United States Patent Office 3,157,982 Patented Nov. 24, 1964

3,157,982

PROCESS FOR MANUFACTURING CREPE FABRICS WITH MULTIFILAMENT TEXTILE YARNS OF SYNTHETIC ORIGIN

Albert Marcel Cyprien Alexandre, Saint-Pierre-de-Colombier, France

No Drawing. Filed Aug. 20, 1962, Ser. No. 218,133
Claims priority, application France Aug. 25, 1961
12 Claims. (Cl. 57—157)

As is known, textile fibres of superpolyamide and other synthetic materials, such as those known by the trademarks "nylon," "Rilsan" etc., are manufactured using a spinneret and are therefore initially smooth continuous filaments devoid of the crimps and crinkles exhibited by fibres of natural origin, such as wool, silk, etc.

It has already been proposed to treat multi-filament synthetic yarns for the purpose of giving them crimps or undulations imparting to them properties of flexibility, heat insulation, etc. comparable with those of wool. To this end, a multi-filament yarn having initially only the spinning twist is over-twisted, then fixed in this twisted state by a thermal treatment at fairly high temperature, so that the material begins to become plastic, and finally untwisted so that the fibres deformed helically by the over-twist tend to separate from one another, freeing their curls.

In this process the thermal treatment has the result of producing the shrinkage to which the synthetic fibres are subject when they are heated to a sufficiently high temperature. Moreover, this shrinkage is regarded as desirable for increasing the deformations of the over-twisted fibres. For certain applications, however, for example for the manufacture of crepe fabrics, I have found that the fact that the yarns have already undergone this shrinkage is a very serious drawback.

The present invention has for its primary object to provide a method of throwing and treating multi-filament yarns which are at least partially synthetic in order to make it possible to give high degrees of twist to such yarns and to preserve in them all the characteristics of uncontracted fibres of plastic material, while giving them suppleness, to work the said yarns easily on frames and looms, both by knitting and by weaving, and to produce in particular fabrics of a beautiful crepe appearance.

The invention also comprises, as new industrial products, multi-filament yarns which are synthetic at least in part and are obtained by this method.

Another object of the invention is to provide a method of producing a fabric with these multi-filament yarns and the invention also comprises, as new industrial products, fabrics produced in this way.

The method of treating the yarns is characterised in that two multi-filament yarns, twisted or over-twisted in the S or Z direction, are assembled and then twisted together at a lower rate than the initial twisting, the composite doubled yarn thus formed being finally subjected to a thermal twist-stabilising treatment, which is carried out slowly under moist heat and at a temperature which is controlled at a fairly low value so as not to cause any shrinkage or contraction of the synthetic fibres in the composition of the yarns, but producing, owing to the action of the moisture, a swelling of the coils or turns of the assembled yarns which stabilizes the doubled yarn.

The twisting of the yarns may reach 2000 to 5000 turns per metre and the assembly twist, in the opposite direction to the initial twist, may amount to several hundred turns per metre.

It is advantageous to moisten the yarns received on a bobbin very considerably after the first over-twisting stage in order to render the yarns supple and enable them to be worked more easily for assembly purposes.

The assembly twist varies little with the count of the yarns, contrary to what would be expected according to Koechlin's law according to which yarns of different denier but having similar properties (i.e., properties which are proportional to their respective denier) have twist inversely proportional to their denier square root. In practice, it ranges between 1400 and 1800 turns per metre. For example, for two multi-filament yarns of "Rilsan" each of 29 denier, over-twisted first at 3000 turns per metre in the S direction or the Z direction, the assembly twist in the opposite direction to the initial over-twist is at the rate of 1700 turns per metre. For the same yarns over-twisted at the rate of 4000 turns per metre it is still 1700 turns.

For two multi-filament yarns in nylon of 20 denier, each over-twisted at the rate of 4300 turns per metre, the assembly twist is 1600 turns per metre. For yarns of nylon of 30 denier, each over-twisted at the rate of 3300 turns per metre, the assembly twist is 1500 turns, and so on.

The thermal treatment is advantageously carried out by subjecting the doubled yarn to the action of wet steam in an autoclave, as high a vacuum as possible having been created in the autoclave before the introduction of the steam, and operation of the vacuum pump been continued during the commencement of the admission of the steam. The said treatment, which is carried out very slowly, takes place under the simultaneous action of the moisture and of a temperature which, measured in centigrade degrees along the celsius scale, is equal at the most to 40% of that which, when applied to the synthetic fibres employed, would cause complete shrinkage thereof without degradation. This latter temperature is, for example, close to 130° C. in the case of the synthetic fibre known as "Polyamide 11" or "Rilsan," which fixes the upper limit of the temperature of the stabilization treatment according to the invention at about 50° C. for this fibre. The period of time that the yarn remains in the autoclave at this relatively low temperature is fairly long. It may be of the order of 2 hours or more. Cooling must be slow and prolonged.

The method of manufacturing a fabric in accordance with the invention is characterised in that, starting from the stabilized multi-filament doubled yarn which comprises uncontracted synthetic fibres, the fabric is woven or knitted by the conventional methods with this yarn and the completed fabric is subjected to a fairly intense thermal treatment in order to cause complete shrinkage of the synthetic fibres.

The shrinkage thus produced in the fabric and not in the yarn imparts remarkable properties to the fabric. It is possible to obtain fabrics giving an impression of thickness and having a very beautiful granite appearance simultaneously with a silky feel.

An example of the use of the invention for the manufacture of the yarn will be given hereunder, it being understood that the example is not to be considered in a limiting sense.

Example I

Taking two multi-filament yarns of "Rilsan" each of 29 denier and uncontracted, such as are supplied by the spinning mill, each of them is over-twisted in the S direction at the rate of 3600 turns per metre. The two yarns over-twisted in this way are received on a bobbin which is then immersed in water in order to moisten the yarns considerably, and render them supple in order to facilitate the subsequent operations. This immersion in water may be eliminated if the room or shop in which the

yarns are worked has a very damp atmosphere. The two yarns are then assembled by reeling-off, using heavy spindles (100 to 150 grams) having well lubricated bearings under a controlled constant tension of about 30 grams. The value of this tension naturally varies with the counts and the over-twist of the yarns.

Assembly is effected by passing the two yarns side by side through the same yarn guide. Equality of the tensions of the yarns during this assembly and the constancy of the tension can be obtained by conventional means, in particular by arranging the yarn guide through which the two multi-filament yarns pass side by side at one end of a compensating rocking lever with counterweight of known type, the opposite end of which carries symmetrically a second yarn guide through which the two yarns issue. Reception of the latter is carried out in **Z** form on bobbins rotating in the **Z** direction. Conversely, if the two yarns had been over-twisted initially in **Z** form, reception would be carried out in **S** form.

The composite yarn thus formed by the two multi-filament yarns over-twisted in the same direction, the **S** direction, is then twisted in **Z** form, i.e. in the opposite direction to the initial over-twist, at 1700 turns per metre and the composite doubled yarn is received on cardboard or metal tubes.

These tubes are placed in an autoclave at room temperature in which as high a vacuum as possible is first created. When the maximum vacuum has been obtained, the temperature of the autoclave is slowly increased while introducing thereinto steam which is as wet as possible. The temperature must not exceed 50° C. Operation of the vacuum pump is continued during the commencement of the admission of the steam and this enables the evacuation of the non-condensable gases to be carried further.

The yarn is left in the autoclave at the aforesaid temperature for at least two hours and a half, after which the temperature is lowered in order to cool the yarn slowly, the yarn being removed from the autoclave at a temperature of about 40° C.

The stabilized doubled yarn leaving the autoclave is placed on cones under controlled tension. It is now ready to be supplied to the fabric manufacturer.

The doubled yarn is mechanically inert and stable. It can thus be easily worked on a frame or loom, both by knitting and by weaving. Moreover, it has retained all its possibilities of contraction for the subsequent thermal treatments. If it is necessary to give the doubled yarn a sighting or fugitive colour, as is often done for doubled yarns of **Z** type in weaving, the colouring matter chosen must be such that it is eliminated in a suitable bath at a temperature below or equal to 70° C. For "Rilsan," there may be cited, for example, the blue "Swan" colorant of Compagnie Française des Matières Colorantes which is classified in the Color Index under No. "Blue D. C. No. 22."

In order to manufacture a crepe fabric with the doubled yarn treated in accordance with the invention, the following procedure may be adopted:

With this doubled yarn there is woven in the usual manner a crepe fabric of the desired type, such as crepe georgette, crepe "Romain," crepe de Chine, satin crepe, tick-crepe, etc. Alternatively, it is possible to use in the loom, in a manner known per se, two doubled yarns, manufactured respectively with yarns, the initial over-twists of which were in **S** form in one case and in **Z** form for the other. Desizing is carried out in a bath, the temperature of which is still fairly low (70° C.) so as to cause only the minimum shrinkage but nevertheless detach and desize the fabric and, if need be, eliminate the sighting colour. The fabric is then wound in a very loose state, taking great care to use supports having low heat conductivity or insulated by non-conductive and non-deformable linings or coverings. It is thus possible to use a beam preferably driven with a very slow rotary movement, so that the weight of the fabric does not show in the same place, or again, hurdles made for example of highly stretched synthetic fabric and on which the fabric is arranged flat, and even wires in cords which are very strong while being very thin and kept under constant tension so that they are always absolutely straight. This last method of support is very advantageous.

The fabric prepared in this way is subjected to a thermal treatment which takes place this time at a fairly high temperature in order to produce the whole of the shrinkage. This thermal treatment is conducted rapidly, contrary to the stabilization treatment of the yarn, which was conducted gently at low temperature. In fact, this is a question of obtaining in the finished fabric the complete shrinkage of the synthetic fibres of the yarn.

In order always to obtain an excellent dyeing affinity and homogeneity of shrinkage, it is important to achieve the following conditions in this thermal treatment:

First, absolute and constant vacuum in the autoclave (no air present),

Second, homogeneity of the temperature at the maximum dwell value chosen, which may be very high, 210° C. or more. (The dwell time at this temperature is determined as a function of the nature of the synthetic fibre and of the thickness of the folds of the fabric; generally, this time is a few seconds), and

Third, complete cooling. (The fabric is removed at a low temperature of about 30 to 40° C.)

The autoclave used is equipped in such manner as to produce considerable temperature gradients, both on rise in temperature, after prior vacuum, and on the fall in temperature.

It is possible to reach the chosen temperature sharply and remain there for the required time in order to obtain homogeneity of shrinkage. It is also possible to rise slowly to a relatively low temperature (125° C. for the synthetic fibres known as "Polyamide 11" or "Rilsan," for example) and then to reach rapidly the much higher temperature chosen. Finally, it is possible to arrange one or more successive stages, which are still at relatively low temperatures, and then rise very rapidly to the chosen temperature, which may be very high (210° C. or more). The period of maintenance at the chosen temperature may be a few seconds only.

According to the effect sought, the steam used may be saturated and even superheated.

The rise in temperature is immediately followed by an ultra-rapid cooling promoted by injections of gas, for example carbon dioxide gas, nitrogen or other gases, and by internal and external cooling of the apparatus.

The thermal shock produced in this way by such a succession of heat and cold enables the following effects to be obtained:

First, maximum shrinkage of the synthetic fibres,

Second, excellent dyeing affinity of the fibres,

Third, good dimensional stability of the fabric, and

Fourth, great suppleness of the fabric.

Fabrics manufactured with yarns having a sufficiently high rate of twist have an appearance of granite and of thickness of the kind of that of ordinary crepe, but whereas the latter has a certain roughness, the fabrics according to the invention, on the other hand, have a "silky" feel.

It will be evident that all the usual treatments, such as finishing, embossing, printing, pressure, wrinkling, stentering, etc. can be applied to the fabric, in the cold state or at suitable temperatures, before or after the thermal treatment described above. It is thus possible to produce quite a large variety of fabrics.

It is also evident that the usual dyeing treatment can be applied to these fabrics; these treatments will preferably take place in a vat. An example of the manufacture of a fabric will be given hereunder.

Example II

A crepe georgette made in the usual manner with doubled "Rilsan" yarn prepared in accordance with Ex-

ample I is desized in a bath consisting of caustic soda at 38° Baumé, 6 cc. to the litre, and sulphonated fatty alcohol. The temperature of the bath is 60 to 70° C. If necessary, it is possible to subject the fabric to treatment in a stentering frame with steam at 80° C. (without any tension on the fabric) so as to make the fabric softer.

The fabric is then wound without any folds on a beam constituted by a kind of drum in the form of a squirrel cage, i.e. similar to the beam of a warping mill, the generatrices of which are glass rods mounted so as to be removable in two circular side plates. After winding the fabric on the rods, some of them or even all the rods except one are removed, so that the wound fabric hangs on the remaining rod or rods. The beams are then placed in the autoclave in which as high a vacuum as possible is produced by means of a liquid-ring rotary vacuum pump for at least 20 minutes. The importance of a good vacuum is very considerable. Steam, coming from a boiler at 160° C. at least, is then admitted under conditions such that the temperature of the autoclave rises very rapidly to about 150° C. This temperature is maintained for a period of a few seconds to one minute and, immediately afterwards, rapid cooling is carried out, either by means of cooling coils of large capacity arranged within the autoclave, or by blowing in nitrogen or other inert gas. The fabric is removed from the autoclave at about 50 to 60° C. It is then ready for the dyeing and other usual operations. Dyeing is preferably carried out in a vat, in order to avoid fractures and not to have any tension on the fabric.

The shrinkage of the synthetic fibres which has been carried out on the manufactured fabric gives this fabric a beautiful crepe appearance. If it is desired to limit the crepe effect, it is sufficient to subject the fabric to treatment in a stentering frame at 120° C. or more, in the dry state or in steam, so as either to bring it to a greater width, or to reduce the crepe grain.

By way of example of the shrinkage obtained:

A 2/29 "Rilsan" crepe georgette woven to a width of 1.12 metres on a loom having 35 dents to the inch, 2 yarns, 68 strokes to the inch, contracts in width to 82 to 83 centimetres in the course of the thermal treatment in the autoclave, subject to the fabric not undergoing any checking of its shrinkage during the preliminary operations of desizing, paring, etc.

Experiments have enabled me to establish that the special thermal treatment of the fabric described in detail hereinbefore constitutes a very important feature of the invention and that the latter can be applied to a wide range of synthetic yarns, provided that at least part of the fibres of which they are constituted is free from any shrinkage.

By reason of the thermal stabilization treatment carried out at a temperature which must never exceed 50° C., the doubled yarns may, if necessary, be only twisted an average amount, or even less than usual.

It is possible to alternate them, during weaving or knitting, with yarns contracted to a greater or lesser extent and twisted to a gerater or lesser extent so as to obtain varied effects, such as crepe, organdie, crepe mousse, tick-crepe, etc., giving a very wide range of fabrics.

Starting with highly twisted yarns enabling a crepe to be manufactured by the method of the invention, it is also possible to obtain either muslin effects or flat fabrics (organdie) which are very soft and drape very well. For this purpose, it is sufficient to compress the grey fabric by pressure between two smooth rolls before the thermal treatment.

In Example I given above, the case has been considered of a 58 denier composite "Rilsan" doubled yarn twisted at the rate of 1700 turns per metre in Z form and produced from two 29 denier multi-filament twisted yarns A and B free from all shrinkage and each over-twisted in S form at the rate of 3600 turns per metre.

Many variants may be conceived.

In order to form the yarn in varied combinations, it is possible to retain one of the twisted yarns or singles, such as A, and replace the twisted yarn or single B for example by:

Either, a yarn C of the same count but having a different twist (2000 or 1000 or 500 turns per metre, etc),

Or else, a yarn D of different count but having an equal twist (18 or 45 denier or another count and twist),

Or else, a yarn E of unequal count and twist,

Or else, a yarn F which is at least partially contracted,

Or else, a contracted fast colour dyed yarn G,

Or else, a yarn H of different material which is at least partially synthetic and capable of contracting differently to a greater or lesser extent and of taking the dye differently, so as to obtain mixed colouring effects.

It will be evident, moreover, that combinations are possible between the characteristics accepted in this way for the second yarn: for example, it is possible to associate with the yarn A a yarn combining the characteristics of the yarns E and G, etc.

Owing to the thermal treatment of the yarn, it is also possible to modify the twist of the single yarns and of the doubled yarn, separately or simultaneously, by increasing or reducing the same, so as to reduce, increase or generally modify the effect on the fabric.

It is possible to oppose twisted yarns or singles, that is to say with the yarn A over-twisted at the rate of 3600 S turns it is possible to associate with it a yarn over-twisted in Z form and having all the above characteristics.

Finally, it is obvious that combinations in the pressure, temperature, speed and stages are possible in the thermal treatment of the fabrics and also the utilization of saturated steam, superheated steam and their successive actions.

The features described in this way enable novel and extremely varied fabrics to be obtained. Starting from one and the same grey fabric, it is possible to obtain finally fabrics whose properties and appearances differ and range, for example, from a crepe georgette to a very soft and relatively flat organdie.

It will yet be noticed that the sudden heat treatment can be applied to fabrics made of yarns which are sufficiently stable in themselves, either by reason of the low amount of their twist or as a result of a mechanical stabilization, not to necessitate a thermal stabilization operation at low temperature.

What is claimed is:

1. A process for producing crepe fabrics by the use of synthetic fibers highly twisted to form so-called crepe yarns, which comprises using at least some fibers free from any shrinkage in a crepe yarn for the fabrication operation and thereafter submitting the fabric obtained to a thermal treatment by steam for a short period at a temperature which produces a complete shrinkage without decomposition of the least heat resistant synthetic fiber used in said fabric, and keeping said fabric loose and unfolded during said treatment.

2. A process for producing crepe fabrics according to claim 1 wherein said yarn is submitted before being manufactured into fabric to a stabilization treatment by wet steam at a temperature measured in centigrade degrees along the celsius scale, which is less than 40% of the celsius value of the temperature producing a complete shrinkage without decomposition of the least heat resistant synthetic fiber used, whereby stabilization produces no shrinkage in said yarn.

3. A process for producing crepe fabrics according to claim 2 wherein said wet steam stabilization treatment has a duration over two hours and wherein said thermal treatment producing shrinkage, is only a few minutes, said thermal treatment being preceded by vacuum setting and completed by injections of an inert gas to promote final cooling.

4. A process for producing crepe fabrics according to

claim 2 wherein said fabric is desized at a temperature substantially the same as the stabilization temperature so as to prevent any premature shrinkage before said thermal treatment is effected.

5. A process for producing crepe fabrics according to claim 2 wherein said fabric is subjected to a slow motion during said thermal treatment whereby folds and marks due to the weight of the fabric itself are avoided.

6. A process for producing crepe fabrics according to claim 2 wherein said yarn is a composite yarn comprising at least two multi-filament single twisted yarns one of which at least is a so-called crepe yarn the high twist of which is over 1800 turns per meter (45 t.p.i.), said one yarn being made of a synthetic shrinkable material provisionally free from shrinkage and wherein said single yarns are doubled together with a doubling twist opposed to the twist of the single yarn having the higher twist, the value of said doubling twist being less than the twist of said single yarn having the higher twist.

7. A process for producing crepe fabrics according to claim 6 wherein two single crepe yarns made of synthetic continuous fibers and twisted in a same direction are doubled together with a doubling twist opposed to their own twist, the value of said doubling twist being approximately 1700 turns per meter (43 t.p.i.) and substantially independent of the single yarns denier.

8. A process for producing crepe fabrics according to claim 6 wherein two different shrinkable single twisted yarns are doubled together, said single yarns having different shrinkage capacities whereby the crepe texture of the fabric is enhanced.

9. A process for producing crepe fabrics according to claim 8 wherein said single yarns are over twisted at different rates.

10. A process for producing crepe fabrics according to claim 8 wherein said single yarns have different deniers.

11. A process for producing crepe fabrics according to claim 8 wherein a first single yarn free from any shrinkage and a second single yarn at least partly shrunk and casually fast color dyed are doubled together.

12. A process for producing crepe fabrics according to claim 8 wherein said single yarns are made of different materials, having different shrinkage and dying capacities.

References Cited in the file of this patent

UNITED STATES PATENTS

2,134,022	Bell	Oct. 25, 1938
2,241,442	Bell et al.	May 13, 1941
2,369,395	Heymann	Feb. 13, 1945
2,979,883	Waltz	Apr. 18, 1961
2,980,492	Jamieson et al.	Apr. 18, 1961
3,022,565	Fitzgerald	Feb. 27, 1962

FOREIGN PATENTS

478,207	Great Britain	Jan. 13, 1938
804,151	Great Britain	Nov. 12, 1958