The amounts which previously had to be applied with some finishes such as $MgCl_2$/diethylene glycol/H_2O mixtures, were sufficient to cause corrosion of metal parts on carding machines, drawing frames and the like. In applying less finish, an object of the invention is to reduce the corrosion to an unappreciable degree yet retain adequate anti-static properties.

Such finishes as the $MgCl_2$/diethylene glycol/H_2O type provided a non-lubricative type of scroop to the fibers causing some pilling, tangling and breaking in carding and drafting operations whether mixed with other fibers such as wool, silk, viscose, cotton, ramie, etc., or not. When two or more fibers are mixed, such non-lubricative scroopy properties, of course, result in poor blending and when such scroopy non-lubricative finish is involved in any form of carding or opening, more work has to be conducted on the card and more breakage of filaments occurs and unevenness results in the yarn owing to the lack of smooth flow of the filaments in the various drawing and twisting processes. A reduction in the amount of antistatic finish and the formation of a thinner yet continuous film on the filaments offers considerable advantages in this respect.

The formation of "spun" yarn from comparatively short lengths or staples of filaments or threads composed of organic derivatives of cellulose presents serious difficulty. This is due to the fact that such organic derivatives of cellulose have a very high dielectric constant and have low electro-conductivity and when the filaments are rubbed together during the various operations involved in spinning, a great static charge of electricity is produced. Because of the static electrical charge, the staple fibres do not adhere to each other readily and cause great difficulty in the spinning operation.

I have found that if a solution of an electrolyte in a solvent of relatively high boiling point is applied to or incorporated in staple fibres, the tendency to generate static electricity during the spinning operation is greatly reduced. Moreover, I have found that if such solution of electrolyte is applied to or incorporated in continuous lengths of artificial filaments, especially those made by the dry or evaporative method, the great difficulty encountered in cutting such filaments to uniform staple lengths is overcome.

The application of anti-static finishes to yarn, filaments and fibres has been practiced heretofore, as is evidenced by my co-pending application S. No. 611,943 filed May 17, 1932, now Patent No. 2,086,590. These finishes, if applied directly to a yarn or group of filaments in transit by means of a furnishing device, have been applied in quantities usually above 3% on the weight of the yarn. This large quantity was necessary in order to obtain a continuous film of the coating material on the filaments. Dipping hanks or bales of the yarn has also been resorted to in an attempt to completely coat the filaments. The dipping treatments, however, may be both injurious to the filaments and also cause them to matt and wad together.

In the past, about 1.5% of finish on the weight of the filaments has been the lower limit which could be applied to the filaments at the spinning cabinet or other winding operation without running into static troubles in cutting the filaments to staple length, and when lower percentages were employed undesirable static effects were produced on the card under such conditions of humidity as, say, 50% to 55% relative humidity. Larger amounts produce an undesirable effect on card clothing and machine parts contacted by the treated fibres. Also large amounts, when blending the treated artificial fibres with wool fibres, caused a matting of the wool fibres that resulted in pills forming on the carding device. The fibres also become scroopy and develop an inability to slip over each other and to untangle without hairing.

I have now found that the anti-static finish may be applied to the yarns or filaments in an amount less than 1% on the weight of the yarn or filaments and still form a perfectly continuous film of the anti-static material of the filaments. This film is sufficient to conduct away the electric charge built up on the fibres and yet it is not sufficient to produce a wet or soggy blend when mixed with wool or other animal fibres. Neither does it impart a scroopiness to the filaments or fibres. Furthermore, the reduced amount of finish greatly reduces the amount of detrimental

effect upon the card clothing and other parts of the machines contacted by the fibres.

In accordance with my invention, I prepare staple fibres containing a continuous film of an electrolyte in a solvent of relatively high boiling point. I prefer to apply this solution of electrolyte to the relatively continuous lengths of artificial filaments in an amount less than 1% of the weight of the filaments and then cut the continuous lengths into staple fibres. However, the staple fibres themselves may be treated with the solution of the electrolyte either before any spinning operation or at any suitable intermediate stage of the spinning operation or to the "spun" yarn itself.

While this invention is of general application and is applicable to the treatment of natural fibres such as cotton or wool, or staples cut from natural silk or yarns or filaments made of reconstituted cellulose (such as may be made by the viscose, cuprammonium or nitrate method), it is of particular importance in connection with staple fibres made of organic derivatives of cellulose such as organic esters of cellulose and cellulose ethers. Examples of organic esters of cellulose are cellulose acetate, cellulose formate, cellulose propionate, cellulose butyrate and cellulose acetate-propionate, while examples of cellulose ethers are ethyl cellulose, methyl cellulose and benzyl cellulose. Therefore, this invention will be described more particularly in connection with the preparation or treatment of staple fibres made of cellulose acetate or other organic derivatives of cellulose.

The artificial filaments of organic derivatives of cellulose may be formed from solutions of the same in suitable solvents by extruding such solutions through orifices into a drying evaporative atmosphere, as in dry spinning, or by extrusion through orifices into a bath containing a precipitating liquid as in wet spinning. Such filaments may be treated while in the untwisted state by my process, or two or more of such filaments may be associated together by twisting, to form yarns or threads, which yarns or threads may be treated by my process.

By treating with or incorporating in the staple fibres, a solution of an electrolyte in a solvent of relatively high boiling point, because of the high electric conductivity of such solution, the building up of electric static charges is largely or entirely avoided.

While any suitable organic or inorganic electrolyte may be employed, I prefer to employ a hygroscopic electrolyte, examples of which are magnesium chloride, magnesium acetate, magnesium nitrate, magnesium chlorate, ammonium citrate, calcium chloride, calcium nitrate, zinc chloride, amines or their salts such as triethanolamine, triethanolamine stearate, triethanolamine oleate, methylamine, or a mixture of two or more of these. When employing the anti-static finish on organic acid derivatives of cellulose only a very small amount, if any, of triethanolamine, methylamine and like materials should be contained therein as these act as saponifying agents.

As a solvent for the electrolyte I prefer to employ a liquid having a relatively high boiling point, i. e., above 100° C., so that it does not tend to evaporate too readily from the filaments or staple fibres with the result that the resistance against electrification is preserved for a long period of time. The solvent will usually be an organic liquid which preferably, but not necessarily, is hygroscopic. Examples of such liquids are compounds of the polyhydric class such as diethylene glycol, ethylene glycol or glycerol or mixtures of two or more of these, which liquids have a more or less softening action on organic derivatives of cellulose. In case of treatment of staple fibres made of cellulose acetate or other organic derivatives of cellulose, there may be added to the solution, softening agents such as ethers of ethylene or poly-olefine glycols such as the mono methyl ether of ethylene glycol, the mono ethyl ether of ethylene glycol or the diethyl ether of diethylene glycol. In order to stabilize the solution against change of volume, viscosity or concentration due to evaporation or absorption of water, it is preferable to add a quantity of water substantially equal to that quantity of water the finish will absorb from normal atmospheres in reaching equilibrium with such atmosphere. These liquids tend to absorb from the air, the amount of water being 30% in the case of diethylene glycol, 13% in the case of ethylene glycol and 33% in the case of glycerol.

The amount of electrolyte present in the solution and the amount of solution applied will vary in accordance with the nature of both the electrolyte and solvent, the nature of the staple fibres and the result to be obtained. Generally, the electrolyte will be present in concentrations of 1 to 25%, and the amount of solution applied or incorporated in the fibres will be less than 1% of the weight of the fibres.

The filaments or yarns may be treated with the solution of the electrolyte while they are still in the comparatively continuous lengths in which they are formed. Conveniently, the solution of electrolyte may be applied by means of wicks, rollers or other furnishing devices to the yarns or filaments while they are in transit. A desirable method is to apply the electrolyte solution to the artificial silk immediately after they leave the spinning cabinet in which they are formed while on the way to a cutting device which cuts them into staple fibre. A suitable arrangement for cutting the yarn after leaving the spinning machine is shown and described in the U. S. application S. No. 695,503, filed Oct. 27, 1933. If desired, the relatively continuous lengths may be treated in the form of hanks or other suitable package prior to being cut into staples or chappe of suitable length.

In order to place a very thin continuous film, of the solution of electrolyte in a high boiling solvent, on the filaments it is necessary to dilute the solution of electrolyte with a volatile solvent, preferably water. The solution of electrolyte intended to remain on the filaments may be from 1 to 25 parts by weight of electrolyte to 100 parts by weight of high boiling solvent and 20 to 40 parts by weight of water to bring the moisture content to an equilibrium with the atmosphere. The application of this solution to filaments in continuous films of less than 1% by weight requires that the said solution be applied in a diluted form. This may be accomplished by forming a diluted solution in a low boiling diluent containing from 5% to 15% of the desired finish material containing the electrolyte, high boiling solvent and water of equilibrium.

As to the length of the staples, lengths ranging from 0.25 to 10" or more in length are suitable. The artificial filaments may be of any suitable weight per unit length, say from 1 to 30 denier or more, examples of which are 1.9, 3.5 or 5.5 denier.

After treatment with the dilute solution of elec-

trolyte the low boiling solvent is removed by evaporation. Other methods of removing the low boiling solvent or diluent tends to wash out the electrolyte from the film on the filaments. After or during the removal of the low boiling diluent the continuous filaments may be cut to a staple length. The short lengths of filaments or threads, with or without mixing them with fibres of wool, cotton, etc., are then subjected to a suitable spinning operation, such as is used for the spinning of short lengths of natural silk, cotton or wool fibres to form threads by any of the well known systems, such as the "cotton", the "French", the "worsted", the "woolen", the "spun silk", the "Bradford" system, etc.

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

Example

From a spinning metier for forming artificial filaments spinning 180 ends, each end containing 40 filaments of 2 denier of acetone soluble cellulose acetate, the ends are drawn at the rate of 100 meters per minute to a rotary cutting device such as is described in U. S. application S. No. 695,503, filed October 27, 1933. On their way to the cutting device, the ends are caused to pass over wicks or rollers which furnish from 3 to 5% of the weight of the filaments of the following finish:

	Parts by weight
Diethylene glycol	100
Water	30
Magnesium chloride	7
Diluent (water)	1,400

Application of this finish is conveniently accomplished by contacting the filaments with hard lamp wicks which dip into the finish, the wicks being positioned at the foot of the spinning cabinets so that the filaments contact with the finish material after they leave the spinning chamber. It is preferable that the filaments travel for a short distance prior to being cut after having the finish applied thereto in order to allow the low boiling diluent to at least partially evaporate before the cutting operation. If desired, heat in the form of heated air may be applied to the filaments just prior to or during the cutting operation to remove the diluent to a point where it will be in equilibrium with the atmosphere. Cut fibres so produced are substantially free of and resistant to the development of electro-static charges and may be spun into yarn without any difficulty. Furthermore, the cut fibres so produced do not have a wet or soggy feel and do not cause, upon being mixed with animal fibres, a matting or wadding of the animal fibres due to excessive moisture or liquids being present.

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.

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

1. In the method of forming spun yarns containing comparatively short lengths of artificial fibres, the step of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C.

2. In the method of forming spun yarns containing comparatively short lengths of artificial fibres of organic derivatives of cellulose, the step of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C.

3. In the method of forming spun yarns containing comparatively short lengths of artificial fibres of cellulose acetate, the step of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C.

4. In the method of forming spun yarns containing comparatively short lengths of artificial fibres, the steps of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C., and removing the diluent.

5. In the method of forming spun yarns containing comparatively short lengths of artificial fibres of cellulose acetate, the step of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C., the diluent being of lower boiling point than said solvent.

6. In the method of forming spun yarns containing comparatively short lengths of artificial fibres, the steps of forming on the fibres a continuous film of a solution which comprises 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C., the diluent being of lower boiling point than said solvent, and removing the diluent.

7. Method of forming staple fibres in a continuous manner which comprises continuously extruding a solution of an organic derivative of cellulose through orifices into a setting medium, continuously applying to the filaments so formed a solution comprising 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solven for said electrolyte, which solvent has a boiling point above 100° C., removing said diluent, and then continuously cutting said filaments into relatively short lengths.

8. Method of forming staple fibres in a continuous manner which comprises continuously extruding a solution of cellulose acetate through orifices into a setting medium, continuously applying to the filaments so formed a solution comprising 85 to 95% of a diluent and 15 to 5% of a mixture which contains 1 to 25% of an electrolyte together with a solvent for said electrolyte, which solvent has a boiling point above 100° C., removing said diluent, and then continuously cutting said filaments into relatively short lengths.

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