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DESCRIPTION

FIELD OF THE INVENTION

[0001] The present invention relates to a composite stretch yarn and the stretch woven fabric comprising such yarn. The invention also relates to an apparatus and a method of producing said stretch yarn.

BACKGROUND OF THE INVENTION

[0002] More specifically, this invention relates to a stretch yarn having a composite core and a cotton fibres sheath; a preferred stretch fabric is denim.

[0003] There are several ways to make stretch fabrics in woven textile industry; mono stretch fabrics include elastic yarns only in warp or weft direction, in bi-stretch fabrics both in warp and weft directions elastic yarns are used.

[0004] The most common way of producing stretch fabric is weft (filling) stretch fabrics. Weft stretch fabrics have non elastic warp yarns and elastic weft yarns. In these fabrics different kind of elastic weft yarns such as core spun elastane yarns, twisted elastane yarns, intermingled or twisted synthetic elastane yarns etc. are used. Elastic yarns are well known; the earlier fabrics, such as in US 3,730,679 comprised stretch yarns that contained one elastomeric fiber and cotton fibers. These yarns provided fabrics with low recover after stretching: a typical elongation of these fabrics is of 15 to 40% in the weft direction, but the recovery characteristics are very low, usually as low as about 90% (ASTM D3107), i.e. the fabric has a growth of about 10%. To solve this problem, woven stretch fabrics comprising polyester bicomponent fibers have been disclosed, for example in U.S. Pat. Nos. 5,922,433 and 6,782,923. The fabrics disclosed in these references are comprised of bare bicomponent fibers and have strong synthetic appearance and hand due to the exposure of the bicomponent fibers on the fabric surface.

[0005] There is another way to make stretch fabric without using elastane, in this type of fabrics usually elastic type of synthetic yarns are used like PBT, PTT or T400, i.e. a bicomponent PTT/PET.

[0006] Stretch denim fabrics made from a bi-component polyester and cotton are described in US. Pat. Nos. 7,310,932 and 5,874,372. However, fabrics made from elastic polyester lack good elasticity.

[0007] US 20080268734 discloses an elastic composite yarn comprising a core bi-component fiber in a cotton fibers sheath; the core comprises an elastic fiber and an inelastic fiber loosely wound around the elastic one. The purpose of the inelastic fiber is to improve the recovery properties of the yarn, so as to increase the recovery properties of the fabric including the above mentioned yarns. Drawbacks of this embodiment are that the inelastic fiber of the core is also acting as a block to the stretch of the elastic fiber and that the bundle of inelastic fibers appears through the cotton sheath in the final fabric.

[0008] The surfacing of the elastic core in the inelastic fibers sheath also occurs in other types of stretch yarns.

[0009] Therefore, there is the need to improve the known techniques and to provide a stretch yarn that can provide stretch fabrics with reduced fabric growth and still having a good stretch performance.

SUMMARY OF THE INVENTION

[0010] It is an aim of the present invention to solve the above problems and provide yarns and fabrics having great elasticity and excellent stretch recovery.

[0011] A further aim is to provide a stretch yarn that is completely covered by the fibres sheath, preferably a cotton fibres sheath, without the core surfacing through the fibres, especially after use.

[0012] Such an aim is obtained by means of the yarn according to claim 1. According to the invention the yarn has a stretchable core comprising at least two fibers, or bundle of fibers, having elastic properties and wherein at least one has excellent recovery properties.
[0013] A further object of the invention is a fabric, particularly a denim fabric, containing a stretch yarn as above defined.

[0014] The invention also relates to a method of producing a stretch yarn according to claim 10, said method comprising: providing a stretchable core comprised of first and second fibers that have elastic properties, said fibers being connected together at least a plurality of points; wherein said first fiber is an elastomer and said second fiber is a polyester based (co)polymer, said second fiber being in the range of 60-90% (w/w) of the stretchable core; tensioning said fibers and providing a sheath of inelastic Staple fibers to completely cover said core. Staple

[0015] With the wording “first fiber” or “second fiber” of the core it is meant a bundle of fibers, such as in elastane and in T400 elastic fibers; with the wording elastic properties it is meant that in the fibers some elasticity is always present and that in some preferred embodiments further elasticity can be developed with a thermal treatment.

[0016] An apparatus for producing a yarn as here disclosed comprises means for housing at least a cotton roving and a composite core bobbin for each spool and spindle, and further comprises tensioning rollers to draft the composite core yarn before feeding it together with the cotton staple fibers to a spindle or equivalent device.

[0017] Further objects of the invention are a fabric including the invention yarn and a garment that contains the above mentioned fabric. Another object of the invention is a stretchable core according to claim 14.

[0018] According to an aspect of the invention, the second fiber is a bi-component polyester fiber, preferably a PTT/PET fiber.

[0019] The two fibers, or bundles of filaments, must be connected, i.e. bound, together to provide a final elastic “core yarn” that combines the technical characteristics of the two, or more, bundles of filaments. More particularly, the first fiber, that is an elastomer, has very good elastic and stretch properties, while the second fiber is a polyester based fiber having excellent recovery properties.

[0020] In general, the first fiber can be stretched at least 400% and the second fiber is less elastic but can be stretched at least 20%; an important property of the second fiber is its recovery property, at least 93%, preferably at least 96% or 97% or higher of the fiber.

[0021] Concerning the connection of the two fibers, this should be carried out at least at a plurality of points.

[0022] According to the invention, the first and second fibers are connected together by intermingling or co-extrusion or by twisting. Especially when the second fiber, too, is made of two different polymers, e.g. it is an elastomultiester such as PTT/PET and similar filaments, such as those disclosed in EP 1846602, coextrusion of the three polymers appears to be an advantageous production process.

[0023] Intermingling is carried out according to the known techniques of the art, such as open or closed intermingling jets. The system is arranged to provide a number of connecting points that is within the range of 50 to 200 points per meter, preferably 80 to 120 points per meter and most preferably 95 to 105. The method of measuring the number of intermingling point is by direct count of the combined fibers; in the latter method, the elastic core “yarn” is put on a black or dark surface and is inspected by eye, possibly with a magnifying glass, and the connecting points in a meter of yarn are manually counted. As recited in claim 1, in an exemplary embodiment the core fibers of the invention yarn are connected to each other by twisting. This means that twisting is not carried out loosely (i.e. with about 75-125 twist per meter, as in above quoted prior art US734) but that the number of twists per meter is sufficiently high to provide a connection between the fibers.

[0024] For twisting of a bicomponent fiber and elastane a preferred range is 300-600 twist/meter, preferably 350-550, in general at least 400 and most preferably 450-525 twist per meter.

[0025] In a preferred embodiment, before connecting the first and the second core fibers at least the first, elastic, fiber is stretched, so that after interconnection the released fiber will recover and reduce its length. This will result in an amount, or in a length, of the second fiber being available for stretching of the the core, multicomponent, yarn; the composite yarn can be significantly stretched even if one of the two fibers (so called second fiber) is less or much less elastic than the other, first, fiber. Preferably, the first elastic fiber is stretched with a draft ratio of 2.5 to 4.2, more preferably 3.0 to 4.0 times and most preferably about 3.5. It should be noticed that in the exemplary embodiment the interconnected first and second fibers of the core of the invention yarn act substantially as a single fiber, contrary to what happens in prior art embodiments. The high recovery properties of the second fiber will result in the invention yarn, and, more particularly, in the final fabric, being at the same time stretchable
and with excellent recovery.

[0026] The non elastic sheath or cover is made of non elastic fibers, namely staple fibres and preferably the fibers are cotton fibers.

[0027] The amount of the second fiber in the composite elastic core of the yarn, i.e. the sum of all elastic fibers, is 60% to 90% by weight, preferably 73% to 87% by weight on the total weight of the core fibers.

[0028] According to the invention, the composite elastic core is stretched before being spun with the staple fibers, the draft ratio of the composite core is within the range of 1.05 to 1.16 and preferably from 1.12 to 1.14. The draft or stretch ratio is generated by the difference of the speed of the rollers that feed the composite core fibers to the spinning device and is calculated as the ratio of the speed of the faster roller and the speed of slower roller (faster/slower); the speed is that of a point on the cylindrical surface of the roller. When the composite core is drafted in the preferred range of 1.12 to 1.14 the resulting yarn is totally free from surfacing of the core through the staple fibers and the yarn can provide a final fabric having an even color effect and a hand that cannot be distinguished from a corresponding fabric free from stretchable yarns.

[0029] The amount of elastic core (elastic fiber and polyester based fiber (mono or bi-component) in the yarn is depending on the English cotton count (NE) of the yarn and depending on the title, e.g. the deniers, of the core fibres; in a preferred embodiment, the yarn NE count is within the range of 5 to 25 (1181-236 dtex) and the amount of core fibres is from 8 to 35% (ww) on the total weight of the yarn, preferably 8 to 30%. Possible combinations of the two fibers are, in the case of Hvis, or T400, and elastane (Lycra), the following ones (in deniers) 70/40; 70/70; 50/40;50/20; 30/40;30/20; 70/20; 50/70; 30/70, the first value refers to the denier of Hvis or T400 and the second one to denier of elastane. The range of the amount of core fibres can be as low as 3.5-23.6% (ww) in the case of the combination 30/20, where the NE is in the range 6-40 (984 - 148 dtex) and the draft ratio is 1.14. A combination 70/70 will provide useful yarns with a draft ratio of 1.14, NE of 6-20 (984 - 295 dtex) and an amount of core fibers within the range of 8.9 to 29.7.

BRIEF DESCRIPTION OF THE FIGURES

[0030] The invention will now be further disclosed in greater detail with reference to the drawings enclosed for non-limiting purposes, in which:

- fig. 1a and fig. 1b are a schematic view of a stretch yarn according to the invention;
- fig. 2 is a schematic front view of an apparatus suitable for the production of a composite core stretch fiber;
- fig. 3 is a side view of an apparatus for the production of the stretch yarn of the invention.

DESCRIPTION OF AN EXEMPLARY EMBODIMENT

[0031] In the present description, the term "ww" means (as is known in the art) weight on weight, e.g. as in the amount in weight of first fiber with respect to the total weight of the core fibers of the invention yarn. The word "(co)polymer" means "polymer or copolymer".

[0032] With reference first to fig. 1a and fig. 1b, the stretch yarn 1 of the invention comprises a stretchable core 2 and an inelastic fibers sheath 3 that covers core 1; the stretchable core 1 comprises first and second fibers 4, 5, more precisely bundles of filaments, that have elastic properties, more particularly, first fiber 4 is an elastomer known in the art and second fiber 5 is a polyester based (co)polymer, known in the art. First and second fibers are connected to each other or secured together at least at a plurality of points P. One of the fibers is more elastic than the other and the other fiber has greater recovery than the first one.

[0033] Fig. 1a refers to an embodiment in which the fibers are coextruded and fig. 1b to an embodiment in which the fibers are intermingled; the coextruded fibers are connected substantially continuously and the intermingled fibers are connected at a plurality of points P.

[0034] Suitable materials for the first fiber 4 are polyurethanic fibers such as elastane, spandex and those fibers that have similar
The second fiber 5 is a fiber with limited elasticity level (less than the first fiber but at least 20%) but high recovery properties (more than the first one); as previously mentioned, said second fiber amount with respect to the total core combination of fibers, is in the range of 60-90% (w/w) of the weight of stretchable core fibers.

Suitable materials are polyesters and elastomultiesters such as PBT and the bicomponent polyesters PTT/PET and similar disclosed e.g. in EP 1846602. Preferably, as shown in figures 1 a and 1 b, second fiber 5 is a PTT/PET bicomponent elastomultiester, such as the products commercially available from Huvis e.g. as Zentra, or as T400 from Invista.

Suitable fibers for the sheath 3 are fibers such as cotton, wool, polyester, rayon nylon and similar, preferably cotton staple fibers, to provide a natural look and a natural hand to the elastic yarn; as previously mentioned, the sheath 3 is provided in such a way as to completely cover the stretch core 2. To this end, any suitable process is used to cover the core 2 with the cotton fibers 3; a preferred process is ring spinning.

The amount of cotton in the final yarn (core + sheath) typically is within the range of 60-95%, preferably 70-92% (w/w), according to the deniers of the core 2. The amount of twist per inch is also depending on the features of the yarn; generally, for the yarns according to the present invention, in the formula \( T/\text{inch} = \alpha / \text{NE} \), where \( T/\text{inch} \) is the number of twist per inch, \( \alpha \) is the twist multiple and \( \text{NE} \) is the English cotton count; the value of \( \alpha \) is within the range of 4.0 to 5.0, preferably of 4.4 to 4.6, most preferably 4.5.

As will be better explained hereinafter, the multicomponent core 2 is stretched with a draft ratio of at least 1.05, preferably of at least 1.1 and most preferably of 1.14 prior to being spun with the fibers to provide sheath 3. The tensioning step results in a perfect centering of the core in the sheath and in the possibility of having better cotton coverage of core "yarn" in the final yarn (core + cotton cover/sheath); the yarn thus obtained as well as the fabrics produced with said yarn, have a look and a feel that cannot be distinguished from a yarn or a fabric not provided with the stretch core while at the same time being provided with excellent elastic and recovery properties.

Tests carried out on fabrics made with the stretch yarns according to the invention and corresponding fabrics made with stretch yarns comprising only elastane as core fiber show that the recovery of the invention fabric is at least 50% higher than the recovery of the control fabric. Recovery improvement can be up to 100%.

It is believed that this excellent result is due to the combination of three elements together to achieve the best performance. The invention combined a fiber (possibly composite) with very high recovery performance elastic yarn but with weak elasticity level (such as Zentra or T400 - PET/PTT) together with an elastic fibre, such as elastane (lycra,dorlastan etc.), with great elasticity levels.

The two fibers are attached together with intermingling, twisting or co-extrusion technology and this combined core yarn has been put inside of the cotton sheath. In this way a yarn that has the best elasticity, the best recovery and with excellent cotton touch was obtained.

Twisting can be carried out in a way known in the art, such as e.g. by Ring twisting or Hamel or 2for1; intermingling is carried out, according to the known art or according to the following method.

A T-400 yarn package is loaded on the creel (not shown). The T-400 yarn is guided to a feeding roller and wound around the roller five times. An elastomer, e.g. Elastane yarn package is loaded on draft rollers to be provided a draft, and the Elastane yarn is guided through a sensor and combined with T-400 yarn at a feeding roller. From the feeding roller the combined fibers are guided to an intermingling Air Jet 18, e.g. a Sincro Jet intermingling device from Fadis, Italy.

Subsequently, the intermingled fibers are guided to a lubricating station and are eventually wound on composite yarn package 6 that is shown in fig. 2 and 3 after having being mounted in the invention apparatus. The system is arranged to provide a number of connecting points that is within the range of 50 to 200 points per meter, preferably 80 to 120 points per meter and
most preferably 95 to 105.

[0046] Figures 2 and 3 show a preferred embodiment for the production of a yarn according to the invention.

[0047] In a typical composite core 2 as above disclosed, comprised of T400 and elastane, the T400 fibers have 75 Denier (83 dtex) and elastane fibers have 40 or 70 Denier (44 - 78 dtex). The yarn count of this composite core is 81,5 or 90 denier (91 - 100 dtex) which is 2,25-7 times thicker than regular corespun elastane yarns.

[0048] Due to the dimensions of a T400+Elastane composite core 2, the relevant bobbin is much bigger than a bobbin of elastane; therefore, as shown in figures 2 and 3, bobbin 6 of core 2 is located on a frame 9 close to cotton roving spool 7.

[0049] T400+Elastane composite core "yarn" 2 is guided between two tension bars 10 that are used to give a low pre-tension to the yarn, just to align and straighten yarn 2. This is very useful in view of the nature of composite core "yarn" 2, especially when the composite yarn is obtained by intermingling of two fibers, namely T400 and elastane. From pre-tension bars 10, composite core 2 is fed to two driving rollers 11 on which a weight 12 is placed; core 2 is guided between the driving rollers and the weight 12 to avoid free movement of the core yarn with respect to the rollers 11; however, other suitable means for imparting a controlled speed to the core yarn 2 may be used instead of the combination of rollers 11 and weight 12, e.g. means such as draft rollers known in the art.

[0050] The advantage of the above disclosed arrangement is mainly in the fact that the same apparatus can be used also to prepare a standard elastane core yarn in this case the elastane fibre is loaded in a package that is placed on the rollers 11 in the place of weight 12.

[0051] From the first drafting arrangement 11, 12, core yarn 2 is guided to a rolling guide 13 and from it to draft rollers 14, that are the foremost couple of a plurality of drafting rollers for the cotton roving 8, known per se in the art. Cotton roving 8 is guided from spool 7 in front of pre-tension rollers 10, tension rollers 11, into a first guide 15 and a second guide 16; as can be seen in fig. 3, guide 15 is staggered to the front of the apparatus with respect to second guide 16 in order to create a tension in the roving and keep the roving in a fixed position, avoiding that the roving moves freely.

[0052] From guide 16, cotton roving 8 is sent to draft rollers 14. Draft rollers 14 are in common between core yarn 2 and roving 8.

[0053] According to the invention, core yarn 2 is tensioned before being coupled with the cotton roving, the tensioning or stretching is obtained by means of the speed difference between rollers 11 and rollers 14, i.e. the speed difference between rollers 11 and the last draft roller 14 create the draft ratio in composite core "yarn". As mentioned, the draft ratio of the composite core is within the range of 1.05 to 1.16, preferably in the range of 1.10 to 1.14 and most preferably from 1.12 to 1.14.

[0054] The above draft ratio is calculated as the ratio of the speed of rollers 14 vs. the speed of rollers 11, where the speed is the angular speed on the surface of the rollers.

[0055] It should be noticed that also pre-tensioning bars 10, contribute to obtaining the required draft ratio. The additional pretension bars 10 are useful in increasing the draft ratio from 1.05 to 1.14 because they provide an alignment and slight tension of the composite yarn 2, thus helping in the further stretch step. This results in the extreme accuracy with which the composite core "yarn" 2 is kept in the center of the final yarn 1.

[0056] Use of additional guide 15 and its staggered position with respect of guide 16 also allow to feed the cotton roving always at the same position and to prevent the moving of cotton roving during the long run production. The combination of a better control in keeping the position of cotton roving 8 and a high tension on composite yarn 2 makes it possible to keep core 2 always in the center of the final yarn 1 and to perfectly cover the core with the staple fibers 3.

[0057] The two portions of final yarn 1 leaving draft rollers 14 are fed through guide 17 and spun together at spinning device 18, known per se in the art and comprising in one embodiment ring, traveler and spindle.

[0058] Any spinning method to produce a yarn 1 having a core 2 centered in a sheath 3 is within the scope of the present invention. Such methods include e.g. covered yarn system (using machinery by JGBT, Menegato, OMM, RATTI, RPR, Jschikawa) or twisting machines (using machinery by Hamel, 2for1 by Volkman, SiroSpin by COGNETEX or Zinser).
[0059] The elastic yarn produced as big weft packages as above described with reference to figures 2 and 3 can be used in production of elastic denim fabric and garments, especially as weft yarn. Machinery and methods of producing denim are well known in the art, as an example, Morrison Textile Machinery or Sulzer Machinery or modifications thereof may be used to produce a denim fabric with great elasticity and excellent stretch recovery.

[0060] The obtained fabric is then treated with finishing processes, e.g. additional processes can be carried out such as a thermal treatment of the stretched fabric to set the required stretch value for the fabric itself. These treatments are known in art and are carried out in function of the final characteristics required for the fabric.

[0061] The invention will now be further disclosed with reference to the enclosed non-limiting examples.

EXAMPLE 1

Yarn count test

ZWEIGLE L 232 (Zweigle, Germany)

[0062] 109 meters (120 yards) of yarn is wound to hank form using a Zweigle device. The hank was weighted using a Metler PM600 (Metler, Switzerland) weight scale. The yarn count was calculated using dtex count system chart. This test was repeated 5 times for consistency and accuracy.

EXAMPLE 2

Yarn evenness test

USTER TESTER 4 (Uster, Switzerland)

[0063] Yarn package was set on the creel of the Uster tester 4. The following parameters were set:

Yarn name was entered

*Yarn* was selected as the setting for material class

Yarn count was entered

*Uster statistic section can not be accepted* has been selected

*Cotton* was entered as the setting for Raw material

The value of Fibre micronare was entered

[0064] UT 4-S section, Numbers of packages was set as "5"; number of tests was set as "1"; test speed was set as "400 m/min"; testing time was set as "0,5"; measurement slot was set as "automatic"; sucker was set as "60%"; test mode was set as "normal"; diagram resolution was set as "standard"

EXAMPLE 3

Strength, elasticity and breaking force measurement
USTER TENSORAPID -3 DEVICE (Uster, Switzerland).

[0065] Yarn was placed on the creel of the Uster tensorapid -3 device.

[0066] Yarn was passed through the spring guide.

[0067] The parameters entered in the program were:

*Synthetic yarn* option was selected

Measured yarn count (Example 1) was entered as Dtex yarn count system

Number of the test was set to "50"

Testing speed was adjusted to "2000 m/min"

Clamp pressure was set to "30%"

Suct-off pressure in the device was set to "50%"

Blowing jets was set to "off" position

Yarn change was set to "IX" position

Yarn tensioner was set to "out" position

Type of measure was set to "test automatic" position

EXAMPLE 4

**Corespun Cotton + T-400**

[0068] 150 Denier (167 dtex) -400 (Invista) as core yarn and cotton as sheath was Core Spun in yarn mill Rieter Type G30 (Rieter, Germany) equipped with Amsler core spinning device (STG4000, Amsler, Switzerland). T-400 yarns were rewinded from big cylindrical cheese packages to smaller cheese packages. The T-400 yarn was directly fed to the center of the cotton drafting area. Draft ratio was set to "1,1". The English Yarn count (hereinafter "Ne") 10/1 (591 dtex) yarn was spun. The yarn twist was set to "TM 4,2". The yarn spools were wound in Savio Orion packaging machine as a weft packages.

[0069] See Table 1 for the result of measured strength, elasticity and breaking force; yarn count test; and yarn evenness test as described in EXAMPLES 1, 2, 3.

EXAMPLE 5

**Corespun Cotton + ELASTANE**

[0070] 70 Denier (78 dtex) ELASTANE (Lycra, Invista) as core yarn and cotton as sheath was Core Spun in yarn mill Rieter Type 30 (Rieter, Germany) equipped with core spinning device. ELASTANE is supplied in packages that can be loaded directly to corespinning frames.

[0071] Draft ratio was set to "3,67"; Ne "12/1" (492 dtex) yarn was spun; the yarn twist was set to TM "4,5"; the yarn spools were wound in Savio Orion packaging machine as a weft packages.
[0072] See Table 1 for the result of measured strength, elasticity and breaking force; yarn count test; and yarn evenness test as described in EXAMPLES 1, 2, 3

EXAMPLE 6

T-400+ELASTANE

[0073] Preparation of the core yarn:

70 Denier (71 dtex) T-400 Invista yarn was intermingled with 40 Denier (44 dtex) ELASTANE yarn using a intermingling machinery (Sincro Jet, Fadis, Italy).

Counting the number of the intermingling points: 1 meter of yarn was placed on a black cloth; the intermingled points were counted by eye. The test was repeated 5 times and average number was defined as the intermingled points per meter.

[0074] The draft ratio of ELASTANE was set to "3.5"

[0075] Average 110 intermingling points were used in every 1 meter.

[0076] The core yarn (T400 + ELASTANE composite yarn) is wound to a package that can be loaded on the creel in the back side of the ring spinning frame. The new yarn count was 77 Denier (86 dtex).

EXAMPLE 7

Cotton+ T-400+ELASTANE

[0077] Production of the core spinning cotton yarn with the core yarn T-400+ELASTANE is as described in EXAMPLES 4 and 5. The new composite T-400+ELASTANE yarn was fed into core of the cotton yarn.

[0078] Draft ratio was set to "1.14 "; Ne "12/1" (492 dtex) yarn was spun; the yarn twist was set to TM "4.5" (a); The yarn spools were wound in Savio Orion packaging machine as a weft packages.

[0079] See Table 1 for the result of measured strength, elasticity and breaking force; yarn count test; and yarn evenness test as described in EXAMPLES 1, 2, 3. From Table 1 it is apparent that, as far as elasticity is concerned, the invention yarn according to example 7 is comparable with the cotton/elastane-only yarn and is better than the cotton/T400-only yarn; other parameters such as resistance (RKM), break force, tick places etc. of the three yarns are comparable.

EXAMPLE 8

Weft Stretch Fabrics from cotton+ T400

[0080] Weft Stretch Denim was prepared using corespun cotton+T400 yarn prepared as described in EXAMPLE 4; Weaving specification:

Warp Yarn: Ne 7,4/1 (798 dtex) Ring slub yarn dyed with indigo

Warp Density in reed: 21

Reed Width: 194 cm
Weaving Loom: Sulzer Double width Projectile

Weft Yarn: No 10/1 (591 dtex) Corespun cotton+T400 (EXAMPLE 4)

Weft Density: 20

Weave: 3/1 RHT

Finishing: Singeing, hot washing with caustic soda (reduce the fabric with), Padding in finishing pad (lubricant, sewing agent and hand builder),

and Sanforizing

EXAMPLE 9

Weft Stretch Fabrics from cotton+ ELASTANE

[0081] Weft Stretch Denim was prepared using corespun cotton+ELASTANE yarn prepared as described in EXAMPLE 5; weaving specification:

Warp Yarn: No 9/1 (656 dtex) Ring Slub yarn dyed with indigo

Warp Density in reed: 24,4

Reed Width: 194 cm

Weaving Loom: Sulzer Double width Projectile

Weft Yarn: No 12/1 (492 dtex) Corespun cotton-ELASTANE (EXAMPLE 5)

Weft Density(Finished fabric): 19,5

Weave: 3/1 RHT

Finishing: Singeing, hot washing (reduce the fabric with), Padding in finishing pad (lubricant, sewing agent and hand builder), Thermo fixation in stenter frame (190 C in 43 seconds in width 158 cm), Sanforizing

EXAMPLE 10

Weft Stretch Fabrics from cotton+ T-400+ELASTANE

[0082] Weft stretch Denim was prepared using corespun cotton+T-400+ELASTANE yarn prepared as described in EXAMPLE 7; Weaving specification:

Warp Yarn: No 9/1 (656 dtex) Ring sub yarn dyed with indigo

Warp Density in reed: 24,4

Reed Width: 194 cm

Weaving Loom: Sulzer Double width Projectile

Weft Yarn: No 12/1 (492 dtex) Corespun cotton+T400+Lycra (EXAMPLE 7)
Weft Density: 19.5
Weave: 3/1 RHT
Finishing: Singeing, hot washing (reduce the fabric with), Padding in finishing pad (lubricant, sewing agent and hand builder), Thermofixation in stenter frame (185 C in 30 seconds in 158 cm width), Sanforizing

EXAMPLE 11

Testing

[0083] Denim fabric test samples were prepared from fabrics produced in EXAMPLES 8, 9, and 10. Stretch and Recovery Tests were conducted according to ASTM D3107.

Sample preparation

[0084] Fabrics were washed in Wescator (Electrolux, Sweden) washing machine according to BS 6330 2A at 60 C and subsequently dried in Miele homotype dryer (Miele, Germany). This wash and dry process were repeated 3 times. After the third drying, the fabrics were conditioned (4 hours in conditioned lab 65% humidity, 20±2 C hereinafter "conditioned"). After conditioning these fabrics were cut and prepared for stretch and recovery tests. Three rectangular section 60 mm x 455 mm (wherein 455 mm was the direction of stretch, hereafter "stretch side") of each fabric was cut. The 60 mm side of each sample was raveled to exactly 50.5 mm. Each sample was folded 32 mm from one end a seam was stitched 25 mm from the fold. A 10 mm slit in the center of the strip on the fold was created. The sample was left for 30 minutes on a flat surface. A mark at center of the sample (250 mm) was made with a ruler.

Testing procedures

[0085] The end of the sample in the top clamp of the stretch testing instrument was clamped so that the looped end hangs free. The marking distance was measured and recorded "A".

[0086] A dowel pin was inserted through the loop. A 1360 gr weight was hooked through the slit. The sample was slowly pre-stressed by cycling 3 times from zero to full load back to zero load taking about 5 seconds per cycle and making sure the load stays down for three seconds. After the third cycle the load was applied and the sample was extended for 30 minutes. After 30 minutes the distance between the benchmarks with the weight on the dowel was measured "B". After measurement the weight was released and the sample unclamped from the board and laid flat on the table. The sample was relaxed for 60 minutes and the distance between the benchmarks was measured "C".

Calculation

[0087] Fabric stretch was calculated according to following formula:
\[
\text{% stretch} = \frac{100 \times (B-A)}{A}
\]

[0088] Fabric growth was measured at different time intervals according to the following formula:
\[
\text{% growth} = \frac{100 \times (C-A)}{A}
\]

[0089] Table 2 test results show that the stretch of the invention fabric is comparable with the stretch of the more elastic fabric containing the cotton/elastane only yarn. The stretch of the fabric obtained from the T400-based yarn is comparable with the stretch of a standard "natural" fabric, i.e. a fabric free of stretch yarns, that is typically about 10%. 
The growth of the invention fabric (3.1) is less than half the value of the growth of the traditional fabric (7.8), thus confirming the excellent results obtainable from the invention yarn.

| Table 1 |
|---|---|
| yarn count (NE) | spinning method |
| % strength of yarn | 16.8  |
| % RKM cy | 5.8  |
| % ELN. | 9.8  |
| % ELN cy | 6.1  |
| % uniformity of the yarn | 6.1  |
| THIN%40 | 9.3  |
| TICK%35 | 27.3  |
| TICK%50 | 37.0  |
| HAIRNESS | 20.5  |
| B-Force MIN. | 20.5  |
| B-Force MAX. | 37.0  |
| B-Force AVG. | 27.3  |
REFERENCES CITED IN THE DESCRIPTION

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KOMPOSITSTRÆKGARN, FREMGANGSMÅDE OG STOF

PATENTKRAV

1. Stræksgarn (1) omfattende en strækbar kerne (2) og et uelastisk stabilfiberhylster (3), der helt dækker kernen (2), hvor den strækbare kerne (2) omfatter første og anden fibre (4, 5), den første fibre (4) er en elastomer og den anden fibre (5) er en polyesterbaseret polymer eller copolymer, hvor den anden fibre ligger i intervallet fra 60-90 vægt-% af den strækbare kerne (2), kendteognet ved, at

den første fibre (4) og den anden fibre (5) har elastiske egenskaber, hvorved den første fibre (4) er en fibre, der kan strækkes til mindst 400 % af dens oprindelige længde, som bårdforlængelse, og den anden fibre (5) er en fibre med forlængelse, der er mindre end den første fibre, men mindst 20 % af dens oprindelige længde,

den anden fibre har en elastisk genvinding på mindst 93 %, hvilken elastisk genvinding er større end den elastiske genvinding på den første fibre, den første og anden fibre er forbundet med hinanden ved indfletning, cockstrudering eller tvining mindst ved en flerhed af punkter (P) for således at blive strakt og sammen antage form som en enkelt fibre, hvor, når den første og anden fibre er indflettet i hinanden, antallet af forbindelsespunkter ligger inden for intervallet fra 50 til 200 punkter pr. meter, og når den første og anden fibre er tvundet, antallet af tvindinger pr. meter adskiller sig med fra 75-125 tvindinger pr. meter og er tilstrækkeligt høj til at tilvejebringe en forbindelse mellem fibrene.

2. Garn ifølge krav 1, hvor den anden fibre (5) er en elastomultiester-tokomponentfibre og den første fibre er en polyolefin- eller en polyurethan-lastomer.

3. Garn ifølge et hvilket som helst af de foregående krav, hvor, når den første (4) og anden (5) fibre er indflettet i hinanden, antallet af forbindelsespunkter ligger inden for intervallet fra 80 til 120 punkter pr. meter og fortrinsvis 95 til 105 punkter pr. meter.

4. Garn ifølge krav 2, hvor, når den første (4) og anden (5) fibre er tvundet, antallet af tvindinger pr. meter ligger inden for intervallet fra 300 til 600 tvindinger pr. meter, fortrinsvis 350-550 tvindinger pr. meter, mest fortrinsvis 450-525 tvindinger pr. meter.

5. Garn ifølge et hvilket som helst af kravene 1 til 4, hvilket garn har et dtex inden for intervallet fra 1181 til 148 dtex (5 til 40 NE-tal, fortrinsvis 984 til 197 dtex (6 til 30 NE-tal), hvor mængden af kernefibre er fra 3 til 35 vægt-% af stræksgarnets tote vægt, hvor mængden af den anden fibre (5) i den strækbare kerne ligger inden for intervallet fra 75 til 87 vægt-%, og hvor mængden af hylsterfibre (3) i stræksgarnet (1) ligger inden for intervallet fra 60-95 vægt-%, fortrinsvis 70-92 vægt-%.


7. Strækstof indfattende et garn ifølge et hvilket som helst af de foregående krav.

8. Strækstof ifølge krav 7, der er et denim-strækstof.


10. Fremgangsmåde til fremstilling af et garn ifølge et hvilket som helst af kravene 1 til 6, hvilken fremgangsmåde omfatter følgende trin: tilvejebringelse af en strækbar kerne (2) bestående af første og anden fibre (4, 5), der har elastiske egenskaber, hvorved fibrene er forbundet med hinanden mindst ved en flerhed af punkter (P) ved indfletning, cockstrudering eller tvining for således at blive strakt og sammen
antage form som en enkelt fiber; hvor den første fiber (4) er en elastomer og den anden fiber (5) er en polyesterbaseret polymer eller copolymer, hvilken anden fiber ligger i interвалlet fra 60-90 vægt-% af den strækbare kerne; spænding af kernefibrene og tilvejebringelse af et hylster af uelastiske stabile fibre (3) til helt at dække kernen;

hvor den strækbare kerne (2) strækkes mellem to tilstødende strækningsmidler (11,12; 14), inden den spindes med de uelastiske stabile fibre (3), hvor strækningsforholdet for den strækbare kerne (2) ligger inden for interвалlet fra 1,05 til 1,16;

hvor den første fiber (4) er en fiber, der kan strække sig mindst til 400 % af dens oprindelige længde, som brudforlængelse, og den anden fiber (5) er en fiber med forlængelse, der er mindre end den første fiber, men mindst 20 % af dens oprindelige længde, og som har en elastisk genvinding på mindst 93 %, hvilken elastisk genvinding er større end den første fibers elastiske genvinding;

hvor, når den første og anden fiber er indflettet i hinanden, antallet af forbindelsespunkter ligger inden for interвалlet fra 50 til 200 punkter pr. meter, og når den første og anden fiber er tvundet, antallet af tvindinger pr. meter adskiller sig med 75-125 tvindinger pr. meter og er tilstrækkeligt højt til at tilvejebringe en forbindelse mellem fibrene.

11. Fremgangsmåde ifølge krav 10, hvor strækningsforholdet for den strækbare kerne (2) ligger inden for interвалlet fra 1,12 til 1,14.

12. Fremgangsmåde ifølge krav 11, hvor den strækbare kerne (2) er forspændt, inden den forspændes til strækningforholdet.

13. Fremgangsmåde ifølge et hvilket som helst af kravene 10 til 12, hvor, før den første og anden fiber forbindes, den første fiber (4) strækkes med et strækningsforhold på 2,5 til 4,2, mere fortrinsvis 3,0 til 4,0 gange og mest fortrinsvis ca. 3,5.

14. Strækbart kerne- (2) garn, omfattende den første og anden fiber (4, 5), der har elastiske egenskaber, hvilken første fiber (4) er en elastomer og hvilken anden fiber (5) er en polyesterbaseret polymer eller copolymer, hvor den anden fiber er i interвалlet fra 60-90 vægt-% af den strækbare kerne (2), hvor den første fiber (4) er en fiber, der kan strække til mindst 400 % af dens oprindelige længde, som brudforlængelse, og den anden fiber (5) er en fiber med forlængelse, der er mindre end den første fiber, men mindst 20 % af dens oprindelige længde, og som har en elastisk genvinding på mindst 93 %, hvilken elastisk genvinding er større end den første fibers elastiske genvinding, hvor den første og anden fiber er forbundet med hinanden mindst ved en flerhed af punkter (P) ved indfletning, cockstruderering eller tvinding for således at blive strakt og sammen antage form som en enkelt fiber, hvor, når den første og anden fiber er indflettet i hinanden, antallet af forbindelsespunkter ligger inden for interвалlet fra 50 til 200 punkter pr. meter, og når den første og anden fiber er tvundet, antallet af tvindinger pr. meter adskiller sig fra 75-125 tvindinger pr. meter og er tilstrækkeligt højt til at tilvejebringe en forbindelse med fibrene.

15. Strækbart kernegarn ifølge krav 14, hvor den første fiber (4) er en polyurethan- eller en polyolefinelastomer, såsom elasthan, og den anden fiber (5) er en PTT/PET-tokomponent fiber.