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PROCESS FOR PRODUCING KNITTED FABRIC

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2 Claims. (Cl. 66—201)

The present invention relates to a process for producing knitted fabric and, more particularly, to knitted nylon fabrics, especially hosiery fabrics, possessing increased elasticity.

The elasticity of a knitted fabric is dependent on several characteristics of the fibre or fibres comprising the same and the fabric itself, namely, strength of fibre, longitudinal elasticity of fibre, angular or bending elasticity of fibre, the number and shape of loops or stitches in the fabric and position of loop in the fabric. Normally, a knitted hosiery fabric contains well rounded stitches or loops which lie flat in the fabric and, as a result of the loop formation, the fabric is limited in its stretch characteristics. For example, the stretch of full-fashioned nylon hosiery runs approximately 70% in either direction. This stretch is known as fabric stretch and is due to the nature of the construction of fabric in that the loops become deformed when stress is applied. With nylon, or other yarn of good resiliency, the loops return to their normal shape when the stress applied to stretch the fabric is released.

Greater fabric stretch than 70% can be attained in nylon fabric if sufficient stress is applied thereto. However, under this condition, the yarn in the fabric is itself stretched excessively and the stress necessary to accomplish this is uncomfortable under actual wear condition. Furthermore, repeated stretching under such conditions necessarily induces a loss of shape in the knitted fabric. These difficulties are particularly apparent in ladies' nylon hosiery where considerable strain is imposed on the fabric about the knee area.

It will be apparent from the foregoing that the production of knitted nylon fabric, particularly hosiery fabric, possessing increased elasticity, is highly desirable and the principal object of the present invention is to provide such knitted nylon fabric of increased elasticity.

Another object of the invention is the provision of knitted fabric which offers increased comfort in wear under stress conditions and in general possesses an improved overall appearance.

A further and more specific object of the invention is to provide a knitted nylon hosiery fabric which, by virtue of its increased elasticity, possesses a greater latitude of wear and covers a wider range of leg and foot sizes.

Still another object of the invention is the provision of novel procedures for producing knitted nylon fabrics possessing increased elasticity and comfort in wear and improved appearance.

Other and more specific objects will appear hereinafter.

The improved knitted fabric is obtained, according to the present invention, by a process which includes the steps of first presetting nylon yarns, twisting one yarn in one direction to impart a right twist torque thereto and twisting another yarn in the opposite direction to impart a left twist torque thereto, sizing said twisted yarn to hold the torque therein dormant temporarily while knitting, forming a fabric from the twisted yarn by alternately knitting at least one course first with the yarn which has

been twisted in one direction and then with the yarn which has been twisted in the other direction and, thereafter, removing the size from said fabric to release the torque in said twisted yarn.

In contrast to conventional knitted hosiery fabrics which possess a pattern of uniform loops or stitches that lie in a plane or flat surface, the loops or stitches in the fabric of the invention turn over on edge when the size is removed, due to the torque in the yarn, and thus the face of the fabric shows a series of loop edges rather than open stitches. The torque of the yarn also causes a fabric torque, so that the chains of loops or wales move in a diagonal direction to regular or normal fabric. In other words, the loops in the fabric take a different position than in conventional knitted fabrics, due to the force of the torque and, as a result, more loops or stitches automatically form in a given area. Thus, for example, where a normal knitted fabric may finish five inches long, a fabric of the invention could reasonably finish only two and one-half inches long. However, the latter fabric has the ability to stretch up to 250%, whereas the stretch of the normal fabric is about 70%, as noted above.

In view of the torque created in the fabric, wherein loops form in a diagonal direction to normal stitches, it is essential to alternate oppositely twisted yarn, i. e., yarn with right and left twist torque, in the courses forming the fabric. For example, forty-eight courses can be knitted with yarn having left twist torque and then alternated with forty-eight courses of yarn of right twist torque. Alternately, the fabric may be knitted one and one, or two and two, i. e., by knitting one or two courses, respectively, with yarn twisted in one direction and then knitting one or two courses with yarn twisted in the opposite direction. In short, the number of courses knitted with each yarn can be varied at will, e. g., from at least one to 400 and even higher, and depends primarily on the nature and ultimate use of the fabric. In all cases, however, the fabric produced according to the invention, using oppositely twisted nylon yarn, possesses a herringbone pattern which is more pronounced the larger the number of courses alternately knit with oppositely twisted yarn and which improves the stretch characteristics, appearance and comfort in wear.

According to the process of the invention, the nylon yarn must be initially preset, otherwise the twisted yarn does not produce the angularity of stitch direction which gives the desired results. Nylon yarn is thermoplastic and by presetting the same, i. e., by treating the yarn in high wet heat, before twist insertion, the individual filaments are shaped or set in parallelism with each other. Accordingly, when twist is inserted, a permanent torque takes place in the yarn which has sufficient force to create diagonal stresses, due to the tendency of the yarn to seek its original shape of filament parallelism. The presetting operation also serves to prevent further shrinkage of the yarn in subsequent operations and avoids the possibility of permanently setting the twist in the yarn, and thereby eliminating the torque necessary to give the desired results, in the event the yarn is exposed to further heat treatment after it has been twisted.

The conditions for presetting the nylon yarn with wet heat, i. e., steam or hot water, will be readily appreciated by those skilled in the art. Normally, this operation may be effected by exposing the yarn to steam having a temperature within the range of 220° F. to 270° F. for a period of time between 15 and 60 minutes, or hot water at a temperature between 190° F. to 212° F. for between 10 and 60 minutes, although these conditions can be varied, depending upon other operating features.

In a typical presetting operation, the yarn is first wound onto a bobbin, tube or cylinder made up of a material that will withstand the presetting temperature.

The resulting package of nylon yarn is then placed in an appropriate retort and subjected to treatment with steam at a pressure of 25 pounds per square inch, gauge for for at least 15 minutes to give a satisfactorily preset yarn. Substantially similar results can be obtained by treating the yarn in skein or cake formation with steam and/or hot water, although presetting the yarn on package is preferred.

After the presetting operation, the yarn is twisted sufficiently to insert therein the torque necessary to produce the desired fabric. The amount of twist inserted in the yarn can be widely varied and depends primarily on the size of the yarn being treated and the use to which the fabric will be put. Generally speaking, however, when using nylon yarn varying from 20 denier to 100 denier, a twist of from 32 turns to 9.5 turns per inch will give satisfactory fabrics. For example, a highly desirable fabric is obtained by alternately knitting equal multiples of courses with oppositely twisted 40 denier nylon yarns containing 15 to 20 turns per inch.

The twist imparted to the yarn should be of the same degree in both directions if the number of courses in the bands are to be equal. Otherwise, if the number of courses in bands are unequal to form a different pattern fabric, different twist factors in right and left directions are necessary to balance the fabric.

After the desired twist has been inserted in the yarn, a coating or sizing is applied thereto preliminary to the knitting of the desired fabric. The sizing binds the filaments of the yarn together, deadens the liveliness thereof and restricts the action of the torque imparted thereto sufficiently to avoid kinking in the knitting operation. After the fabric has been knit, the size is removed in any conventional manner, e. g., by scouring, and the fabric which, up to this point, has the appearance of conventional knitted fabric, assumes a herringbone pattern, due to the release of the torque in the yarn.

Any of the sizes normally used in knitted and other textile operations can be used for the purpose of sizing the yarn according to the process of the invention. However, particularly desirable for use in the present invention is the polyvinyl alcohol size known in the trade as "PM 90."

As will be appreciated, the quantity of size utilized can be widely varied, the optimum amount thereof depending upon other operational details, e. g., nature of the size or yarn, or amount of twist. Broadly speaking, however, enough size should be utilized to retain the right or left twist torque in the yarn and usually from 5% to 7% solid size or weight of yarn is sufficient.

It will be understood that the nylon yarns, preset, twisted and sized, as above described, can be knitted in any suitable way into the desired fabrics. For example, the yarn can be knit on circular or flat knitting machines to give seamless or full-fashioned hosiery. A particulary advantageous product is obtained by replacing the welt of otherwise conventional knitted hosiery with a welt construction comprising alternate series of courses of oppositely twisted nylon yarn, according to the present invention. A welt of this nature has been found to possess substantially increased elasticity which relieves the strain on the hosiery under stress conditions, for example, when the wearer's knee is flexed or when the wearer is in a sitting position, and permits the hosiery to return to its original shape without bagging when the wearer changes from a sitting to a standing position.

It will also be understood that the knitted fabric of the invention may be exposed to any conventional after-treatment upon removal of the size. For example, knitted hosiery prepared according to the invention may be dyed, finished, extracted and/or boarded.

The invention, as described above, is further illustrated by the following examples.

Example I

Forty denier raw nylon yarn is drawn from pirn packages and wound into skeins. These skeins are then placed in a retort and subjected to 30 pounds of steam pressure at a temperature of 275° F. for a period of approximately 30 minutes. This treatment preshrinks and presets yarn permanently, provided higher temperatures are not used in subsequent operations. After a short lagging period, the yarn is transferred from skein formation onto a twister supply bobbin. The yarn then has 15 turns per inch inserted—half of the quantity of yarn having twist inserted in a right or counterclock direction and the other half in the opposite direction.

Following the twisting operation, the yarn is sized with an application of polyvinyl alcohol size. 6% of size is applied to yarn in two operations of sizing, applying 3% in each operation. The yarn is sized by the common method of passing yarn over size dip roll onto large take-up package. After each sizing operation, the yarn is lagged for 16 hours in an atmosphere of 50% relative humidity at a temperature of 84° F. and force-dried in oven for 3 hours at a temperature of 160° F. Following the last drying period, the yarn is lagged for 4 hours in a relative humidity of 62% at 78° F. to allow yarn to reach an equilibrium of a moisture regain of approximately 4%. The yarn is then transferred onto a coning package and in this operation, 4% oil is applied by passing over oil roll.

In the knitting operation, the yarn is set up on machine under two carrier systems, one cone package of yarn having right twist torque and the other cone package having left twist torque. In the weld area, the yarn is knit alternately 48 courses right twist torque and 48 courses left twist torque. The fabric in this state appears very similar to ordinary knit fabric, due to the size holding torque in yarn dormant. When the fabric is subjected to steam or hot water, the size breaks down and torque of yarn comes into action contracting fabric 100% or more. The torque causes loops to turn over on edge and move in a diagonal direction as compared to perpendicular direction in normal knitted fabric.

Example II

Forty denier raw nylon yarn is drawn from pirns onto cylinders, bobbins or some constricting package under low tension. These packages of yarn are then placed in a retort and are subjected to 30 pounds of steam pressure at a temperature of 275° F. for a period of approximately 30 minutes. The treatment presets yarn permanently, provided higher temperatures are not used in subsequent operations. Thereafter, the procedure described in Example 1, involving twisting, sizing and knitting, is carried out to give a product similar to that of Example 1, possessing highly desirable elasticity characteristics.

While the invention is of particular advantage in connection with the production of hosiery fabrics, it will be appreciated that the invention is broadly applicable to the production of any type of knitted nylon fabrics where increased elasticity or fabric stretch is a desirable characteristic. Likewise, it is to be understood that the term "nylon," as used herein, refers to the well-known synthetic linear polyamides, as exemplified in U. S. Patent No. 2,157,116, issued May 9, 1939, to Wallace H. Carothers, and similar thermoplastic polymers which, as yarns, are capable of being preset, twisted and knit into fabric according to the invention.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that this invention is not to be limited to the specific embodiments thereof, except as defined in the appended claims.

This application is a division of my copending application Serial No. 367,776, filed July 13, 1953, which is a continuation-in-part application of Serial No. 342,709, filed March 16, 1953.

I claim:

1. A process for producing knitted nylon fabric of substantial stretchability, which comprises presetting a continuous filament nylon yarn and then twisting said yarn to the left to impart substantial liveliness and twist torque thereto, presetting another continuous filament nylon yarn and then twisting said yarn to the right to impart substantial liveliness and twist torque thereto, to produce two oppositely twisted markedly lively but uncrimped and uncoiled continuous filament nylon yarns, applying a size to said oppositely twisted, lively, twist torque yarns to subdue temporarily the said liveliness and restrict the action of the torque imparted thereto, knitting said left and right twist yarns in alternation to form a fabric, and thereafter removing said size to release the torque in the yarn.

2. A process according to claim 1, in which the said lively, twist torque yarns are sized with a sufficient amount of a polyvinyl alcohol size to retain the twist torque in the yarn.

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