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PREPARATION AND USE OF TEXTILE
THREADS

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This invention relates to the manufacture of
crepe threads and filaments of cellulose acetate
or other organic derivatives of cellulose and to
the production of fabrics therefrom where an aid,
containing a mixture or solution of a plasticizer in
oil, for enhancing the crepe and textile properties
is incorporated with yarns prior to forming them
into crepe threads.

An object of this invention is the economic
and expeditious production of threads, contain-
ing organic derivatives of cellulose, which have
a high degree of crepe suitable for the produc-
tion of crepe fabrics. A further object of this
invention is the treatment of yarns and the twist-
ing of the same to a high degree of twist in such
a manner as to produce fabrics having a uniform
creping property. A further object of this inven-
tion is the production of crepe threads that
shrink and buckle in a very short period of
time when immersed in a heated creping bath.
Other objects of the invention will appear from
the following detailed description.

It has been found that if yarns of organic de-
rivatives of cellulose are tightly twisted, especial-
ly in the presence of steam, the same may be
woven into a fabric which produces a substantial
amount of crepe. It has also been found that
the crepe threads containing organic derivatives
of cellulose form a crepe fabric, the type and
amount of crepe therein materially differing ac-
cording to physical conditions of the thread at
the time the high degree of twist is placed there-
in. These conditions, which influence the type
and amount of crepe that the threads will pro-
duce, causes difficulties in the manufacture of
crepe fabrics consisting entirely or substantially
of threads of organic derivatives of cellulose. By
employing this invention, however, the condi-
tions may be disregarded within wide limits and
threads that will produce a uniform type of
crepe are formed. Furthermore, by employing
this invention, the degree and type of crepe pro-
duced is governed by fewer variables, which may
be easily controlled, such as the amount of twist
imparted to the thread, the type and temperature
of treatment given to the fabric and such other
manual operations. Further, by employing this
invention, the length of treatment of the fabric
in a boil-off bath or creping bath is materially
shortened. Furthermore, fabric formed from
threads produced in accordance with the present
invention shrink faster and more uniformly than
fabrics formed by the prior methods.

In accordance with the present invention, high-
ly twisted crepe threads of filaments of organic

derivatives of cellulose are produced from threads
of filaments of organic derivatives of cellulose,
which have incorporated therewith a mixture or
solution of a plasticizer and an oil, by crepe twist-
ing in a single stage and during the insertion of
the crepe twist steaming the threads. It is of
great advantage to have moisture present dur-
ing the steaming. Thus, during the twisting op-
eration wet steam may be applied to the travel-
ing yarn over at least a portion of that part of
its track in which twisting takes place.

This invention is of especial value and will be
more particularly described in connection with
the production of crepe threads or filaments of
cellulose acetate.

By incorporating a mixture or solution of a
plasticizer and an oil with the filaments of cellu-
lose acetate, it has been found possible to produce
crepe threads which yield fabrics exhibiting
crepe effects of an excellence hitherto unattained
with cellulose acetate crepe threads. Moreover,
with this new process cellulose acetate there may
be produced crepe threads which have an aver-
age strength very much greater than that of
cellulose acetate crepe threads produced by a
simple twisting operation without the aid of plas-
ticizers and oil during the twisting and steam
treatment. Further, apart from the great advan-
tage of a strong resultant thread, the twisting
operation itself is greatly facilitated in that
twisting may be satisfactorily accomplished un-
der conditions of twist and spindle speed which,
in the absence of the plasticizer and oil, would
give rise to frequent thread breakage and render
impossible the insertion of the desired twist or
at least lead to a very weak and useless thread.

By incorporating a mixture or solution of a
plasticizer and an oil with the filaments of cel-
lulose acetate, not only are the threads given en-
hanced properties for the textile operations and
a more uniform crepe pebble produced in the
fabric but the speed of shrinkage in the boil-
off or creping bath is greatly increased. This is
especially true when employing a plasticizer of
the tri-aryl phosphate type.

Any suitable plasticizer, and by that term
is meant softening agent, swelling agent, etc.,
for the cellulose acetate, may be mixed with or
dissolved in an oil and this mixture or solution,
when incorporated with the yarns or filaments
prior to or during the twisting operation, aids
in imparting the high degree of twist thereto.
The plasticizer may be mixed with or dissolved
in the oil in amounts up to 80% of the weight
of the oil. This mixture or solution may then

be incorporated with the filaments or threads of cellulose acetate by adding same to the spinning solution or dope from which the filaments constituting the thread or yarn are formed.

5 Thus, up to 10% by weight of a plasticizer-oil creping aid or agent may be added to a solution of an organic derivative of cellulose in a volatile solvent and the same extruded through orifices of suitable diameter to form the type of yarn

10 desired. Either the wet or dry method of spinning may be employed. By another modification the plasticizer mixed with or dissolved in an oil may be incorporated with the yarn by applying same as a coating to the yarn after the yarn has

15 been formed. The plasticizer-oil creping aid may be applied to the yarn as a coating at the metier as the yarns are formed or during any subsequent winding operation prior to imparting twist thereto. The coating material may consist of

20 from 5 to 80 parts or more of a plasticizer and 95 to 20 parts of an oil lubricating material such as olive oil, castor oil, tea-seed oil, cotton-seed oil, etc. Although vegetable oils are generally preferred, mineral oils, animal oils or mixtures

25 of various oils may be employed. A dispersion of plasticizer and sulphonated naphthene in mineral oil or any suitable vegetable oil alone or in mixtures may be employed as the aid for enhancing the textile and creping properties of the thread. The lubricating material containing the

30 plasticizer may be applied to the yarn, while the yarn is in a stage of travel as during its formation or during a winding operation, by causing the yarn to contact with a wick or roller that

35 dips into the mixture or solution containing the same, or by any other suitable furnishing device or method.

Any suitable plasticizer may be employed in solution or mixture with an oil. The plasticizer

40 may be any suitable one for the particular cellulose derivative or mixture of cellulose derivative employed as the base constituent of the filaments. The plasticizers may be any of the high boiling solvents or softening agents, etc., as for example:

45 the aryl sulphonamides such as para ethyl toluol sulphonamide, the alkyl phthalates such as dimethyl phthalate, the di-alkyl tartrates as dibutyl tartrate, the alkoxy esters of polybasic organic acids such as diethoxy ethyl phthalate,

50 the polybasic organic acid esters of the mono-alkyl ethers of polyhydric alcohols such as diethylene glycol ethyl ether ester of phthalic acid, the alkyl esters of phosphoric acid such as tri-butyl phosphate or tri-ethyl glycolphosphate, the

55 aryl esters of phosphoric acid such as tri-cresyl phosphate and the mixed alkyl and aryl phosphates such as ethyl glycol di-cresyl phosphate.

Although any suitable plasticizer-oil mixture or solution may be employed, it is found preferable to employ a mixture of tri-cresyl phosphate or triphenyl phosphate and castor oil in the proportions of up to 60 parts of plasticizer to 40 or more parts of oil.

The threads may consist of substantially continuous filaments of cellulose acetate or they may contain discontinuous filaments of cellulose acetate, the length of which may vary within wide limits. For example, the threads may be those spun from a mass of discontinuous filaments or those prepared in the manner described

70 in co-pending U. S. application S. No. 726,275 filed May 18, 1934. The threads may contain, besides organic derivatives of cellulose, other textile, filaments or fibers. Further, the threads

75 may be formed from a bundle of substantially

continuous filaments or by doubling two or more yarns. The threads also may be formed from fibers by cotton and woollen methods of forming yarns.

If desired, the filaments of the threads may contain water-insoluble compounds, such as compounds of pigment-like character, in such form as materially to modify the luster of the filaments (e. g. barium sulphate or titanium dioxide), or loading metal compounds, for example, tin compounds.

In carrying out the new process, twisting may be effected on a device of the kind in which the thread is drawn off over the end of a rotating package through a guide fixed preferably substantially in line with the axis of rotation of the package and is thereafter wound on a bobbin or the like, the thread being passed, on its way from the guide to the bobbin, through steam. In this way the thread is subjected to the action of the steam during the actual application of a substantial amount of the twist, or to the action of both steam and moisture if it is passed through steam under such conditions that moisture is present.

On the other hand, any other suitable crepe twisting device may be employed in conjunction with steaming. For example, a ring twister may be used for the crepe twisting of thread consisting of discontinuous cellulose acetate filaments, or by other suitable devices. As examples of such devices may be mentioned flyers and the floating ring device described in British Patent No. 304,806 to British Celanese Limited and others.

Steaming may conveniently be effected by allowing the thread to pass through a suitable chamber supplied with steam preferably under such conditions that moisture is present. The chamber is provided with small holes, top and bottom, to permit passage of the thread, and also with a steam inlet. If desired, a single steam chamber may be arranged to serve a number of twisting devices, being provided with inlet and outlet holes for the thread of each device. Such an apparatus may conveniently consist of a horizontal pipe mounted over a row of twisting devices and provided with eyes of porcelain, stainless steel, or other suitable material at appropriate points on top and bottom for the entrance and exit of the threads. The diameter of the pipe may be sufficient to afford the thread the requisite length of travel in the steam. Alternatively, a pipe having a smaller diameter may be used, in which case the pipe may be provided with hollow nipples communicating therewith and through which the yarn passes, the nipples being of sufficient length to provide, together with the diameter of the pipe, the requisite length of travel in the steam.

The presence of the desired moisture may be assured by supplying wet steam to the steaming device and/or by arranging for the condensation of steam to supply the requisite amount of moisture. Wet steam may be conveniently produced by passing steam through water at suitable velocity, for instance, small traps for condensed water may be provided at suitable intervals in the steaming chamber and steam injected there-through by means of small pipes or orifices. Another method of ensuring the presence of moisture is to wet the thread with water. For example, the bobbins of thread may be wetted before the twisting operation or, better, water may be applied to the thread by means of a wick or other

device after the thread leaves the spindle and prior to its entering the steaming device.

Steam at slightly above atmospheric pressure, or at a pressure of 1 to 2 millimeters of water, is most conveniently employed. If desired, however, the steaming may be effected with steam at any desired super-atmospheric pressures, e. g. steam at 10-25 lbs. per square inch.

A steaming treatment of relatively short duration such as may be secured by passing the yarn at a speed of from 2 to 10 metres per minute through say from 1" to 6" of steam has been found to give satisfactory results. Lengthier treatments may, however, be employed, for example, the yarn may be passed at the said speeds through 6 to 12" or more of steam.

The cellulose acetate filaments of the threads having incorporated therein a plasticizer mixed with or dissolved in an oil very readily undergo stretching when the threads have incorporated therewith when the threads are twisted under the influence of the steam and moisture. The amount of stretch may be measured by comparing the original thread denier with the final thread denier (after untwisting). It has been found that when a cellulose acetate thread is crepe twisted by the new process involving the treatment of the same with a plasticizer-oil creping aid and steaming during twisting so as to produce a crepe thread of good strength and creping properties, the denier of the resultant thread is, in general, owing to imparted stretch, less and even substantially less than if the thread is simply crepe twisted without such treatments. The stretch imparted to the filaments of the thread during the twisting operation may, for example, be of the order of 5-25% of their original length, and particularly 10-20%. For example, the stretching may be such that the denier of the crepe twisted thread is from 95 to 115%, 120% or 125% or more, and particularly 100 to 110% of that of the thread before crepe twisting, especially in case of threads having an original denier of 200 or less. In the case of heavier threads, i. e. those having a denier above 200, the denier increase may be greater and still good crepe effects attained.

The degree of twist applied in accordance with the new process may vary within wide limits. A feature of the process is that it enables a very high degree of twist to be applied without such a great weakening of the thread as is invariably experienced when cellulose acetate crepe threads are prepared without steaming in the presence of plasticizer-oil aids. The process also enables the use of a reduced number of turns per inch to produce the same type of crepe from prior processes. The process, moreover, permits of the insertion of twists which are impossible of attainment without the steaming in the presence of a plasticizer-oil aid, owing to the breakage of the thread. This is important since it enables crepe fabrics having very pronounced crepe effects to be produced. The crepe figure can be regulated according to requirements. The degree of twist desirable in any particular case depends upon a number of factors, including the precise effects required, and the denier and number of filaments in the thread. For example, threads of 150 denier may be twisted to about 55 to 75 or more turns per inch, while 100 denier threads may be twisted to about 60 to 100 or more turns per inch. Proportionate twists may be used in case of threads of other deniers.

By the new process highly twisted cellulose

acetate crepe threads may be produced in which the filaments are extremely closely packed. As appears from a microscopic examination of the cross-sections of yarns twisted in accordance with this invention, the filaments are squeezed together into substantially as close contact as possible, causing some distortion of the cross-section of at least some of the filaments thereof. The filaments, however, are not stuck together nor packed together and can be separated upon untwisting into individual filaments. The threads produced in accordance with the present invention have a specific gravity of at least 85% of that of a solid thread.

While this invention enables production of threads which yield satisfactory crepe effects without a special treatment other than the twisting of the thread while it contains a plasticizer-oil creping agent in the presence of a steaming treatment characteristic of the process, other devices and treatments may, if desired, be employed further to improve the properties of the crepe threads and/or fabrics produced therefrom. For example, crepe threads, that have the plasticizer-oil dispersed in the filaments, may be sized at any suitable stage of their manufacture, for example, in the course of winding on to a bobbin from which twisting is effected. In this connection, particular mention may be made of sizing materials selected in accordance with the considerations laid down in British Patent No. 348,589. For example, a casein, egg albumen, or other size which is not very readily removed by aqueous treatments, may be employed. Another size which may be employed is a drying oil, if desired, one which has been only partially oxidized, e. g. boiled or blown linseed oil.

The highly twisted crepe threads may be incorporated in the fabrics in various ways, for example, the weft alone may be wholly or partially composed of such threads or the warp may also contain them. Valuable fabrics may be produced by employing in the warp, threads of relatively low twist and in the weft both crepe threads having a left-hand twist and crepe threads having a right-hand twist, pairs of threads of left-hand twist alternating with pairs of threads of right-hand twist.

If desired, the cellulose acetate crepe threads may be associated in the fabrics with highly twisted crepe threads of other materials, e. g., of natural silk or regenerated cellulose, or threads of artificial silk produced by other processes. Where the fabrics contain threads of low twist these may wholly be of cellulose acetate or wholly or in part of other materials, e. g., natural silk or regenerated cellulose.

After the yarns or threads have been formed into a fabric, if said threads or any of said threads have been treated with an aid containing a large amount and a very active plasticizer such as diethylene glycol, etc., the fabric to produce the best creping should be scoured in cold water or other liquid to remove substantially all of the plasticizer present. If a large amount of active plasticizer is present in the thread during the creping operation in a hot bath, the filaments become too plastic and the creping forces release themselves without buckling the yarn. When the fabric is first scoured cold, however, it crepes heavily in the creping bath and produces a very uniform fabric. When smaller amounts or less active plasticizers are employed such as tricresyl and triphenyl phosphate, the fabric need not be scoured cold prior to the treat-

ment in the hot bath to produce the crepe effect on the fabric. The action of the various plasticizers employed may be tested to ascertain which, if any, and to what extent the same should be scoured in the cold before placing the fabric in the hot bath to develop the crepe effect or buckle in the fabric. The use of an agent containing castor oil-tricresyl phosphate is preferred as this agent is efficient as a textile lubricant as well as an excellent creping aid. Furthermore, it is comparatively stable and resistant to oxidative changes.

Fabrics containing highly twisted crepe threads prepared in accordance with this invention may be scoured in the cold bath to remove a part or all the plasticizer in the creping agent or aid employed during the twisting operation, if the removal thereof is necessary, and then subsequently scoured, for example, in the manner adopted in connection with fabrics comprising highly twisted yarn of natural silk. Enhanced crepe effects may be obtained by employing scouring or other aqueous crepe baths at or near the boiling point. The fabric made in accordance with this invention may be caused to crepe by immersing the same in a bath, containing up to 10 grams or more per litre of soap, that is maintained at about 95° to 105° C. However, by employing certain plasticizers, the temperature of the creping bath may be considerably lower. The period of treatment in the heated bath may be from about 1 to 30 minutes or more. The delustering effect of all high temperature scouring baths upon fabrics containing threads of lustrous cellulose acetate may be minimized by incorporating therein salts or sugars.

An important characteristic of fabrics exhibiting crepe effects produced in accordance with this invention is that unlike crepe fabrics heretofore produced, they do not shrink substantially when washed or otherwise treated with aqueous liquids, nor do they tend to develop spots when subjected locally (such as by rain) to aqueous liquids. Therefore, garments or other articles made of such fabric may be laundered in the ordinary way without recourse to dry cleaning.

As illustrations in describing this invention and not as limitations, the following examples are given:

Example 1

A spinning solution is formed by mixing substantially 25 parts of acetone-soluble cellulose acetate, 75 parts of acetone and 1.0 part of a mixture containing 40 parts of castor oil and 60 parts of tricresyl phosphate. This solution is spun into filaments by the dry method of spinning. The yarn is twisted to a crepe thread by imparting thereto, in the presence of steam, a twist of about 75 turns per inch. This yarn is woven into a fabric and then it is treated for 10 minutes in an aqueous bath maintained at 99° C. The fabric produced has a heavy and uniform crepe effect produced therein, which crepe effect is spot-proof and substantially free from further shrinkage upon treatment in aqueous or other cleaning baths normally met with in the use of the fabric.

Example 2

A spinning solution is formed by mixing substantially 25 parts of acetone-soluble cellulose acetate, 75 parts of acetone and 0.5 of a part of an agent containing 60 parts of olive oil and 40 parts of tricresyl phosphate. This solution

is spun by the dry method of spinning into a yarn and twisted in the presence of steam to a crepe thread having approximately 75 turns per inch. This thread is woven into a fabric and the same scoured in a heated aqueous bath maintained at a temperature of above 80° C. for from 5 to 15 minutes. The fabric produced has a heavy crepe effect, is exceptionally uniform and strong. This material is spot-proof and does not materially shrink upon further treatment in cleaning baths or solutions.

Example 3

A yarn of cellulose acetate is caused to contact with a furnishing device which applies thereto a coating containing 60 parts of tricresyl phosphate and 40 parts of castor oil. The amount of coating applied to the yarn may be any suitable amount, for example, from 1 to 5% or more based on the weight of the yarn. This yarn is twisted to a crepe thread in the presence of steam, such that approximately 75 turns per inch are inserted therein. The threads are woven into a fabric and the fabric treated in a hot bath maintained at above 80° C. for a period of from 10 to 20 minutes. The fabric produced is similar in all respects to that produced by Example 2.

In the appended claims the term "plasticizer" is intended to include within its scope any reagent, some of which are listed above, which has a swelling, softening or slight solvent action upon the filaments containing organic derivatives of cellulose at the temperature of the steam treatment. This term is intended to include plasticizers, softeners and swelling agents.

While this invention has been described in particular connection with cellulose acetate, it is applicable for use with yarns or threads made of other organic derivatives of cellulose, such as cellulose formate, cellulose propionate, cellulose butyrate, or other organic esters of cellulose, or cellulose ethers such as methyl cellulose, ethyl cellulose and benzyl cellulose.

It is to be understood that the foregoing detailed description is merely given by way of illustration and many alterations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. Process for the production of highly twisted crepe thread of filaments of an organic derivative of cellulose which comprises incorporating with the thread a plasticizer-oil creping aid, crepe twisting the thread of filaments in a single stage and steaming the thread during the actual insertion of the crepe twist.

2. Process for the production of highly twisted crepe thread of filaments of an organic derivative of cellulose which comprises incorporating with the thread of filaments of an organic derivative of cellulose a plasticizer-oil creping aid, crepe twisting said thread and, during the actual insertion of the crepe twist, steaming the thread under such conditions that moisture is present.

3. Process for the production of highly twisted crepe thread of filaments of an organic derivative of cellulose which comprises incorporating a plasticizer-oil creping aid, with a thread of filaments of an organic derivative of cellulose, crepe twisting said thread and, during the actual insertion of the crepe twist, steaming the thread and stretching the filaments thereof.

4. Process for the production of highly twisted

crepe thread of filaments of cellulose acetate which comprises incorporating with the thread a plasticizer-oil creping aid, crepe twisting the thread of filaments in a single stage and steaming the thread during the actual insertion of the crepe twist.

5 5. Process for the production of highly twisted crepe thread of filaments of cellulose acetate which comprises incorporating a plasticizer-oil creping aid, with a thread of filaments of cellulose acetate, crepe twisting said thread in a single stage and, during the actual insertion of the crepe twist, steaming the thread under such conditions that moisture is present and stretching the filaments of the thread so that the denier of the crepe twisted thread is 95% to 125% of that of the thread before crepe twisting.

6. Process for the production of highly twisted crepe thread of filaments of cellulose acetate which comprises incorporating a coating containing tricresyl phosphate and an oil with a thread of filaments of cellulose acetate, crepe twisting said thread and steaming the threads during the actual insertion of the crepe twist.

7. Process for the production of highly twisted crepe thread of filaments of cellulose acetate which comprises incorporating a coating containing an alkyl or aryl phosphate and an oil with a thread of filaments of cellulose acetate, crepe twisting said thread and steaming the threads during the actual insertion of the crepe twist.

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