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- **ZHANG, Qing**
Nantong
Jiangsu 226009 (CN)
- **LIANG, Haiyan**
Nantong
Jiangsu 226009 (CN)
- **FAN, Hongwei**
Nantong
Jiangsu 226009 (CN)
- **GUAN, Qibing**
Nantong
Jiangsu 226009 (CN)

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(71) Applicants:

- **Toray Fibers & Textiles Research Laboratories (China) Co., Ltd.**
Nantong, Jiangsu 226009 (CN)
- **Toray Fibers (Nantong) Co., Ltd.**
Nantong, Jiangsu 226009 (CN)

(74) Representative: **Hoefer & Partner Patentanwälte mbB**
Pilgersheimer Straße 20
81543 München (DE)

(72) Inventors:

- **WENG, Foquan**
Nantong
Jiangsu 226009 (CN)

(54) **IMITATION COTTON-KNITTED FABRIC, TERYLENE FILAMENT AND PRODUCTION METHOD THEREFOR**

(57) The present invention discloses a cotton-like knitted fabric, a polyester filament and a production method thereof. The fabric is a weft-knitted fabric obtained by material containing at least above 45% by weight of polyester filaments; the pore area distribution of the fabric is centered on 6000 to 22000 μm^2 and has a statistical variability of above 2σ , and the coefficient of variation of the pore area is greater than 40%. The polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direc-

tion have an average length of less than 0.3 cm, a coefficient of variation of length of above 60%, a diameter that is 30% to 70% of the diameter of the twist regions in the opposite direction, and a total length that is 20.0% to 40.0% of the total length of the polyester filaments. The knitted fabric of the present invention feels like real cotton, and is excellent in air permeability, bursting strength, hygroscopic and fast-drying performance, and ultraviolet resistance.

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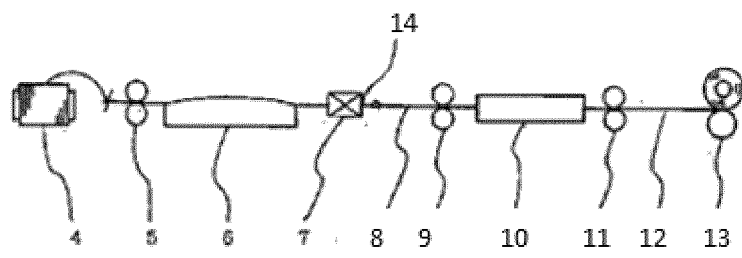


Fig. 2

Description**Technical Field of the Invention**

5 [0001] The present invention relates to a cotton-like knitted fabric, a polyester filament and a production method thereof, and in particular to a cotton-like knitted fabric suitable for manufacturing T-shirts and a polyester filament used as a raw material thereof.

Background of the Invention

10 [0002] At present, the majority of commercially available knitted T-shirts are mainly made of cotton fibers. In comparison with T-shirts made of chemical fibers, such knitted T-shirts are highly soft and hydroscopic. However, when in use, the disadvantages of the cotton products are gradually revealed. For example, they exhibit low air permeability and fast-drying performance. In addition, with the continuous increase in market demands, the cotton fibers are somewhat in short supply. Furthermore, since the cultivation of cotton is easily vulnerable to climate changes, the supply of cotton raw material is very unstable. Therefore, it is very necessary to replace cotton fibers with chemical fibers to produce cotton-like knitted fabrics which have the advantages of cotton and may overcome the disadvantages of cotton.

15 [0003] At present, there are many researches on the cotton-like knitted fabric. For example, the Patent Document CN103898670A has disclosed a cotton-like knitted fabric and a production method thereof, wherein the cotton-like knitted fabric is obtained by jointly knitting pure polyester staple yarns, polyester-cotton staple yarns and spandex yarns. The obtained fabric is processed by high-temperature alkali dewighting to achieve excellent softness and cotton-like effect, the hydroscopic and fast-drying performance is greatly improved, and the defect that a fabric made of chemical fibers is stuffy when worn is overcome. However, the high-temperature alkali dewighting will dissolve hairs on the surface of the fabric and reduce the hairiness of the fabric. Moreover, due to the high processing temperature and the use of caustic soda, the purpose of saving energy and reducing emission cannot be realized, and the processing cost is increased. In addition, since the majority of the materials are staple fibers, the air permeability and bursting strength of the fabric will be affected.

20 [0004] For another example, the Patent Document CN102517775A has disclosed a hygroscopic and exothermic super cotton-like knitted fabric with a jacquard air layer, which is formed from blended yarns made of Porel fibers (capillary polyester long fibers) and cellulosic fibers, with the content of the cellulosic fibers in the blended yarns being 50% to 60%. Thus, the resulting knitted fabric is very excellent in cotton-like effect and hydroscopic and fast-drying performance. However, since the used Porel fibers belong to special functional fibers, the relatively high content of the Porel fibers increases the product cost.

25 [0005] In addition, at present, there are technologies for performing false-twisting on polyester filaments in order to allow yarns to exhibit a certain natural fiber style. For example, the Patent Document CN103603113A has disclosed a textured yarn obtained by fusing and false-twisting polyester filaments, which is soft and has a concavo-convex feeling on the surface when touched. A fabric formed from such a textured yarn has a gritty and hollow-out texture. However, since twist regions in a false-twist direction of the yarn have a too small coefficient of variation, the obtained fabric does not have the appearance and touch feeling of cotton products although it has a uniform pore area distribution and a high glossiness. For another example, the Patent Document JP2000-303287 has disclosed a partially-fused polyester yarn, where twist portions in a false-twist direction, twistless crinkled portions and twist portions in a untwist direction are alternatively arranged. On the surface of the yarn, there are basically no nubs, and the glossiness is reduced, so that the heterogeneity and roughness of the surface of a linen fabric are solved. However, it is difficult to control the presence of twistless crinkled portions between the twist portions in the false-twist direction and the untwist portions in the untwist direction, and the processing is complicated and high in cost. Moreover, the obtained fabric feels like linen and is unable to be compared with cotton products in touch feeling and appearance.

Summary of the Invention

30 [0006] In view of the above problems, an objective of the present invention is to provide a polyester filament which is simple in processing, soft in touch feeling and high in natural fiber feeling, and a cotton-like knitted fabric obtained from the polyester filament, which feels like real cotton and is excellent in air permeability, bursting strength, hydroscopic and fast-drying performance, and ultraviolet resistance.

[0007] The present invention employs the following technical solutions.

35 [0008] The present invention provides a cotton-like knitted fabric which is a weft-knitted fabric obtained by material containing at least above 45% by weight of polyester filaments; and, the pore area distribution of the fabric is centered on 6000 to 22000 μm^2 and has a statistical variability of above 2σ , and the coefficient of variation of the pore area is greater than 40%.

[0009] The present invention provides a polyester filament which is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of less than 0.3 cm, a coefficient of variation of length of above 60%, a diameter that is 30% to 70% of the diameter of the twist regions in the opposite direction, and a total length that is 20.0% to 40.0% of the total length of the polyester filaments.

[0010] The cotton-like knitted fabric of the present invention has the same pore area distribution and the same appearance as the cotton-containing products. Meanwhile, since the polyester filament is used as the main raw material, compared with a product made of staple fibers, the cotton-like knitted fabric is excellent in air permeability (JISL 1096-2010 standard method A: 75 to 150 cm³/cm²/s) and bursting strength (JISL 1096-2010 standard: above 700 kpa), and compared with a cotton-containing product, it is excellent in hygroscopic and fast-drying performance (Corken method: the residual moisture after 60 min is below 10%). Moreover, since the non-uniform diameter of the polyester filaments used in the present invention improves the diffuse reflection effect of the fabric and the polyester itself has an ultraviolet-resistant aromatic ring molecular structure, the fabric is excellent in ultraviolet resistance (Australian standard AS/NZS4399-1996: the value of UPF is above 45). The fabric of the present invention is particularly suitable for manufacturing T-shirts or the like. In addition, the method for processing the polyester filament of the present invention is simple and easy, and provides for soft touch feeling and high natural fiber feeling.

Brief Description of the Drawings

[0011]

Fig. 1 is a side view of a polyester filament in the length direction according to the present invention, in which: 1: twist region in a false-twist direction; 2: twist region in an opposite direction; and, 3: twist region in the false-twist direction; and

Fig. 2 is a flowchart of processing the polyester filament according to the present invention, in which: 4: polyester pre-oriented yarn POY; 5: first roller; 6: first hot box; 7: false twister; 8: moving sliver; 9: second roller; 10: second hot box; 11: third roller; 12: polyester filament (drawn textured yarn DTY); and, 13: reeling drum.

Detailed Description of the Invention

[0012] The present invention provides a knitted fabric which is a weft-knitted fabric obtained by material containing at least above 45% by weight of polyester filaments; and, the pore area distribution of the fabric is centered on 6000 to 22000 μm^2 and has a statistical variability of above 2σ , and the coefficient of variation of the pore area is greater than 40%.

[0013] Considering that the polyester filament among the chemical fibers is simple in processing and low in cost and the polyester filament fabric is excellent in air permeability, bursting strength and other performances when compared with a polyester staple fiber fabric, the polyester filament is used as a material in the present invention. In addition, considering that the weft-knitting stitch has better flexibility, softness and comfort than other types of stitches, the weft-knitting stitch is used as a knitting stitch in the present invention.

[0014] In the material of the present invention, if the content of polyester filaments is less than 45%, the pores of the fabric will be reduced and the air permeability will be degraded, and as a result, the wearing comfort will be influenced. Furthermore, the appearance of cotton-containing products cannot be realized, and the pore area distribution is not centered within 6000 to 22000 μm^2 .

[0015] In the present invention, the pore area distribution of the fabric is centered within 6000 to 22000 μm^2 and has a statistical variability of above 2σ , the coefficient of variation (C.V) of the pore area is greater than 40%, and the fabric has the same appearance as cotton-containing products. When the pore area distribution of the fabric is centered less than 6000 μm^2 , it is indicated that the fabric has smaller pores and higher compactness and does not feel like cotton due to too stiff touch feeling. In addition, if the fabric is too compact, the fabric has reduced air permeability and lower flexibility, and the wearing comfort is greatly degraded. When the pore area distribution of the fabric is centered more than 22000 μm^2 , it is indicated that the fabric has larger pores and is too loose, and as a result, the requirements on slenderness and thickness of the cotton-containing products cannot be met. If the pore area has a statistical variability of within 2σ and a coefficient of variation of the pore area of the fabric is less than 40%, it is indicated that the fabric has uniform pores, low concavo-convex feeling and high glossiness (i.e., feels like chemical fibers), which are contrary to the low glossiness of the cotton-containing products.

[0016] In order to make the pore distribution of the fabric closer to that of the cotton-containing products, the content of the polyester filaments of the present invention is preferably 100%. If the content of polyester filaments is higher, the distribution of the pore area is more non-uniform, and the appearance and touch feeling of the pure cotton staple fiber fabric may be more imitated. Of course, in the present invention, polyester staple yarns, natural fiber staple yarns or the like may be knitted with the polyester filaments of the present invention to realize the cotton-like effect.

[0017] Preferably, the present invention provides a polyester filament which is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of less than 0.3 cm, a coefficient of variation of length of above 60%, a diameter that is 30% to 70% of the diameter of the twist regions in the opposite direction, and a total length that is 20.0% to 40.0% of the total length of the polyester filaments. Such a polyester filament looks like a cotton spun yarn in terms of appearance and various performances. Here, the twist regions in the false-twist direction are twisted portions of the yarn, and the twist regions in the opposite direction are untwisted portions of the yarn.

[0018] With regard to the polyester filament of the present invention, if twist regions in the false-twist direction have an average length of greater than 0.3 cm, the proportion of the twist regions in the false-twist direction in the length direction of the yarn will be increased, and the yarn will become thinner and stiffer. Although the slenderness of the obtained fabric is enhanced, the fabric tends to become stiffer when touched.

[0019] With regard to the polyester filament of the present invention, if the coefficient of variation of length (C.V) is less than 60%, the pore area distribution of the obtained fabric tends to become uniform, and it is possible to reduce the cotton-like effect, so that it is difficult to obtain the cotton-like appearance.

[0020] With regard to the polyester filament of the present invention, if a ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is smaller, that is, there is a larger difference between the diameter of the twist regions in the false-twist direction and the diameter of the twist regions in the opposite direction, the fabric has a more non-uniform pore area distribution and an appearance more similar to the cotton-containing products. However, if the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is less than 30%, that is, there is a too large difference between the diameter of the twist regions in the false-twist direction and the diameter of the twist regions in the opposite direction, it is possible to result in too large pores of the fabric, decrease the compactness and thus influence the cotton-like effect. If the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is greater than 70%, that is, there is a small difference between the diameter of the twist regions in the false-twist direction and the diameter of the twist regions in the opposite direction, it is possible to result in too uniform pore distribution of the fabric, and thus influence the cotton-like appearance effect. In addition, it is also possible to result in a smaller diameter of the twist regions in the opposite direction of the yarn, so that the softness of the fabric is decreased.

[0021] In addition, with regard to the polyester filament of the present invention, if a ratio of the total length of the twist regions in the false-twist direction to the total length of the polyester filament is smaller, better fluffiness and softness may be endowed to the fabric. If the proportion of the twist regions in the false-twist direction is less than 20%, it is possible to decrease the slenderness even if the fluffiness and softness of the fabric are improved, so that the balance between the slenderness and the softness of cotton products cannot be realized. However, if the proportion of the twist regions in the false-twist direction is greater than 40%, it is possible to decrease the softness even if the slenderness of the fabric is increased, and the balance between the slenderness and the softness of the cotton product cannot also be realized.

[0022] The polyester filament of the present invention has a total fineness of 56 to 220 dtex. When the total fineness is less than 56 dtex, the fabric formed from the polyester filament has a smaller pore area, a reduced pore area difference and a smaller thickness, and the cotton-like appearance effect and the touch feeling are likely to be decreased. However, when the total fineness is greater than 200 dtex, the fabric formed from the polyester filament has larger pores, a too large thickness and poor cotton-like effect, and the compactness of full-cotton products may not be realized.

[0023] The polyester filament of the present invention preferably has a monofilament fineness of less than 1.3 dtex. If the monofilament fineness is greater than 1.3 dtex, it is possible to influence the smoothness of the fabric and decrease the cotton-like effect.

[0024] The fabric of the present invention is obtained by knitting a single polyester filament or jointly knitting two polyester filaments, refining, dying, sizing and other processes. In this way, the balance between the compactness and the pore distribution of the fabric may be ensured. For example, if polyester filaments having a total fineness of 56 to 100 dtex are to be used, two polyester filaments may be fed for knitting. For another example, if polyester filaments having a total fineness of 100 to 200 dtex, a single polyester filament may be fed for knitting.

[0025] To make the touch feeling of the fabric similar to cotton products, the cotton-like fabric of the present invention is preferably obtained by fluffing. The equipment for fluffing is not specifically limited, and may be a sanding machine from Sperrotto in Italy, with a speed of 5 to 30 m/min, a tension of 0.4 to 0.6 MPa and a mesh of 160# to 240#.

[0026] Preferably, the cotton-like knitted fabric of the present invention has a bending rigidity (B) of 0.015 to 0.045 N • cm²/cm, a surface roughness (SMD) of 3 to 6 μ, and a compression energy (WC) of 0.2 to 0.8 N • cm/cm². These performances are consistent with those of the commercially available full-cotton T-shirt fabric. The present invention solves the technical difficulty that the bending rigidity and the compression energy of the common polyester filament cotton-like fabric cannot meet the requirements for the cotton products even if its surface roughness is the same as the cotton-containing products. The bending rigidity here refers to the stiffness and flexibility of the fabric and reflects the slenderness of the fabric. If the bending rigidity has a larger value, the fabric is stiffer. The cotton products have a certain

flexibility and slenderness. The surface roughness refers to the flatness of the surface of the fabric. If the surface roughness has a smaller value, the fabric is smoother; or otherwise, the fabric is rougher. The compression energy refers to the fluffiness of the fabric. If the compression energy has a larger value, the fabric is more fluffy.

[0027] With regard to the cotton-like knitted fabric of the present invention, the knitting stitch is not specifically limited. Plain stitch, close-mesh stitch or the like may be used as long as a certain compactness is endowed to the fabric. The plain stitch is preferred.

[0028] The polyester filament of the present invention may be obtained by the following method: leading a polyester pre-oriented yarn POY into a first roller, then into a first hot box for heating, and finally into a false twister, a second roller, a second hot box and a third roller in accordance with the procedure of Fig. 2 to obtain the finished product, where the temperature in the first hot box is 230°C to 250°C, and the D/Y ratio in the step is 1.5 to 2.5. In the above procedure, the speed is not limited, and may be preferably 300 to 500 m/min for convenient operation; and, the extension rate is also not limited, and may be preferably 1.10 to 2.00 for convenient operation.

[0029] The polyester pre-oriented yarn POY used in the above procedure may be obtained by a known method in the art, for example, by melt spinning commercially available polyester chip material. The speed of melt spinning may be set properly, preferably 2500 to 3500 m/min. The fineness of the obtained polyester pre-oriented yarn POY and the number of monofilaments are not specifically limited. To obtain the polyester filament applicable to the present invention conveniently, the fineness of the polyester pre-oriented yarn POY is preferably 70 to 280 dtex, and the number of monofilaments is preferably 70 to 208.

[0030] In the above processing process, when the temperature in the first hot box is lower than 230°C, the ratio of the total length of the twist regions in the false-twist direction to the total length of the polyester filament will be less than 20% even if the average length of the twist regions in the false-twist direction may be controlled less than 0.3 cm; and the fabric obtained from the polyester filament cannot feel like real cotton even if its softness is increased and the slenderness is decreased. Moreover, the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction will also be less than 30%, and the difference in diameter between the two kinds of regions will become larger. Thus, although the pore area distribution of the fabric may become more non-uniform, the partial pore area of the fabric will be too large, so that the same compactness as the cotton products cannot be realized. However, if the temperature in the first hot box is higher than 250°C, the average length of the twist regions in the false-twist direction is greater than 0.3 cm, the ratio of the total length of the twist regions in the false-twist direction to the total length of the filament will be also greater than 40%, and the fabric obtained from the filament has a greatly decreased softness although its slenderness is increased, so that the cotton-like touch feeling cannot also be realized. If the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is greater than 70%, the diameter of the twist regions in the opposite direction of the yarn becomes smaller, the yarn is too stiff as a whole, and the cotton-like effect (softness) of the fabric is thus influenced.

[0031] To realize the cotton-like effect, the coefficient of variation (C.V) of length of the twist regions in the false-twist direction of the polyester filament is to be controlled above 60%. Therefore, in the processing process, the D/Y ratio is to be set as 1.5 to 2.5. The D/Y ratio here is obtained by dividing the surface speed of stacked discs by the surface speed of the two rollers. If the D/Y ratio is less than 1.5, the untwist tension is too large, the twist regions in the false-twist direction are damaged, the distribution in the length direction is too uniform, and the coefficient of variation (C.V) is too small. When the coefficient of variation (C.V) is less than 60%, the pore area distribution of the obtained fabric tends to become uniform, the nep-like effect is decreased, and it may be impossible to realize the appearance of the cotton-containing products. However, if the D/Y ratio is greater than 2.5, the untwist tension is too small and the quality of the yarn cannot be ensured.

[0032] Preferably, the polyester filament of the present invention has a fineness of 56 to 220 dtex. If the fineness is less than 56 dtex, that is, the used raw yarn is thin, in the false-twisting process in the first hot box, the excessive fusion and false-twisting phenomenon may be caused due to too thin raw yarn, and it is difficult to untwist the twist regions in the opposite direction in the untwisting process, so that the diameter of the twist regions in the opposite direction becomes smaller. As a result, the difference in diameter between the twist regions in the false-twist direction and the twist regions in the opposite direction becomes smaller, the pore area of the formed fabric becomes smaller, and the difference in the pore area tends to be not obvious, so that it may be impossible to realize the appearance of the cotton-containing products. In addition, it may be possible to make the average length of the twist regions in the false-twist direction greater than 0.3 cm and the ratio of the total length of the twist regions in the false-twist direction to the total length of the filament higher than 40%. Such a polyester filament is relatively stiff, and the formed fabric is difficult to realize the same softness as the cotton-containing products even if its slenderness is increased. If the fineness is greater than 200 dtex, that is, the used raw yarn is relatively thick, in the false-twisting process in the first hot box, the insufficient fusion phenomenon may be caused due to too thick raw yarn, so that the diameter of the twist regions in the opposite direction becomes larger and the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction may be less than 30%. As a result, the difference in diameter between the two regions becomes larger, the pore area of the formed fabric becomes larger, and, like the cotton-containing products, the compactness

tends to decrease. In addition, it is also possible to make the ratio of the total length of the twist regions in the false-twist direction to the total length of the filament less than 20%, and the formed fabric is difficult to realize the slenderness of the cotton-containing products.

[0033] Meanwhile, preferably, the polyester filament of the present invention has a monofilament fineness of less than 1.30 dtex. When the temperature in the first hot box is set as 230 to 250°C and the D/Y ratio is set as 1.5 to 2.5, and if the monofilament fineness of the finished product polyester filament is greater than 1.30 dtex, the monofilament fineness of the raw yarn is relatively large. The polyester filament obtained under these processing conditions is similar to the cotton yarn in appearance or the like, and the pore distribution of the fabric obtained from the polyester filament is also similar to that of the cotton-containing products. However, since the monofilament fineness is relatively high, it may be difficult to realize the smoothness of the cotton-containing products.

Embodiments

[0034] Various parameters in the present invention are tested as follows.

(1) Standard variance of the pore area of the fabric and the pore area distribution center value
① Preparation of samples: a sample fabric having a size of 20cm×20cm and a flat surface is cut off from the fabric.

② A fabric surface picture of the sample is taken by a digital microscope (KEYENCE) with a 50X lens.

(a) The brightness of the sample is adjusted between 1/3 and 2/3 by a brightness knob on a rotary control board. When the brightness is less than 1/3, the exposure rate is too low, the picture of the sample is too dark, and the pores of the sample cannot be recognized. When the brightness is greater than 2/3, the exposure rate is too high, and the pores of the sample cannot also be recognized.

(b) The lens is adjusted to 50X, and the definition of the sample is adjusted by rotating a focusing knob on an XY platform or a control board, so as to ensure the clarity of the pores of the sample. When the magnification of the lens is too low, the appearance area of the pores of the sample is too small, and the precision of subsequent brightness extraction and pore area will be influenced. However, when the magnification of the lens is too high, the total area of the taken picture of the sample is too small, the number of pores is less, and the actual distribution precision of the pore area is influenced.

(c) The picture is saved, and the area of the fabric in the picture is about $3.6 \times 10^7 \mu\text{m}^2$.

③ A brightness extraction method in the automatic area measurement function of the VHX-2000/Ver2.35 software provided by KEYENCE is used.

(a) An automatic area measurement button is clicked.

(b) The brightness extraction method is checked to extract a brightness region graph of the picture of the sample.

(c) The option "DARK" in the interface is checked to obtain a pore graph in the picture.

(d) The threshold is adjusted so that the pores of the sample are exactly covered, where the threshold ranges from -80 to +80.

A too large or too small threshold cannot ensure that the actual pores of the sample are covered exactly. When the threshold is too small, the measured pore area is smaller than the actual area. However, when the threshold is too large, the measured pore area is larger than the actual area.

(e) The data of the pore area of the sample is obtained by clicking "NEXT", and then saved. The standard variance σ of the pore area and the pore area distribution center value μ (unit: μm^2) of the sample are recorded.

(2) Coefficient of variation

① Coefficient of variation of the pore area of the fabric:

the standard variance σ of the pore area $\div$ the pore area distribution center value $\mu \times 100\%$.

② Coefficient of variation of length of the twist regions in the false-twist direction of the polyester filament:

the coefficient of variation of length of the twist regions in the false-twist direction = the standard variance σ of length of the twist regions in the false-twist direction $\div$ the average value μ of length of the twist regions in the false-twist direction $\times 100\%$.

[0035] Wherein, a polyester filament having a length of 50 cm is randomly selected, the length of 20 twist regions in the false-twist direction is then measured, and finally, the standard variance σ and the average length value μ are

calculated (the measurement method refers to $\Gamma(7)$ Ratio of the length of the twist regions in the false-twist direction of the polyester filament to the total length of the polyester filament) hereinafter).

(3) Bending rigidity

[0036] The KES FB2 method is used. (The KES fabric style tester is a fabric style tester designed and manufactured by Professor Kawabata Sueo from the Kyoto University, where FB2 is a bending performance tester.)

(4) Surface roughness

[0037] The KES FB4 method is used. (The KES fabric style tester is a fabric style tester designed and manufactured by Professor Kawabata Sueo from the Kyoto University, where FB4 is a friction and surface roughness tester.)

(5) Compression energy

[0038] The KES FB3 method is used. (The KES fabric style tester is a fabric style tester designed and manufactured by Professor Kawabata Sueo from the Kyoto University, where FB3 is a compression performance and thickness tester.)

(6) Ratio of the diameter of the twist regions in the false-twist direction of the polyester filament to the diameter of the twist regions in the opposite direction

[0039] Five polyester filaments each having a length of 20 cm in the present invention are randomly selected from the fabric, and the diameter of the twist regions in the false-twist direction and the diameter of the twist regions in the opposite direction of each polyester filament are measured by a measurement tool of the KEYENCE digital system by using a digital microscope with a 50X lens from KEYENCE. Five groups of data are measured for each polyester filament, the average of specific values of each polyester filament is calculated, and the average of the total specific values of the five polyester filaments is eventually calculated.

(7) Ratio of the length of twist regions in false-twist direction of the polyester filament to the total length of the polyester filament

[0040] Five polyester filaments each having a length of 50 cm in the present invention are randomly selected from the fabric, and a tension of 0.1 g/D is applied to each filament. The length of the twist regions in the false-twist direction of each filament is measured by EIB-E (model: LAWSON-HEMPHILL, from LAWSON-HEMPHILL). Five groups of data are measured for each polyester filament, and the average of the length ratios of each polyester filament is calculated. The average of the total length ratios of the five polyester filaments is eventually calculated.

(8) Softness of the polyester filament

[0041] By perceptive evaluation from 20 persons, on the basis of the degree of softness of the filament, there are four levels, i.e., Excellent, Good, Pass and Poor. Wherein, if 15 persons or more consider that the filament is soft, the softness of this filament is Excellent; if 10 to 14 persons consider that the filament is soft, the softness of this filament is Good; if 5 to 10 persons consider that the filament is soft, the softness of this filament is Pass; and, if less than 5 persons consider that the filament is soft, the softness of this filament is Poor.

[0042] The present invention will be further described below by embodiments and comparison examples.

Embodiment 1

[0043] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0044] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.13 cm, a coefficient of variation (C.V) of length of 78%, a diameter that is 43% of the diameter of the twist regions in the opposite direction, and a total length that is 31.3% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 2

[0045] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 252 dtex and a monofilament number of 278. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 200 dtex, a monofilament number of 278 and a monofilament fineness of 0.72 dtex.

[0046] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.10 cm, a coefficient of variation (C.V) of length of 78%, a diameter that is 40% of the diameter of the twist regions in the opposite direction, and a total length that is 22.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 3

[0047] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 71 dtex and a monofilament number of 78. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 56 dtex, a monofilament number of 78 and a monofilament fineness of 0.72 dtex.

[0048] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.18 cm, a coefficient of variation (C.V) of length of 79%, a diameter that is 55% of the diameter of the twist regions in the opposite direction, and a total length that is 35.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 4

[0049] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 232°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0050] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.10 cm, a coefficient of variation (C.V) of length of 77%, a diameter that is 39% of the diameter of the twist regions in the opposite direction, and a total length that is 21.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 5

[0051] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 245°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0052] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.25 cm, a coefficient of variation (C.V) of length of 78%, a diameter that is 54% of the diameter of the twist regions in the opposite direction, and a total length that is 38.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 6

[0053] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.6, so as to obtain a polyester

filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0054] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.25 cm, a coefficient of variation (C.V) of length of 61 %, a diameter that is 56% of the diameter of the twist regions in the opposite direction, and a total length that is 38.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 7

[0055] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 2.3, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0056] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.10 cm, a coefficient of variation (C.V) of length of 90%, a diameter that is 38% of the diameter of the twist regions in the opposite direction, and a total length that is 21.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 8

[0057] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 169 dtex and a monofilament number of 96. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 134 dtex, a monofilament number of 96 and a monofilament fineness of 1.40 dtex.

[0058] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.12 cm, a coefficient of variation (C.V) of length of 79%, a diameter that is 40% of the diameter of the twist regions in the opposite direction, and a total length that is 28.0% of the total length of the polyester filament, specifically referring to Table 1.

Comparison example 1

[0059] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 40 dtex and a monofilament number of 36. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 28 dtex, a monofilament number of 36 and a monofilament fineness of 0.78 dtex.

[0060] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.31 cm, a coefficient of variation (C.V) of length of 78%, a diameter that is 80% of the diameter of the twist regions in the opposite direction, and a total length that is 42.0% of the total length of the polyester filament, specifically referring to Table 1.

Comparison example 2

[0061] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 410 dtex and a monofilament number of 288. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 250 dtex, a monofilament number of 288 and a monofilament fineness of 0.87 dtex.

[0062] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.08 cm, a coefficient of variation (C.V) of length of 79%, a diameter that is 28% of the diameter of the twist regions in the opposite direction, and a total length that is 18.0% of the total length of the polyester filament, specifically referring to Table 1.

Comparison example 3

[0063] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 252°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0064] The obtained false-twisted polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.35 cm, a coefficient of variation (C.V) of length of 79%, a diameter that is 78% of the diameter of the twist regions in the opposite direction, and a total length that is 42.0% of the total length of the polyester filament, specifically referring to Table 1.

Comparison example 4

[0065] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 225°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.9, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0066] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.06 cm, a coefficient of variation (C.V) of length of 80%, a diameter that is 26% of the diameter of the twist regions in the opposite direction, and a total length that is 18.0% of the total length of the polyester filament, specifically referring to Table 1.

Comparison example 5

[0067] Polyester chip material (produced by Toray Fiber(Nantong) Co., Ltd.) is selected and then melt and spun at a speed of 2800 m/min to obtain a polyester pre-oriented yarn POY having a fineness of 128 dtex and a monofilament number of 144. Then, false-twisting is performed according to the procedure of Fig. 2 at a speed of 400 m/min, a temperature of 238°C in the first hot box, an extension rate of 1.26 and a D/Y ratio of 1.3, so as to obtain a polyester filament having a fineness of 100 dtex, a monofilament number of 144 and a monofilament fineness of 0.69 dtex.

[0068] The obtained polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of 0.38 cm, a coefficient of variation (C.V) of length of 55%, a diameter that is 68% of the diameter of the twist regions in the opposite direction, and a total length that is 55.0% of the total length of the polyester filament, specifically referring to Table 1.

Embodiment 9

[0069] 55% by weight of common false-twisted polyester yarns in 56 dtex to 78f (produced by Toray Fiber(Nantong) Co., Ltd.) and 45% by weight of the polyester filaments obtained in Embodiment 3 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72s) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0070] The obtained fabric has a pore area distribution centered on 6000 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 41%, a bending rigidity (B) of 0.025 N • cm²/cm, a surface roughness (SMD) of 4.1 μ and a compression energy (WC) of 0.35 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Embodiment 10

[0071] 55% by weight of common false-twisted polyester yarns in 200 dtex to 278f (produced by Toray Fiber(Nantong) Co., Ltd.) and 45% by weight of the polyester filaments obtained in Embodiment 2 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0072] The obtained fabric has a pore area distribution centered on 15000 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 47%, a bending rigidity (B) of 0.015 N • cm²/cm, a surface roughness

(SMD) of 3.0μ and a compression energy (WC) of $0.80\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Embodiment 11

[0073] 35% by weight of common false-twisted polyester yarns in 100 dtex to 144f (produced by Toray Fiber(Nantong) Co., Ltd.) and 65% by weight of the polyester filaments obtained in Embodiment 7 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined ($80^\circ\text{C} \times 20\text{min}$), dyed ($98^\circ\text{C} \times 30\text{min}$), sized ($160^\circ\text{C} \times 72\text{S}$) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0074] The obtained fabric has a pore area distribution centered on $14000\mu\text{m}^2$, a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 51%, a bending rigidity (B) of $0.024\text{ N} \cdot \text{cm}^2/\text{cm}$, a surface roughness (SMD) of 3.8μ and a compression energy (WC) of $0.75\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Embodiment 12

[0075] 35% by weight of common false-twisted polyester yarns in 100 dtex to 144f (produced by Toray Fiber(Nantong) Co., Ltd.) and 65% by weight of the polyester filaments obtained in Embodiment 6 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined ($80^\circ\text{C} \times 20\text{min}$), dyed ($98^\circ\text{C} \times 30\text{min}$), sized ($160^\circ\text{C} \times 72\text{S}$) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0076] The obtained fabric has a pore area distribution centered on $13000\mu\text{m}^2$, a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 48%, a bending rigidity (B) of $0.034\text{ N} \cdot \text{cm}^2/\text{cm}$, a surface roughness (SMD) of 4.9μ and a compression energy (WC) of $0.30\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Embodiment 13

[0077] 100% by weight of the polyester filaments obtained in Embodiment 3 are knitted, in a double-yarn merging manner, by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined ($80^\circ\text{C} \times 20\text{min}$), dyed ($98^\circ\text{C} \times 30\text{min}$), sized ($160^\circ\text{C} \times 72\text{S}$) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0078] The obtained fabric has a pore area distribution centered on $6900\mu\text{m}^2$, a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 58%, a bending rigidity (B) of $0.045\text{ N} \cdot \text{cm}^2/\text{cm}$, a surface roughness (SMD) of 6.0μ and a compression energy (WC) of $0.20\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Embodiment 14

[0079] 100% by weight of the polyester filaments obtained in Embodiment 2 are knitted by plain stitch on a single-sided circular knitting machine to obtain a gray fabric, and the grey fabric is then refined ($80^\circ\text{C} \times 20\text{min}$), dyed ($98^\circ\text{C} \times 30\text{min}$), sized ($160^\circ\text{C} \times 72\text{S}$) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0080] The obtained fabric has a pore area distribution centered on $22000\mu\text{m}^2$, a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 63%, a bending rigidity (B) of $0.037\text{ N} \cdot \text{cm}^2/\text{cm}$, a surface roughness (SMD) of 5.1μ and a compression energy (WC) of $0.50\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Embodiment 15

[0081] 100% by weight of the polyester filaments obtained in Embodiment 8 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined ($80^\circ\text{C} \times 20\text{min}$), dyed ($98^\circ\text{C} \times 30\text{min}$), sized ($160^\circ\text{C} \times 72\text{S}$) and fluffed to obtain the cotton-like knitted fabric.

[0082] The obtained fabric has a pore area distribution centered on $19000\mu\text{m}^2$, a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 64%, a bending rigidity (B) of $0.046\text{ N} \cdot \text{cm}^2/\text{cm}$, a surface roughness (SMD) of 6.3μ and a compression energy (WC) of $0.48\text{ N} \cdot \text{cm}/\text{cm}^2$. The performance parameters of the obtained fabric refer to Table 2.

Comparison example 6

[0083] 60% by weight of common false-twisted polyester yarns in 56 dtex to 78f (produced by Toray Fiber(Nantong Co., Ltd.) and 40% by weight of the polyester filaments obtained in Embodiment 3 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0084] The obtained fabric has a pore area distribution centered on 4600 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 30%, a bending rigidity (B) of 0.012 N • cm²/cm, a surface roughness (SMD) of 2.1 μ and a compression energy (WC) of 0.36 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Comparison example 7

[0085] 60% by weight of common false-twisted polyester yarns in 200 dtex to 278f (produced by Toray Fiber(Nantong Co., Ltd.) and 40% by weight of the polyester filaments obtained in Embodiment 2 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0086] The obtained fabric has a pore area distribution centered on 12000 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 35%, a bending rigidity (B) of 0.008 N • cm²/cm, a surface roughness (SMD) of 1.8 μ and a compression energy (WC) of 0.85 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Comparison example 8

[0087] 55% by weight of common false-twisted polyester yarns in 28 dtex to 36f (produced by Toray Fiber(Nantong Co., Ltd.) and 45% by weight of the polyester filaments obtained in Embodiment 1 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0088] The obtained fabric has a pore area distribution centered on 4200 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 27%, a bending rigidity (B) of 0.030 N • cm²/cm, a surface roughness (SMD) of 5.0 μ and a compression energy (WC) of 0.18 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Comparison example 9

[0089] 55% by weight of common false-twisted polyester yarns in 250 dtex to 288f (produced by Toray Fiber(Nantong Co., Ltd.) and 45% by weight of the polyester filaments obtained in Embodiment 2 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0090] The obtained fabric has a pore area distribution centered on 25000 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 51%, a bending rigidity (B) of 0.007 N • cm²/cm, a surface roughness (SMD) of 1.6 μ and a compression energy (WC) of 0.90 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Comparison example 10

[0091] 100% by weight of the polyester filaments obtained in Embodiment 6 are knitted by plain stitch on a single-sided circular knitting machine to obtain a grey fabric, and the grey fabric is then refined (80°C×20min), dyed (98°C×30min), sized (160°C×72S) and fluffed to obtain the cotton-like knitted fabric of the present invention.

[0092] The obtained fabric has a pore area distribution centered on 8000 μm^2 , a statistical variability of above 2σ , a coefficient of variation (C.V) of the pore area of 25%, a bending rigidity (B) of 0.050 N • cm²/cm, a surface roughness (SMD) of 7.1 μ and a compression energy (WC) of 0.15 N • cm/cm². The performance parameters of the obtained fabric refer to Table 2.

Table 1

Distinction	Embodi- ment 1	Embodi- ment 2	Embodi- ment 3	Embodi- ment 4	Embodi- ment 5	Embodi- ment 6	Embodi- ment 7	Embodi- ment 8	Compara- son exam- ple 1	Compara- son exam- ple 2	Compara- son exam- ple 3	Compara- son exam- ple 4	Compara- son exam- ple 5
POY	Spinning speed	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800
	Fineness (dtex)	128	252	71	128	128	128	169	40	410	128	128	128
	Number	144	278	78	144	144	144	96	36	288	144	144	144
False- twisting	Processing speed (m/min)	400	400	400	400	400	400	400	400	400	400	400	400
	Temperature in the first hot box (°C)	238	238	238	232	245	238	238	238	238	252	225	238
	Extension rate (times)	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
	D/Y ratio (times)	1.9	1.9	1.9	1.9	1.9	2.3	1.9	1.9	1.9	1.9	1.9	1.3

(continued)

Distinction	Embodi- ment 1	Embodi- ment 2	Embodi- ment 3	Embodi- ment 4	Embodi- ment 5	Embodi- ment 6	Embodi- ment 7	Embodi- ment 8	Compari- son exam- ple 1	Compari- son exam- ple 2	Compari- son exam- ple 3	Compari- son exam- ple 4	Compari- son exam- ple 5
	Total fineness (dtex)	100	200	56	100	100	100	134	28	250	100	100	100
Polyester filament	Monofilament fineness (dtex)	0.69	0.72	0.72	0.69	0.69	0.69	1.40	0.78	0.87	0.69	0.69	0.69
	Average length (cm)	0.13	0.10	0.18	0.10	0.25	0.10	0.12	0.31	0.08	0.35	0.06	0.38
	Coeffi- cient of variation of length (%)	78	78	79	77	78	90	79	78	79	79	80	55
	Twist region the diam- eter of the twist regions in the op- posite di- rection (%)	43	40	55	39	54	38	40	80	28	78	26	68
	Ratio to the total length of the fila- ments (%)	31.3	22.0	35.0	21.0	38.0	21.0	28.0	42.0	18.0	42.0	18.0	55.0
Softness		Good	Good	Pass	Good	Pass	Excellent	Poor	Poor	Excellent	Poor	Excellent	Poor

Table 2

	Yarn 1			Yarn 2			Fabric performance					
	Type	Content (%)	Total fineness (dtex)	Type	Content (%)	Total fineness (dtex)	Monofilament fineness (dtex)	Pore area distribution center (μ m ²)	Coefficient of variation of the pore area (%)	Bending rigidity (N • cm ² /cm)	Surface roughness (μ)	Compression energy (N • cm/cm ²)
Embodiment 9	Common polyester	55	56	Polyester filament in Embodiment 3	45	56	0.72	6000	41	0.025	4.1	0.35
Embodiment 10	Common polyester	55	200	Polyester filament in Embodiment 2	45	200	0.72	15000	47	0.015	3.0	0.80
Embodiment 11	Common polyester	35	100	Polyester filament in Embodiment 7	65	100	0.69	14000	51	0.024	3.8	0.75
Embodiment 12	Common polyester	35	100	Polyester filament in Embodiment 6	65	100	0.69	13000	48	0.034	4.9	0.30
Embodiment 13	-	-	-	Polyester filament in Embodiment 3	100	56	0.72	6900	58	0.045	6.0	0.20
Embodiment 14	-	-	-	Polyester filament in Embodiment 2	100	200	0.72	22000	63	0.037	5.1	0.50
Embodiment 15	-	-	-	Polyester filament in Embodiment 8	100	134	1.40	19000	64	0.046	6.3	0.48
Comparison example 6	Common polyester	60	56	Polyester filament in Embodiment 3	40	56	0.72	4600	30	0.012	2.1	0.36
Comparison example 7	Common polyester	60	200	Polyester filament in Embodiment 2	40	200	0.72	12000	35	0.008	1.8	0.85

(continued)

	Yarn 1			Yarn 2			Fabric performance					
	Type	Content (%)	Total fineness (dtex)	Type	Content (%)	Total fineness (dtex)	Monofilament fineness (dtex)	Pore area distribution center (μ m ²)	Coefficient of variation of the pore area (%)	Bending rigidity (N • cm ² /cm)	Surfaces roughness (μ)	Compression energy (N • cm/cm ²)
Comparison example 8	Common polyester	55	28	Polyester filament in comparison example 1	45	28	0.78	4200	27	0.030	5.0	0.18
Comparison example 9	Common polyester	55	250	Polyester filament in comparison example 2	45	250	0.87	25000	51	0.007	1.6	0.90
Comparison example 10	-	-	-	Polyester filament in comparison example 5	100	100	0.69	8000	25	0.050	7.1	0.15

[0093] It can be seen from Table 1 that:

(1) It can be seen from Embodiments 1, 2 and 3 that, if the total fineness is higher, the average length of the twist regions in the false-twist direction is shorter, the proportion of the twist regions in the false-twist direction in the filament is lower, and the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is smaller. However, the coefficient of variation of length basically remains unchanged.

(2) It can be seen from the Embodiments 1, 4 and 5 that, when the same polyester pre-oriented yarn POY is processed at a same false-twisting speed, a same extension rate and a same D/Y ratio, if the temperature in the first hot box is higher, the average length of the twist regions in the false-twist direction of the polyester filament becomes larger relatively, the proportion of the twist regions in the false-twist direction in the filament is higher, and the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is larger. However, the coefficient of variation of length is close to each other.

(3) It can be seen from the Embodiments 1, 6 and 7 that, when the same polyester pre-oriented yarn POY is processed at a same false-twisting speed, a same temperature in the first hot box and a same extension rate, if the D/Y ratio is higher, the average length of the twist regions in the false-twist direction of the polyester filament is smaller, the proportion of the twist regions in the false-twist direction in the filament is lower, the ratio of the diameter of the twist regions in the false-twist direction to the diameter of the twist regions in the opposite direction is smaller, the coefficient of variation of length is larger, and the yarn is softer.

(4) It can be seen from Embodiment 8 that, when the monofilament fineness is greater than 1.3 dtex, the yarn feels worse even if the appearance and various performance indexes of the yarn are similar to those of the cotton yarn.

(5) It can be seen from Embodiments 1 and 2 that, when the total fineness of the polyester filament is too small or too large, the appearance and performances similar to those of the cotton yarn cannot be obtained. If the total fineness is too small, the full-stiff polyester yarn will be caused; however, if the total fineness is too large, the common polyester false-twisted yarn is formed.

(6) It can be seen from the comparison example 3 that, when the temperature in the first hot box is greater than 250°C, the yarn is completely stiff. It can be seen from the comparison example 4 that, when the temperature in the first hot box is less than 230°C, the yarn is too fluffy, similar to the common polyester false-twisted yarn.

(7) It can be seen from the comparison example 5 that, when the D/Y ratio is less than 1.5, the appearance and performances similar to those of the cotton yarn cannot be realized, and the yarn is stiff.

[0094] It can be seen from Table 2 that:

(1) It can be seen from Embodiments 9 and 13 and Embodiments 10 and 14 that, at the same fineness, if the content of the yarn 2 increases, the fabric has a larger pore area, a larger coefficient of variation of the pore area distribution, a higher bending rigidity, a higher surface roughness, and a lower compression energy. That is, the cotton-like effect is improved.

(2) It can be seen from Embodiments 11 and 12 that, if the yarn 2 has a smaller diameter ratio and a larger coefficient of variation of length of the twist regions in the false-twist direction, the fabric has a larger pore area and a larger coefficient of variation of the pore area, i.e., a more non-uniform pore area distribution. In addition, if the twist regions in the false-twist direction have a smaller length and a lower proportion, the fabric has an increased softness, a decreased bending rigidity, a decreased surface roughness, and an increased compression energy. That is, the fluffiness is increased.

(3) It can be seen from Embodiments 9 and 10 that, if the yarn 2 has a larger fineness and a smaller diameter ratio, the fabric has a larger pore area and a larger coefficient of variation of the pore area, i.e., a more non-uniform pore area distribution. If the twist regions in the false-twist direction has a smaller length and a lower proportion, the fabric has a lower bending rigidity, a lower surface roughness, and a lower compression energy. That is, the fluffiness is higher.

(4) It can be seen from Embodiment 15 that, although the fabric has a pore distribution similar to that of the cotton-containing products, the fabric has a higher surface roughness which influences the cotton-like effect since the monofilament fineness of the yarn 2 is greater than 1.3 dtex.

(5) It can be seen from Embodiments 6 and 7 that, when the content of the yarn 2 is less than 45%, the same coefficient of variation of the pore area as the cotton-containing products cannot be realized, so that the same appearance as the cotton products is not achieved.

(6) It can be seen from the comparison example 8 that, since the used yarn 2 is a common full-stiff polyester yarn, the fabric is unable to have the same appearance as the cotton-containing products (both the pore area and the coefficient of variation of the pore area are too small); moreover, the fabric has a too low fluffiness and is thus not so soft as cotton products.

(7) It can be seen from the comparison example 9 that, the used yarn 2 is similar to a common full-stiff polyester yarn, and the fabric has a too large pore area and has no compactness like the cotton products. Moreover, the fabric has an insufficient bending rigidity and does not have the same slenderness as the cotton products.

(8) It can be seen from the comparison example 10 that, since the used yarn 2 does not have the appearance and performances similar to those of the cotton yarn, the fabric has a too uniform pore distribution and does not have the same appearance as the cotton products. Moreover, the bending rigidity is too high, and it is thus not so soft as cotton products.

Claims

1. A cotton-like knitted fabric, **characterized in that** the fabric is a weft-knitted fabric obtained by material containing at least above 45% by weight of polyester filaments; and, the pore area distribution of the fabric is centered on 6000 to 22000 μm^2 and has a statistical variability of above 2σ , and the coefficient of variation of the pore area is greater than 40%.
2. The cotton-like knitted fabric according to claim 1, **characterized in that** the content of the polyester filament is 100% by weight.
3. The cotton-like knitted fabric according to claim 1 or 2, **characterized in that** the polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of less than 0.3 cm, a coefficient of variation of length above 60%, a diameter that is 30% to 70% of the diameter of the twist regions in the opposite direction, and a total length that is 20.0% to 40.0% of the total length of the polyester filaments.
4. The cotton-like knitted fabric according to claim 1 or 2, **characterized in that** the polyester filament has a total fineness of 56 to 220 dtex, and a monofilament fineness of less than 1.30 dtex.
5. The cotton-like knitted fabric according to claim 1 or 2, **characterized in that** the fabric is a pile fabric.
6. The cotton-like knitted fabric according to claim 1 or 2, **characterized in that** the fabric is obtained by knitting a single filament or jointly knitting two filaments.
7. The cotton-like knitted fabric according to claim 1 or 2, **characterized in that** the fabric has a bending rigidity of 0.015 to 0.045 $\text{N} \cdot \text{cm}^2/\text{cm}$, a surface roughness of 3.0 to 6.0 μ , and a compression energy of 0.20 to 0.80 $\text{N} \cdot \text{cm}/\text{cm}^2$.
8. A polyester filament, **characterized in that** the polyester filament is formed from alternately arranged twist regions in a false-twist direction and twist regions in an opposite direction, wherein the twist regions in the false-twist direction have an average length of less than 0.3 cm, a coefficient of variation of length of above 60%, a diameter that is 30% to 70% of the diameter of the twist regions in the opposite direction, and a total length that is 20.0% to 40.0% of the total length of the polyester filament.
9. The polyester filament according to claim 8, **characterized in that** the polyester filament has a total fineness of 56 to 220 dtex, and a monofilament fineness of less than 1.30 dtex.
10. A method for manufacturing the polyester filament according to claim 8 or 9, comprising the following steps of:
 leading a polyester pre-oriented yarn into a first roller, then into a first hot box for heating, and finally into a false twister, a second roller, a second hot box and a third roller to obtain the polyester filament,
 wherein the temperature in the first hot box is 230°C to 250°C; and,
 the D/Y ratio in the step is 1.5 to 2.5.

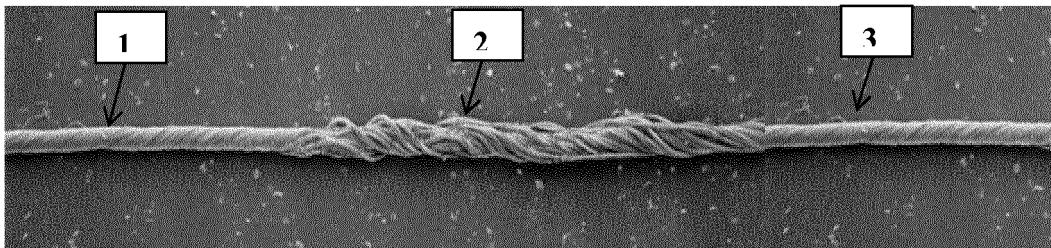


Fig. 1

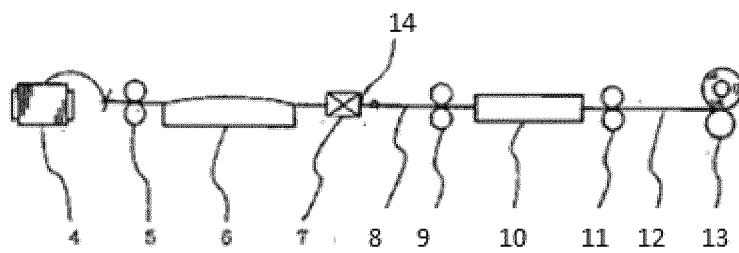


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/097077

A. CLASSIFICATION OF SUBJECT MATTER

D04B 1/06 (2006.01) i; D02G 3/26 (2006.01) i; D02G 1/02 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D02G; D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, CNPAT, CNKI: weft knitting, cotton like, variation coefficient, false twist, reverse direction, knitting, weft, cotton, imitation, fabric, textile, cloth, hole, open, pore, area, CV, variation, polyester, terylene, false, twist, reverse

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 103603113 A (TORAY FIBERS (NANTONG) CO., LTD.), 26 February 2014 (26.02.2014), description, paragraphs 0003-0009 and 0020, tables 1-2, and figures 1-2	1-10
A	CN 103981608 A (ZHEJIANG HENGYI HI-TECH MATERIALS CO., LTD.), 13 August 2014 (13.08.2014), the whole document	1-10
A	JP 4253067 B2 (MITSUBISHI RAYON CO., LTD.), 08 April 2009 (08.04.2009), the whole document	1-10
A	CN 103320923 A (ZHEJIANG HENGYI HI-TECH MATERIALS CO., LTD.), 25 September 2013 (25.09.2013), the whole document	1-10
A	JP 08100340 A (TORAY INDUSTRIES), 16 April 1996 (16.04.1996), the whole document	1-10
A	JP 08226033 A (MITSUBISHI RAYON CO.), 03 September 1996 (03.09.1996), the whole document	1-10
A	CN 103471973 A (DONGHUA UNIVERSITY), 25 December 2013 (25.12.2013), the whole document	1-10

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 18 February 2016 (18.02.2016)	Date of mailing of the international search report 10 March 2016 (10.03.2016)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer ZENG, Hao Telephone No.: (86-10) 62085476

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/097077

5	C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
10	A	DE 2327434 B2 (MITSUBISHI RAYON CO., LTD.), 20 January 1977 (20.01.1997), the whole document	1-10
15			
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Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/097077

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 103603113 A	26 February 2014	CN 103603113 B	30 September 2015
CN 103981608 A	13 August 2014	None	
JP 4253067 B2	08 April 2009	JP 2000303287 A	31 October 2000
CN 103320923 A	25 September 2013	CN 103320923 B	12 August 2015
JP 08100340 A	16 April 1996	None	
JP 08226033 A	03 September 1996	None	
CN 103471973 A	25 December 2013	None	
DE 2327434 B2	20 January 1977	DE 2327434 A1	19 December 1974
		US 3977173 A	31 August 1976
		FR 2230763 A1	24 January 1975
		GB 1431568 A	07 April 1976

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 103898670 A [0003]
- CN 102517775 A [0004]
- CN 103603113 A [0005]
- JP 2000303287 A [0005]