Patented Apr. 29, 1947

2,419,756

UNITED STATES PATENT OFFICE

2,419,756

PROCESS OF SIZING PACKAGES OF YARN

Luther Bishop Arnold, Jr., Richmond, Va., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

No Drawing. Application November 6, 1943, Serial No. 509,324

9 Claims. (Cl. 117—101)

1

This invention relates to the sizing of synthetic continuous filament yarns in package form. More particularly, it relates to the sizing of spun cakes of water-sensitive cellulosic yarns, such as those of regenerated cellulose. It is especially concerned with the use of aqueous sizing compositions for the sizing of spun cakes of viscous rayon yarn destined for a use where high twist is required, as in the knitting of full-fashioned hosiery.

It has been well known in the art to size continuous filament yarns, such as viscose rayon yarns, for many uses. Generally, these sizes have been applied with the objectives of preserving the yarn against mechanical injury during textile operations and/or of lubricating the yarn so that it will pass through fabrication operations successfully. In addition to the protective and lubricating properties of the size, a prerequisite has been water-sensitivity so that the size may be removed from the fabricated structures easily and quickly during the boil-off, which usually follows fabrication. Consequently, these sizes have been formulated to contain a proportion of easily emulsifiable oil which is intended to keep the yarn soft and flexible, together with a proportion of mucilaginous material, such as starch, gelatin, glue or the like, the function of which is to bind the filaments of a multi-filament yarn together during manipulation.

Peculiarly, in yarns destined for conversion into knitted structures, such as full-fashioned hosiery, a high degree of twist is required to provide sheerness in the knitted structure. Such highly twisted yarns tend to kink, snarl and untwist, properties which may be collectively called "wildness," and the twist must, therefore, be set and held in place at least partially by the size. Furthermore, a high degree of flexibility must be maintained in the highly twisted yarn and the customary size composition capable of setting the twist either makes the yarn too stiff or too sticky to run well in the knitting machine or deposits such a brittle size that when the yarn is flexed, the size flakes off, quickly clogging up the very fine openings, as, for example, in the barbs of the knitting needles, whereupon the yarn breaks and it becomes practically impossible to keep the knitting machine in operation.

Knitting sizes have been provided, but they have been applied to the yarn either after the twist has been placed in the yarn or, because of their mucilaginous character, they have been applied to the yarn while the latter is in skein form prior to twisting. Thus, in preparing a viscose

2

rayon yarn for fabrication into full-fashioned hosiery, it has been necessary to wind a spun cake to a spool and thence to a skein which may be soaked in a suitable size composition. After the soaked skein has been wrung free of excess sizing composition, it is scutched or shaken out to separate adjacent yarns in the skein, and thereafter the skein is dried. In some instances, the yarn is wound from the skein to another spool, from which it may be thrown to introduce the high degree of twist or it may be thrown directly from the skein supported on a suitable reel. In any event, the highly twisted yarn is taken up on a bobbin on which it is usually subjected to a steam treatment to set the twist, the size composition helping to hold the twist after it is set. From this bobbin, the yarn is next transferred to a cone, usually being oiled during the coning operation. The coned yarn is then ready for knitting into full-fashioned hosiery, whereupon the knitted structure may be boiled off (during which the size is removed), dyed, and finished for consumption.

Yarn has likewise been prepared for use in the knitting of full-fashioned hosiery by winding a previously unsized yarn, which has been highly twisted, onto a spool or other package and impregnating the wound package of yarn with non-aqueous (organic solvents) solutions of a binder material and, after the excess solution has been removed, as by centrifuging, the organic solvent is removed by evaporation, the binding material serving to maintain the twist in the yarn substantially as it occurred in the yarn prior to the impregnation.

Both of these methods have been fraught with numerous disadvantages. Obviously, the sizing operation which requires passing through the skeining stages exposes the yarn to excess handling and damage besides being expensive and time-consuming. A process which applies a size from an organic solvent solution requires special and expensive apparatus for recovery of the solvent and the avoidance of fire and health hazards. Furthermore, the size deposited from the organic solvent is difficult, if not impossible, to remove from the yarn after the knitting operation has been completed and, in many instances, requires treating the knitted structures with organic solvent to remove the size deposited on the yarn. Since this removal is sometimes not thoroughly done, the knitted structures suffer in final operations, such as dyeing, because of the non-uniform acceptance of the dye caused by traces of the size

remaining on the yarn and preventing uniform penetration of the dye bath.

With particular regard to the application of such knitting sizes to viscose rayon yarn, the prior art has persistently cautioned against the treatment of yarn packages with aqueous sizing compositions, the reason proffered being that the aqueous medium interferes with the uniform penetration of the size throughout the package as the result of the swelling action of the aqueous medium on the cellulose yarn.

It is an object of this invention to provide a process whereby viscose rayon yarn may be prepared for use especially in the knitting of full-fashioned hosiery without undergoing the costly and time-consuming skeining operations. It is also an object of this invention to provide a spun cake of viscose rayon yarn which is sized in cake form and is capable of conversion to a knitting cone by means of simple twisting, setting and coning operations. It is a further object of this invention to provide a spun cake of viscose rayon yarn suitable for the knitting of full-fashioned hosiery, wherein the size has been deposited from aqueous medium. Other objects will be apparent from the following description.

The objects of the invention are attained, in general, by sizing the spun cake of yarn with a non-mucilaginous aqueous sizing composition comprising an emulsion of an unctuous, i. e. soapy or waxy, material having a softening point of the order of 30° C. to 70° C. The sizing composition is advantageously applied while it is at a temperature about the same as the softening point of the unctuous material, and the excess composition is removed by centrifugal wringing before the sizing composition has cooled sufficiently to congeal, and the sized cake is then submitted to an appropriate drying treatment. The soapy or waxy nature of the material insures the maintenance of pliability and flexibility in the yarn during the knitting and similar textile operations. The low softening point within the specified range insures ease of application and sufficient solidity to permit the size to assist in holding the twist and controlling wildness of the yarn while at the same time binding the numerous filaments of the yarn together during textile operations. The non-mucilaginous character of the size composition enables it to be applied to a package, such as a spun cake, to yield a package wherein the individual filaments of each yarn are bound together but adjacent yarns, crossing or parallel, in the package are not stuck together.

In the following examples, which are typical embodiments of the invention and intended to illustrate the invention without limiting it to specific disclosures thereof, the parts are by weight:

Example I

A bucket cake of 75-denier 30-filament viscose rayon yarn spun with a left twist of 3 turns, having been washed, desulfured, bleached and dried in the original package form and weighing about 450 grams, is wrapped in a protective cheese cloth wrapper to avoid injury to the yarn on the outside of the cake. The wrapped package in collapsed form is subjected to a soaking operation which comprises immersing the processed package, supported in a perforated container, for about ½ hour in a bath containing 120 grams of a wax obtained by esterifying a mixture of approximately 48% stearic, 48% behenic and 4% erucic acids with butyl alcohol, dispersed in 1800 cc. of water with a mixture of 10 grams of sodium stearate containing about 10% by weight of free stearic acid and 3 grams of diethylene glycol which had been previously melted together. The bath is maintained at a temperature of 50° C. and the immersion is executed slowly so that no air is trapped within the cake. Thereafter, the cake is removed from the bath and centrifugally wrung in a perforated bucket-type extractor having an internal diameter approximating that of the external diameter of the dry cake before treatment. The extraction is done immediately after removal of the cake from the bath to avoid undue cooling of the cake and the sizing composition and is conducted for about 90 seconds at a speed of about 7,000 R. P. M. in order to reduce the moisture content of the cake to less than 110% of the dry weight of the cake. The extracted cake, still wrapped, is dried for 50 hours at about 65° C.

The finished dried cake is found to contain about 9% of sizing composition based on the dry weight of the yarn. The individual filaments of the yarn are held firmly together but the cake structure is free and open with substantially no stuck yarns, so that the cake may be back-wound with practically no breaks caused by the sticking together of adjacent yarns.

Example II

A spun cake of yarn is treated in the manner described in Example I, using, however, as a sizing composition a bath containing 180 grams of a wax consisting of 2 parts of the amyl alcohol esters of a mixture of approximately 48% stearic, 48% behenic and 4% erucic acids and 1 part of paraffin wax (melting range 52° C. to 57° C.), which has been emulsified with 15 grams of sodium palmitate containing about 20% by weight of free palmitic acid and 3 grams of diethylene glycol in 1800 cc. of water.

Example III

A spun cake of yarn is treated in the manner described in Example I, using a composition similar to that described in Example II except that the wax mixture thereof is replaced by a mixture of 1 part japan wax and 1 part petrolatum wax (micro-crystalline paraffin wax).

Example IV

A spun cake of yarn is treated in the manner described in Example I, using, however, a sizing composition composed of 150 grams of a mixture of 2 parts carnauba wax, 1 part white mineral oil (100 Scott Universal viscosity at 100° C.) and 1 part petrolatum wax, which has been emulsified with a mixture of 5 grams potassium stearate, 5 grams potassium oleate and 4 grams diethylene glycol in 1800 cc. of water.

Example V

A spun cake of viscose rayon yarn is treated as in Example I, using, however, a bath composed of 90 grams of paraffin wax dispersed by means of a colloid mill in 1800 cc. of a 0.5% dispersion of partially hydrolyzed polyvinyl acetate.

Example VI

A spun cake of viscose rayon yarn (75-denier 30-filament 2.5 turns left twist) is immersed in the manner described in Example I in a 20% aqueous solution of a super-fatted soap sold under the trade-name "Lanafin Size 72" (sold by Standard Chemical Products Co., of Hoboken, N. J.) for a period of 1½ hours, the bath being maintained at a temperature of 75° C. In this

case, the wrapped spun cakes are placed on the surface of the size bath and allowed to sink by their own weight in order to obtain uniform penetration and to prevent entrapment of air. At the end of the treating cycle, the cakes are removed from the size bath and the excess liquor allowed to drain, whereupon they are centrifugally wrung as soon as possible to prevent congealing of the size. The wringing cycle is 90 seconds at about 7,000 R. P. M., the wringing bucket having an internal diameter approximating that of the external diameter of the dry cake before treatment, in order to reduce the moisture content of the cake to less than 110% of the dry weight. After wringing, the cakes are dried for 48 hours at about 70° C. The cakes so treated contain about 8% size based on the dry weight of the yarn, and back-winding is excellent.

As has been stated above and as will be readily seen by examination of the above examples, the sizing composition of this invention is an aqueous non-mucilaginous emulsion of a soapy or waxy material having a softening point in the range of 30° C. to 70° C. Among the waxy materials which are suitable for use in the practice of this invention may be included synthetic (wax) esters of saturated or partially unsaturated fatty acids with aliphatic alcohols; the natural wax-esters, such as japan wax, carnauba wax and spermaceti; and the crystalline and micro-crystalline or amorphous paraffin waxes. Mixtures of these waxy materials will frequently be found to be especially useful. Among the soapy materials which may be included are the sodium or potassium salts of partially saponified fats or partially saponified wax-esters in which the degree of saponification and the balance of sodium and/or potassium salts has been adjusted to maintain the soft, wax-like character and to maintain the softening point of the product within the specified range.

It will be apparent, as illustrated by the above examples, that mixtures of these materials may find particular utility. Furthermore, these soapy or waxy materials may be blended with small amounts of mineral oils or vegetable oils to adjust the consistency of the mixture which may be found to be dependent upon the selection of the wax or the type of yarn undergoing treatment.

When a waxy material of the type described above is selected as the principal ingredient of the size, suitable emulsifying materials will be employed to obtain the dispersion in the aqueous medium. When a soapy material, such as a superfatted soap, is selected as the principal ingredient, in many instances the soap will constitute its own emulsifying agent or it may serve as the emulsifying agent for a waxy material. Suitable emulsifiers include the sodium and potassium salts of fatty acids; sulfated vegetable oils; mineral oil sulfonates; and synthetic emulsifiers, such as metallic and amine salts of sulfated fatty alcohols, the sodium salt of taurine oleamide, the half fatty acid ester of ethylene glycol and the partial fatty acid esters of sorbitol or its dehydration products. In using sodium or potassium salts of fatty acids, it is frequently desirable to include a homogenizer, such as diethylene glycol, the monobutyl ether of ethylene glycol, or the lower aliphatic alcohols, such as isopropyl or butyl alcohol.

The sizing composition may be dispersed in the aqueous medium so that it constitutes from 5% to 25% of the emulsion. The concentration

will depend largely on the amount of size desired on the finished yarn. Emulsions containing 10% to 20% of the sizing composition have given particularly good results.

The temperature of the sizing bath is usually selected above the softening point of the soapy or waxy material employed; thus, temperatures of 50° C. to 75° C. will be found to be particularly useful. In this way, the emulsion is kept sufficiently fluid to insure complete and uniform penetration of the yarn package. In this connection, it should be observed that after the yarn package has been impregnated with the emulsion, it should be maintained preferably at about the same temperature as the sizing bath during the wringing operation in which the excess bath is removed in order to prevent congealing of the emulsified sizing composition prior to the removal of the excess.

While in the examples the preferred method of immersion treatment is set forth, it is to be understood, of course, that the yarn package may be impregnated with the size composition in any desired fashion, such as by exposing the package to a shower bath treatment or by supporting the yarn package and forcing the aqueous emulsion through the package structure under pressure, as, for example, from the interior of the package to the exterior.

While it is preferred in the practice of this invention to apply the sizing composition to a dried spun cake which is free from other finishing compositions, the nature of the sizing composition and the process permit wide latitude of action. Thus, the sizing composition may be applied to yarn already containing a finish. This is of outstanding utility in a viscose rayon manufacturing plant producing yarn, a minor portion of which is destined for full-fashioned knitting operations, the remainder being destined for other uses. In such a case, the entire production may be given the conventional finishing treatment prior to initial drying, as, for example, treatment with an oil emulsion of low oil concentration, suitable for the major portion of the production. The minor portion may subsequently receive the special sizing treatment of this invention. In this way, segregation of production up to and including initial drying of the spun cakes is avoided.

Because of the teachings of the prior art, it was indeed surprising that a spun cake of viscose rayon yarn could be impregnated with the sizing composition applied through the medium of an aqueous emulsion. The success of the treatment may be attributed to the waxy or soapy character of the essential sizing material. It was, indeed, still further surprising that emulsions of such high concentration could be used with the resultant deposition of relatively large amounts of size on the yarn, which size would bind the filaments of individual yarns firmly together without at the same time causing adjacent yarns to stick together.

The practice of this invention affords numerous advantages over the prior art. Since the size composition is applied from an aqueous medium, the process is economical and numerous health and fire hazards are avoided. Contrary to expectations, the size is uniformly distributed throughout the package; even the innermost yarns of the spun cakes are thoroughly impregnated.

These sized packages of yarn do not suffer from the phenomenon known as "wicking," a term which is used to describe the migration of the

size to the outer portions of a package, as, for example, at the shoulders of a spun cake of rayon yarn. The resulting increased concentration of the size on the external convolutions of the package cause sticking, snarling, discoloration and numerous other undesirable characteristics, particularly when attempts are made to back-wind the yarn from the spun cake.

Spun cakes of viscose rayon sized according to the present invention exhibit a remarkable freeness of structure so that as many as 100 dried sized cakes may be back-wound to spools with only one or two breaks in the yarn caused by the sticking together of adjacent yarns in the spun cake. As a matter of fact, the yarn may be back-wound directly in a throwing operation, thus avoiding any preliminary spooling. In this way, the yarn is thrown directly to the bobbin customarily used for setting the twist and, after steaming the yarn on that bobbin, the yarn may be transferred to a cone destined for use on the knitting machine. The running properties of the yarns sized according to this invention are excellent, particularly in knitting machines which yield flat-knit fabrics, as in the manufacture of full-fashioned hosiery. The size does not flake off on the knitting needles and sinker bars. It does not stick to the guide or snappers during a temporary shut-down of the knitting machine, which sticking would result in what is known in the art as a "press-off" when the machine is again started. The size softens sufficiently to enable the formation of regular stitches of uniform size and to cement the loops together when the fabric dries. It affords sufficient lubrication so that the yarn passes through the machine around the needles and sinker bars without cutting or snagging. The yarn is rendered flexible and capable of meeting the exacting requirements of the full-fashioned hosiery knitting process. The size assists in the setting of the twist in the yarn so that wildness is controlled.

The sizing composition is easily removed in later processing because of its dispersibility in aqueous media and, because it is so easily scoured from the yarn, it does not interfere with the uniformity of dyeing of the finished materials. As a matter of fact, in those embodiments of the invention which utilize soapy materials, the uniformity of the dyeing is improved since many dyes are applied to fabrics in the presence of soaps; thus, the uniformity in depth of dyeing is advantageously affected.

Many knitters prefer to operate their knitting machines using yarns which have been wetted with water in the so-called dip-trough of the knitting machine. Utilizing yarns of the present invention, the dip-trough may be eliminated or, if it is used, the size composition is amenable to dampening with water, a characteristic which distinguishes it from yarn which has been sized by deposition of organic solvent-soluble material in the absence of proper emulsifying and homogenizing material.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited thereto except as set forth in the appended claims.

I claim:

1. A process for sizing a dried spun cake of rayon which comprises impregnating said cake with an aqueous emulsion of a non-mucilaginous unctuous material having a softening point of the order of 30° C. to 70° C. and selected from the class which consists of soapy and waxy materials, said emulsion being at a temperature at least equal to the softening point of said non-mucilaginous unctuous material, and removing the excess emulsion before the emulsion has congealed, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step.

2. A process for sizing a dried spun cake of rayon which comprises impregnating said cake with an aqueous emulsion of a non-mucilaginous unctuous material having a softening point of the order of 30° C. to 70° C. and selected from the class which consists of soapy and waxy materials, said emulsion being at a temperature at least equal to the softening point of said non-mucilaginous unctuous material, and centrifugally wringing the impregnated cake to remove the excess emulsion, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step.

3. A process for sizing a dried spun cake of rayon which comprises impregnating said cake with an aqueous emulsion of a non-mucilaginous unctuous material having a softening point of the order of 30° C. to 70° C. and selected from the class which consists of soapy and waxy materials, said emulsion being at a temperature at least equal to the softening point of said non-mucilaginous unctuous material, centrifugally wringing the cake to remove excess emulsion and reduce the moisture content thereof to less than 110% of the dry weight of the cake, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step, and drying the cake.

4. A process for sizing a dried spun cake of rayon which comprises impregnating said cake with an aqueous emulsion of a non-mucilaginous unctuous material having a softening point of the order of 30° C. to 70° C. and selected from the class which consists of soapy and waxy materials, said emulsion being at a temperature at least equal to the softening point of said non-mucilaginous unctuous material, centrifugally wringing the cake before the size has congealed to remove excess emulsion and reduce the moisture content thereof to less than 110% of the dry weight of the cake, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step, and drying the cake.

5. A process for sizing a dried spun cake of rayon which comprises impregnating said cake with an aqueous emulsion of a non-mucilaginous unctuous material having a softening point of the order of 30° C. to 70° C. and selected from the class which consists of soapy and waxy materials, said emulsion being at a temperature at least equal to the softening point of said non-mucilaginous unctuous material, centrifugally wringing the cake at about the same temperature as the temperature of the emulsion to remove excess emulsion and reduce the moisture content thereof to less than 110% of the dry weight of the cake, and drying the cake.

6. A process for sizing a dried spun cake of

viscose rayon which comprises impregnating said cake with an aqueous emulsion of a waxy material having a softening point of the order of 30° C. to 70° C., said emulsion being at a temperature at least equal to the softening point of said waxy material, and removing the excess emulsion before it has congealed, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step.

7. A process for sizing a dried spun cake of viscose rayon which comprises impregnating said cake with an aqueous emulsion of a waxy material having a softening point of the order of 30° C. to 70° C., said emulsion being at a temperature at least equal to the softening point of said waxy material, and centrifugally wringing the cake to remove the excess emulsion before it has congealed, the impregnated cake being maintained during the removal of the excess emulsion at a temperature substantially the same as that of the emulsion during the impregnation step.

8. A process for sizing a dried spun cake of viscose rayon which comprises immersing said cake in a bath comprising an aqueous emulsion of a waxy material having a softening point of the order of 30° C. to 70° C., said bath being maintained at a temperature at least equal to the softening point of said waxy material, the immersion being executed slowly to inhibit trapping of air in said cake, removing the cake from the bath, centrifugally wringing the impregnated cake before the size has congealed until the moisture content thereof is less than 110% of the dry weight of the cake, and subjecting the cake to a drying treatment.

9. A process as set forth in claim 8 wherein the bath is maintained at 50° C. and comprises 120 parts of a wax, obtained by esterifying a mixture of approximately 48% stearic, 48% behenic and 4% erucic acids with butyl alcohol, dispersed in 1800 parts of water.

LUTHER BISHOP ARNOLD, JR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,984,325	Stoeckly	Dec. 11, 1934
2,073,857	Stoeckly	Mar. 16, 1937
2,219,728	Strube	Oct. 29, 1940
2,207,229	Sherman	July 9, 1940
2,205,042	Lenher	June 18, 1940
2,051,891	Ostermann	Aug. 25, 1936
1,598,402	Spiess	Aug. 31, 1926
2,069,303	Dreyfus	Feb. 2, 1937
2,151,952	Wasum	Mar. 28, 1939
2,298,432	Thompson	Oct. 13, 1942
2,176,402	Koch	Oct. 17, 1939
2,297,135	Davis	Sept. 29, 1942