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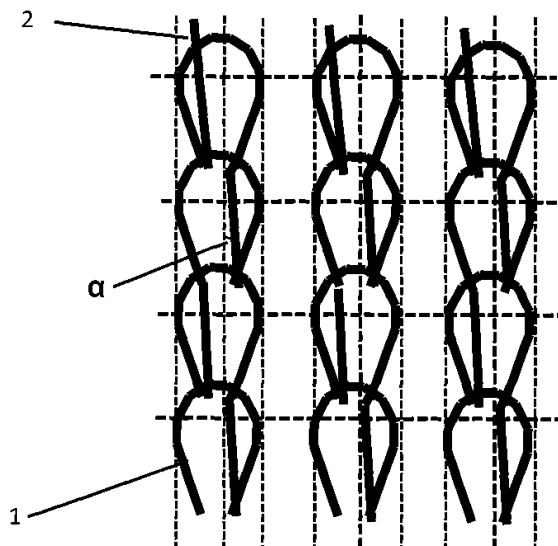
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(54) **SHELL FABRIC WITH MOTION FOLLOWABILITY**

(57) Provided is a stretch fabric with an excellent snap back performance. The stretch fabric is a warp knitted fabric formed from hard yams and elastic yams, wherein the included angle (α) between a sinker loop (2) of the elastic yam and the knitting direction of a needle loop is 0-10°, and the included angle (β) between a sinker loop (4) of the hard yam and the knitting direction of a

loop is 5-85°. Particularly under high-speed stretching and recovery motion conditions, a wearing pressure increase caused by an elongation stress and a wearing pressure decrease caused by a delayed recovery can be effectively inhibited; moreover, the wearing comfort can be maintained and muscle vibration can be prevented.

Fig. 1



Description

FIELD OF THE INVENTION

5 **[0001]** The present invention relates to a stretch fabric with high speed snap back performance, and in particular to a warp knitted fabric formed from hard yarns and elastic yarns.

BACKGROUND OF THE INVENTION

10 **[0002]** An elastic stretch fabric formed by polyurethane fibers has relatively good snap back performance under low speed and constant speed conditions, but it will not recover in time after stretching under high speed and abrupt-acceleration conditions. Moreover, different knitting stitches generate different binding forces on the stretch fabric, and this binding force will also affect the expansion and contraction performance of the stretch fabric, thereby affecting the snap back performance.

15 **[0003]** At present, most of the warp knitted stretch fabrics on the market are often only suitable for sports under low speed and constant speed conditions. For example, Chinese Patent Publication No. CN202323318U discloses an stretch warp knitted fabric, which is knitted by three guide bars, the surface guide bar knits with 20D polyamide yarn, and then the two guide bars respectively knit with 40D, 70D spandex weft laid-in stitches, and the obtained stretch fabric has superior elasticity and softness and is comfortable to wear.

20 **[0004]** As another example, Chinese Patent Publication No. CN205077227U discloses a novel warp knitted body shaping stretch fabric which is knitted by three guide bars, specifically, the front guide bar is made of synthetic fiber filaments and knitted by tricot stitches; the middle guide bar alternately knits by using spandex via tricot stitches and two needle stitches; and the back guide bar knits by using spandex via reserve tricot stitches, and the obtained stretch fabric has different body shaping effects on different portions of the body.

25 **[0005]** As yet another example, Chinese Patent Publication No. CN102648313A discloses an elastic warp knitted fabric, wherein elastic yarns are knitted with knit stitches such as full tricot stitches, two needle stitches or warp sateen stitches, hard yarns are knitted with warp pile stitches or 5-needle warp sateen stitches, the tilt angle of the mesh is 20 to 70 degrees, the obtained stretch fabric has excellent elongation balance and elongation recovery in the warp and weft directions, is well-fitting and unlikely to generate pattern deformation during wear, and has excellent snap back performance, thereby being able to improve the sports functions.

30 **[0006]** It is well known that top-level athletes experience high-speed and abruptly-variable-speed motion states during exercise. However, none of these documents provides relevant solutions for the snap back performance of the stretch fabric under high-speed and abrupt-acceleration conditions.

35 SUMMARY OF THE INVENTION

[0007] The object of the present invention is to provide a stretch fabric having excellent snap back performance, which is particularly suitable for motion under high speed and abrupt-acceleration states.

[0008] The technical solution of the present invention is as follows:

40 A stretch fabric with snap back performance of the present invention is a warp knitted fabric formed by hard yarns and elastic yarns, wherein the included angle between a sinker loop of the elastic yarn and the knitting direction of a loop is 0-10°, and the included angle between the sinker loop of the hard yarn and the knitting direction of the loop is 5-85°.

[0009] The stretch fabric with snap back performance of the present invention can effectively prevent a wearing pressure increase caused by an elongation stress and a wearing pressure decrease caused by a delayed recovery, particularly under high-speed and abrupt-acceleration conditions, so that wearing comfort can be maintained, and muscle vibration can be prevented. In addition, the stretch fabric of the present invention is less prone to problems such as busting and tearing even when being used for a long period of time, and has a long-lasting elastic effect. The stretch fabric of the present invention can be used for making garments suitable for athletes and the like, and is particularly suitable for making tight-fitting athletic wear for top athletes to wear under high speed and abrupt-acceleration conditions.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

55 Fig. 1 is a schematic diagram of a fabric structure of elastic yarns in a stretch fabric of the present invention, wherein 1 represents a needle loop of the elastic yarn, 2 represents a sinker loop of the elastic yarn, and α represents the included angle between the sinker loop of the elastic yarn and the knitting direction.

Fig. 2 is a schematic diagram of a fabric structure of sinker loop in a stretch fabric of the present invention, wherein

3 represents the needle loop of the hard yarn, 4 represents the sinker loop of the hard yarn, and β represents the included angle between the sinker loop of the hard yarn and the knitting direction .

Fig. 3 is a structural schematic diagram of a flex testing instrument of the present invention, wherein 5 represents a flex testing fabric specimen , 6 represents an annular inner frame, 7 represents an annular outer frame, and 8 represents a fixing screw.

Fig. 4 is a structural schematic diagram of the flex testing instrument in a test process, wherein 9 represents a sagging area of the flex testing fabric specimen.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0011] The stretch fabric with excellent snap back performance of the present invention is a warp knitted fabric formed by hard yarns and elastic yarns, wherein the included angle between an sinker loop of the elastic yarn and the knitting direction is 0-10°, and the included angle between the sinker loop of the hard yarn and the knitting direction is 5-85°.

[0012] It is considered that the specific structural characteristics of the elastic yarns and the hard yarns in the stretch fabric are key factors determining the snap back performance of the stretch fabric. For the specific structural features described above, in the present invention, it is characterized by the included angle formed between the sinker loop and the knitting direction. The specific angle size is observed by an SEM electron microscopy or a digital microscope.

[0013] The structure of the elastic yarn in the stretch fabric is mainly composed of two portions, namely needle loop and an sinker loop, wherein the needle loop are sequentially connected along the knitting direction and the stretchability can be maximized in the knitting direction . In order to optimize the stretchability of the sinker loop portion, it is required that the stretchability of the sinker loop portion should be contributed as much as possible in the knitting direction of the loop, that is, the greater projection amount of the sinker loop of the elastic yarn in the knitting direction of the loop is better, that is, the smaller included angle between the sinker loop and the knitting direction of the loop is better. When the included angle is minimum and tends to 0°, the stretchability of the sinker loop is almost entirely contributed to the knitting direction of the loop. When the included angle is greater than 10°, orthogonal decomposition is performed on the sinker loop of the elastic yarn, an obvious component is generated during projection in the horizontal direction, that is to say, the stretchability of the extension line is not concentrated to the knitting direction, which is disadvantageous for improving the snap back performance. Thus, in order to maximize the snap back performance effect, in the present invention, it is required that the included angle between the sinker loop of the elastic yarn and the knitting direction should be 0° to 10°, and preferably 2° to 9°.

[0014] The structure of the hard yarn in the stretch fabric is also composed of needle loop and a sinker loop. The needle loop of the hard yarn are also distributed in the knitting direction, that is, the telescopic motion direction, and the needle loop of the inelastic yarn are overlapped with the needle loop of the elastic yarn. On one hand, the hard yarn itself has almost no stretchability, so it can only provide a telescopic space for the elastic yarn via the deformation of the loop structure; and on the other hand, as the strength of the hard yarn is higher than that of the elastic yarn, the hard yarn loop plays a certain "reinforcing" effect on the elastic yarn loop, which can improve the strength of the stretch fabric.

[0015] The extension line of the hard yarn can not only ensure the connection between the loops to smoothly form the fabric, but also can restrict the stretchability of the stretch yarn to some extent, that is, affect the snap back performance of the stretch fabric. For the entirety of the stretch fabric, the snap back performance, the strength and other properties must be evenly distributed, which requires that the structures of the sinker loop of the hard yarn in the stretch fabric must be consistent, that is, the angles between the sinker loop of all hard yarns and the knitting direction of the needle loops should be consistent. When the included angle between the extension line of the hard yarn and the knitting direction of the needle loop is less than 5°, the distribution of the sinker loop is biased toward the knitting direction of the loops, and links between the transverse loops are relatively small, and it is difficult to ensure the smooth knitting of fabric ; when the included angle between the sinker loop of the hard yarn and the knitting direction of the needle loop is 86° to 90°, the sinker loop of the hard yarn is substantially perpendicular to the knitting direction of the needle loop. For the elastic yarn parallel to the telescopic motion direction, the application of the performance is greatly restricted, which is not conducive to the implementation of the snap back performance. Therefore, in order to maximize the snap back performance, the present invention requires that the included angle between the sinker loop of the hard yarn and the knitting direction should be 5° to 85°, and is preferably 7° to 65°.

[0016] The elastic yarn mentioned in the present invention is not particularly limited, and may be a polyurethane fiber (also called spandex, referred to as PU), or a single-component polyester fiber or a two-component side-by-side polyester fiber, or a high-shrinking false twisted yarn. In view of the original intention of the design of the stretch fabric with the snap back performance, it is hoped that the wearing pressure increase caused by the elongation stress during elongation can be reduced, and the wearing pressure decrease caused by the delayed recovery of the stretch fabric can also be reduced due to the use of the elastic yarn. The stretch fabric is required to have small corresponding tensile stress when a large elongation amount is obtained; meanwhile, it is required that the stretch fabric should have good instantaneous recovery and a higher recovery force retention rate. In addition, from the perspective of durability, it is required that the

stretch fabric should maintain its original size and elasticity after repeated reciprocating expansion and contraction. Therefore, the elastic fiber used in the present invention is preferably the polyurethane fiber, which has low stress and high elongation property, can recover after stretching, and has a high recovery strength maintaining rate and good durability, and more preferably soft elastic spandex. The soft elastic spandex refers to a polyurethane fiber obtained after the reaction of polyether diol having a side chain and a diisocyanate compound with two or more diamine compounds, wherein the molar ratio of ethylenediamine contained in the diamine compound to a branched aliphatic diamine compound having 3 to 5 carbon atoms is 98: 2 to 82: 18. There are many types of spandex available on the market, such as LYCRA® FUSION™ spandex produced by the INVISTA, creora® PowerFit spandex by the Hyosung, and Qianxi spandex produced by Huafo Spandex Co., Ltd. Compared with the spandex described above, the soft elastic spandex used in the present invention has superior softness and elasticity, and its soft elastic index is 0.75-1. The soft elastic index refers to a ratio of the elongation stress at 100% elongation to the recovery stress of 100% recovery after elongation to 300%. The soft elastic index indicates that the soft elastic spandex has a high recovery force retention rate, which is advantageous for improving the elastic recovery of the stretch fabric and reducing the incidence of delayed recovery, thereby improving the motion followability of the stretch fabric.

[0017] In the present invention, the higher the content of the elastic yarn is, the more sufficient and significant the effect of the elastic yarn is played, and the better the snap back performance of the stretch fabric is. Theoretically, the stretch fabric composed of 100% elastic yarns has the best snap back performance, but such a stretch fabric may have problems such as busting and tearing due to insufficient strength. In order to ensure that the strength performance of busting tearing and the like of the stretch fabric can reach the standard, in the present invention, the hard yarns, that is, "hard yarns" are used for reinforcement, the higher the content of the hard yarns is, the higher the strength performance indexes such as busting and tearing is, but relatively speaking, the lower the content of the elastic yarns is, the more easily the hard yarns exert the inhibition on the performance of the elastic yarns, and it may not get a good snap back performance effect. Therefore, it is necessary to find a balance point between the snap back performance and the strength performance, and to maximize the snap back performance under the premise of ensuring the strength. Therefore, the content of the elastic yarns in the present invention is preferably 50 to 90% by weight.

[0018] Considering that if the distribution density of the elastic yarns in the stretch fabric is too small, the elastic stress of the stretch fabric is too small, and the work done to overcome the elastic stress during the stretching process is relatively small. Although it becomes easy to stretch, there is also a problem of insufficient wearing pressure and a tendency of worse muscle vibration prevention effect, and the recovery stress becomes small, and the timely recovery performance at high speed and abrupt acceleration also tends to deteriorate. On the other hand, if the distribution density of the elastic yarns is too large, the elastic stress and the recovery stress of the stretch fabric are too large. Although the timely recovery performance at high speed and abrupt acceleration is remarkably improved, work done to overcome the elastic stress during the stretching process becomes relatively large, so that it may be unlikely to stretch, and correspondingly, if the wearing pressure is too large, the oppressing sensation on the human body will be too strong, and the wearing comfort will be worse. Therefore, the distribution density of the elastic yarns mentioned in the present invention is preferably 30 to 200 w/inch.

[0019] The hard yarn referred to in the present invention preferably has an elongation of 5 to 50%. Since the yarn needs a certain amount of stretching for bending and circling, in a knitting process, if the elongation is less than 5%, the yarn is liable to break, and the knitting requirement may not be satisfied. When the elongation is greater than 50%, the yarn is likely to be over-drafted in the knitting process, so that the yarn feeding may not be smooth, and the passability may be poor. The fiber raw material of the hard yarn satisfying the above elongation range can be a natural fiber such as cotton or wool, or can be an artificial fiber such as viscose or modal, or a synthetic fiber such as nylon or polyester. From the viewpoints of high efficiency and cost of knitting, chemical fiber filaments such as nylon and polyester are preferred. The nylon herein includes ordinary nylon and modified nylon (e.g., having hygroscopic groups or the like), and the polyester includes ordinary polyester and modified polyester (e.g., having cationic dyeable groups or the like).

[0020] In addition to the influence on the contents of the hard yarns and the elastic yarns, the thickness of the yarn also affects the gram weight of the stretch fabric. If the gram weight is too large, the stretch fabric is too thick, the wearing pressure on the human body is relatively large, and the friction force with the skin surface is relatively large, which is not conducive to obtaining a good sport following effect, and also affects knitting comfort. If the gram weight of the stretch fabric is too small, the stretch fabric is too light and thin such that the anti-transparent performance and the like are not ideal enough to meet general cloth requirements. Therefore, it is necessary to make a reasonable choice on the fineness of the yarn used. The hard yarn used in the present invention preferably has a fineness of 10 to 100 deniers (abbreviated as D), and more preferably 10 to 50 D; and the elastic yarn has a fineness of preferably 30 to 300 D, and more preferably 70 to 140 D. In terms of the gram weight of the shell fabric and the like, the hard yarn is selected as a relatively fine yarn as much as possible, and the elastic yarn is selected as a relatively coarse yarn as much as possible. Therefore, it is preferred that the fineness of the elastic yarn is 1 to 10 times, more preferably 1 to 5 times, as large as the fineness of the inelastic yarn.

[0021] The present invention adopts a warp knitted stitch for knitting, and the number of guide bars is preferably 2 or

3, the number of guide bars is too large, and the shell fabric is too thick, which may affect the acquisition of the snap back performance effect. The stretch fabric knitted by two guide bars is used as an example, the stretch fabric is divided into four hierarchical structures from the front face of the process to the reverse side of the process, which are respectively a loop surface of a front guide bar the loop surface of a back guide bar, an extension line surface of the back guide bar and the extension line surface of the front guide bar and the structure formed by the four layers that are sleeved and connected to each other has better structural compactness and stability than the single-side weft-knitted fabric or a knitted fabric, and can ensure the stable performance of the snap back performance. During the knitting, it is preferred that the elastic yarn is located in the back guide bar, so that both the loop surface and the extension line surface are located in the inner layer to prevent the same from being worn and to improve the durability. The stretch fabric knitted by three guide bars is used as an example, the stretch fabric is divided into six hierarchical structures from the front face of the process to the reverse side of the process, which are respectively the loop surface of the front guide bar, the loop surface of a middle guide bar, the loop surface of the back guide bar the extension line surface of the back guide bar, the extension line surface of the middle guide bar and the extension line surface of the front guide bar. With respect to the stretch fabric formed by the three guide bars, it is preferred that the front guide bar and the middle guide bar adopt a threading mode of threading one and leaving one and reversely laying the yarns, in this way, the stretch fabric can be prevented from being too thick on one hand, and the stretch fabric structure can be more stable on the other hand.

[0022] The present invention is produced by conventional refining and dyeing and sorting of a knitted fabric obtained by knitting, and the specific processing conditions are not particularly limited. In the finishing process, water-absorbing soft resin can be adopted to further endow a soft and comfortable hand feeling and good water absorption property to the stretch fabric. The water-absorbing soft resin herein refers to a resin finishing agent having a hydrophilic group and having a lubricating effect, and a commercially available product can be directly used as the water-absorbing soft resin, or can be synthesized according to a technique known in the art, and the dosage thereof is adjusted according to the fiber components of the stretch fabric, is preferably 5 to 30 g/L and is more preferably 10 to 20 g/L.

[0023] In view of the fact that during the actual wearing, the stretch fabric will generate the delayed recovery phenomenon in a reciprocating motion process, in order to recover the phenomenon, in the present invention, the stretch fabric is made into a cylinder having a diameter of 10cm and a height of 5cm, the reciprocating motion is simulated under the condition of 50% elongation and 3 times/second speed expansion and contraction, and it is found that the cylindrical stretch fabric depresses inward in the motion process due to the delayed recovery, the cylindrical edge of the deformed stretch fabric forms a sealed area with the vertical portion, that is, a deformation area generated for the delayed recovery. In order to obtain a superior snap back performance effect, the sagging area formed by the depression of the contour portion of the stretch fabric in the present invention is preferably not greater than 2 cm², and is further preferably not greater than 1.5 cm².

[0024] Preferably, when wearing the clothes made of the stretch fabric of the present invention, the clothes pressure at the middle of the thigh in a static state is measured as 1.5-2.0 kPa, and the recovery stress of the stretch fabric at the corresponding portion is 1.5-3.0 N. Within the above range, the wearing comfort can be guaranteed, and the vibration of thigh muscles can be effectively prevented.

[0025] Preferably, the tear strength of the stretch fabric of the present invention is measured as 9.8 N or more under the test conditions of JIS L 1096:2010 D method; and under the test conditions of the JIS L 1096:2010 A method, the burst strength of the stretch fabric of the present invention is measured as greater than 290 kPa. Within the above range, it can be ensured that the clothes made of the stretch fabric are not easily torn during the multiple times of wearing, taking off and use, and are not easily broken.

[0026] The present invention will now be described in more detail by way of examples and comparative examples. The performance indexes involved in the examples are measured by the following methods.

(1) The included angle between the sinker loop and the knitting direction of the loop

[0027] Step 1, cutting a 150 mm × 150 mm sample and observing the sample at a magnification of 20 times by using an SEM electron microscope or a digital microscope;

[0028] Step 2, selecting two loops (of the elastic yarn or the hard yarn) on any knitting direction, wherein the two are preferably separated by 25 to 50 loops in the knitting direction; respectively using the highest points of the needle loop of the two selected loops as marking points, connecting the two marking points to obtain a sinker loop to serve as a reference line in the knitting direction of the loop, and using the sinker loop as the datum line for measuring the angle of the extension line of the loop;

[0029] Step 3, randomly selecting 12 loops at the top, bottom, left and right positions of the sample, wherein 3 loops are located at each position, measuring the included angles between the sinker loop of the loops (the elastic yarns or the hard yarns) at different positions and the datum line (or a parallel line of the datum line) by using a protractor, and using the average value as the included angle between the extension line (of the elastic yarn or the hard yarn) and the knitting direction of the loop.

(2) Sagging area

[0030] Meaning: the size of the area of the deformed portion due to the delay during the reciprocating telescopic motion of the stretch fabric under specific speed and elongation conditions. The smaller the value is, the better the motion followability of the stretch fabric is. The specific method is as follows:

Test equipment: De Mattia repeated fatigue testing machine DC-210 type (made by the Daiei Scientific Precision Manufacturing Co., Ltd.)

[0031] Step 1, sampling: on any portion of the stretch fabric, horizontally measuring a length of 350 mm to serve as a marking line, longitudinally measuring a length of 120 mm to serve as a marking line, cutting along the marking line to obtain a rectangular sheet sample with length 350 mm $\times$ width 120 mm, and sampling 5 pieces by using the same method;

step 2, pre-treatment of the sample fabric : clamping the upper and lower edges of the sample fabric on upper and lower jaws of the repeated fatigue testing machine and fixing the same, then setting the pre-elongation as 80%, and performing reciprocating pre-stretching treatment for 10 times, so that the bent yarns in the stretch fabric are straightened;

step 3, cylindrical treatment and installation of the sample fabric : adhering the pretreated sample fabric along the knitting direction by tapes or the like to form a cylindrical shape; preparing a pair of annular fixing devices respectively formed by the reedination of inner frames and outer frames, sleeving the cylindrical sample fabric on the outer side of the annular inner frame, and then sleeving the annular outer frame on the outer side of the cylindrical sample fabric , and fixing it with screws or the like firmly to obtain a cylindrical test tool having an effective diameter of 10 cm and a height effective size of 5 cm; and then mounting the cylindrical test tool on the repeated fatigue testing machine as a whole, wherein in the whole installation and fixing process, the stretch fabric should be smooth and free from slack, and there should be no accidental stretching, that is, the stretch fabric should not be tensioned so as not to affect the later test results;

step 4, test: setting the maximum elongation of the stretch fabric as 50%, wherein the test process is specifically low speed (1 time/second), medium speed (2 times/second), high speed (3 times/second), medium speed (2 times/second) and low speed (1 time/second), and respectively testing for 1 minute at the stretching speed. The whole test process is recorded by a high-speed camera, and the high-speed camera used here refers to a camera with a frame rate of 100-1000 fps;

step 5, quantification: the relaxation area generated under a high speed (3 times/second) condition is the evaluation index of the snap back performance of the present invention. An image taken when the above stretch fabric recovers to the initial position state after being subjected to the telescopic test for 1 minute under the high speed (3 times/second) is picked out and printed. The area (in cm^2) of the above-described deformed portion is measured on printing paper by using an area meter or other image processing tools. In addition, the sagging areas under the low speed (1 time/second) and the medium speed (2 times/second) can also be measured according to the same test method, and the data measured under the speed conditions can be compared and analyzed to evaluate the snap back performance of the stretch fabric at various speeds. Furthermore, the relationship curve between the sagging area and the corresponding expansion speed can be made based on these data, and the advantages and disadvantages of the snap back performance of the stretch fabric can be observed and judged by observing the change trend of the curve; and

step 6, testing N number and deviation value: the 5 sample fabric are all tested according to the above steps 1 to 5, and the average value is taken as the test result of the sagging area of the present invention when the data are valid. Whether the data are valid is determined by the change coefficient of the data. The change coefficient of a group of data is obtained by dividing a standard deviation value by the average value of the group of data, that is, the change coefficient = standard deviation value/average value, if the change coefficient of a group of test data is less than 0.1, the group of test data is regarded as valid data, otherwise the test is performed again.

(3) Clothes pressure

[0032] Meaning: indicating the contact pressure of the clothes on the human body. The smaller the value is, the smaller the pressure of the clothes on the human body portion is, and the more unfavorable the prevention of the muscle vibration is. The length 500 mm $\times$ width 100 mm sample fabric is sewed into a cylindrical test sample after reserving 50 mm on the two ends on the length direction by using the Pressure Converter-5S3037-5S clothes pressure tester manufactured by the Japan AMI Co., Ltd., the circumference of the sewed cylindrical test sample is 400 mm, and then the cylindrical test sample is sleeved flatly at the middle of the thigh of a dummy, the circumferential extension reaches 500 mm (the corresponding elongation of use reaches 25%), and the test is performed for three times, and the average value is taken.

(4) Recovery stress

[0033] Meaning: indicating the size of stress when the stretch fabric attempts to return to the original position after being stretched. The larger the value is, the better the recovery of the stretch fabric is. The test method is as follows:

- a. Sample cloth: horizontal 100 mm × wale 150 mm, 6 pieces (3 pieces are used for testing the elongation and 3 pieces are used for testing the recovery stress);
- b. using an electronic universal tensile testing machine equipped with an automatic recording device (made by the Meitesi Industry System (china) Co., Ltd, model number CMT6103), setting a clamping amplitude of 2.54 cm and a clamping distance of 7.6 cm, and applying 29 mN (3g) initial load;
- c. stretching to 10 N at a stretching speed of 10 cm/min, reading the corresponding elongation at this time, and further obtaining the elongation. The average value measured by the three pieces of sample cloth on the same direction is used as the final elongation;
- d. Stretching at a tensile speed of 10 cm/min to 80% of the elongation obtained in the step c, holding for 1 minute, returning to the original position at the same speed, and holding for 3 minutes; and
- e. After repeating the operation of the step d for 5 times, the data automatically recorded by the device is plotted to draw a relationship curve corresponding to the elongation stress and the elongation, reading the recovery stress corresponding to recovery to 25% elongation, testing the three pieces of sample cloth according to the above method, and taking the average value as the test result of the recovery stress of the present invention.

(5) Tear strength

[0034] The test is carried out in accordance with the Japanese Industrial Standard JIS L 1096: 2010 D method. The larger the value is, the higher the tear strength of the stretch fabric is, and the less likely it is to be torn.

(6) Bursting strength

[0035] The test is carried out in accordance with the Japanese Industrial Standard JIS L 1096: 2010A. The larger the value is, the higher the tear strength of the stretch fabric is, and the less the cracking possibility is.

Example 1

[0036] On the RSE4 Raschel warp knitting machine (machine number E32, machine width 136 inches), 40D-34f-nylon FDY (made by the Toray Synthetic Fiber Co., Ltd.) is selected as the yarn of the front guide bar 100D ordinary spandex bare yarn (made by Huaфон) is used as the yarn of the back guide bar a tricot stitch/pillar stitch of crossing two needles by the front guide bar and crossing one needle by the back guide bar is adopted, the front guide bar and the back guide bar perform full threading, the knitting is performed to obtain a gray fabric, and then the stretch fabric of the present invention is made by refining and dyeing and sorting, and reference can be specifically made to table 1.

[0037] Refining conditions: caustic soda 2 g/L, scouring agent 2 g/L, 95° C × 20 min, bath ratio 1: 20; dyeing: 95° C × 30 min, and reduction cleaning: 80° C × 20 min.

Example 2

[0038] On the HKS4 high-speed tricot machine (machine number E32, machine width 136 inches), 20D-12f-cationic dyeable polyester FDY (referred to as CD-PET, made by the Toray Synthetic Fiber Co., Ltd.) is used as the yarn of the front guide bar 140D ordinary spandex bare yarn (made by the Hyosung Co., Ltd.) is used as the yarn of the back guide bar a miss-lapping/pillar stitch of crossing 1-2 needles by the front guide bar and crossing one needle by the back guide bar is adopted, the front guide bar and the back guide bar perform full threading, the knitting is performed to obtain a gray fabric, and then the stretch fabric of the present invention is made by refining and dyeing and sorting, and reference can be specifically made to table 1.

[0039] Refining conditions: caustic soda 2 g/L, scouring agent 2 g/L, 95° C × 20 min, bath ratio 1: 20; dyeing: 120° C × 60 min, and reduction cleaning: 80° C × 20 min.

Example 3

[0040] The 280D soft elastic spandex bare filament (manufactured by the TORAY OPELONTEX Co., Ltd.) is used as the yarn of the back guide bar, a manner of one threading and one empty is adopted, the rest conditions are the same as those in the example 2, the stretch fabric of the present invention is made, and reference can be specifically made

to table 1.

Example 4

5 **[0041]** Knitting is performed on the HKS4 high-speed tricot machine (machine number E32, machine width 136 inches), the rest conditions are the same as those in the example 1, the stretch fabric of the present invention is made, and reference can be specifically made to table 1.

Example 5

10 **[0042]** The 140D soft elastic spandex bare filament (manufactured by the TORAY OPELONTEX Co., Ltd.) is used as the yarn of the back guide bar the rest conditions are the same as those in the example 2, the stretch fabric of the present invention is made, and reference can be specifically made to table 1.

Example 6

15 **[0043]** Knitting is performed on the RSE4 Raschel warp-knitting machine (machine number E28, machine width 136 inches), the rest conditions are the same as those in the example 1, the stretch fabric of the present invention is made, and reference can be specifically made to table 1.

20

Comparative Example 1

25 **[0044]** Knitting is performed on the RSE4 Raschel warp knitting machine (machine number E32, machine width 136 inches), the rest conditions are the same as those in the example 5, the stretch fabric is made, and reference can be specifically made to table 1.

Comparative Example 2

30 **[0045]** Knitting is performed on the HKS4 high-speed tricot machine (machine number E28, machine width 136 inches), the rest conditions are the same as those in the example 4, the stretch fabric is made, and reference can be specifically made to table 1.

Comparative Example 3

35 **[0046]** The 40D-34f-nylon FDY (made by the Toray Synthetic Fiber Co., Ltd.) is selected as the yarn of the front guide bar, 100D ordinary spandex bare yarn (made by Huaфон) is used as the yarn of the back guide bar the tricot stitch/tricot stitch of crossing two needles by the front guide bar and crossing two needles by the back guide bar is adopted, the knitting is performed to obtain the gray fabric, the rest conditions are the same as those in the example 1, the stretch fabric is made, and reference can be specifically made to table 1.

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Table 1

Item	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2	Comparative Example 3
Raw material	Front guide bar	CD-PET	CD-PET	nylon	CD-PET	nylon	CD-PET	nylon	nylon
	Back guide bar	Ordinary spandex	Softelastic spandex	Ordinary spandex	Softelastic spandex	Ordinary spandex	Soft elastic spandex	Ordinary spandex	Ordinary spandex
Stitch	Tricot stitch/ pillar stitch	Miss- lapping/ pillar stitch	Miss- lapping/ pillar stitch	Tricot stitch/ pillar stitch	Miss- lapping/ pillar stitch	Tricot stitch/ pillar stitch	Miss-lapping/ pillar stitch	Tricot stitch/ pillar stitch	Tricot stitch/ Tricot stitch
Runner length (mm/rack)	1300/ 800	1200/ 800	1200/ 800	1300/ 800	1200/ 800	1300/ 800	1200/800	1300/ 800	1300/1050
Finessness of the hard yarn (D)	40	20	20	40	20	40	20	40	40
Elastic yarn	Content (%)	81	81	58	81	58	81	58	64
	Distribution density (w/ inch)	74	28	39	74	39	74	39	39
Included angle between the sinker loop and the knitting direction	Elastic yarn	5°	5°	2°	5°	2°	11°	2°	12°
	Hard yarn	65°	65°	14°	65°	7°	65°	4°	4°
Snap back performance (sagging area, cm ²)	1.9	1.7	1.5	1.1	0.9	1.6	2.9	2.5	3. 3
Middle portion of the thigh	Clothes pressure (Kpa)	1.5	1.2	1.8	1.7	2.1	1.4	1.6	2.3
	Recovery stress (N)	1.9	1.6	2.5	2.3	2.9	1.7	1.8	3.1
Longitudinal tear strength (N)	11.5	12.6	9.9	11.7	13.4	14.5	9.3	10.1	14.2
bursting strength (Kpa)	354	368	292	363	372	417	284	297	381
General effect	Good	Good	Good	Excellent	Excellent	Good	Poor	Poor	Poor

According to the above table,

[0047]

(1) It can be seen from the example 1 and the example 4 that, under the same conditions, the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 9° is compared with the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 2° , the sagging area of the latter is small, and the snap back performance is more excellent.

(2) It can be seen from the example 2 and the example 5 that, under the same conditions, the stretch fabric using the ordinary spandex is compared with the stretch fabric using the soft elastic spandex, the sagging area of the latter is small, and the snap back performance is more excellent.

(3) It can be seen from the example 3 and the example 5 that, under the same conditions, the stretch fabric in which the spandex distribution density is 28 w/inch is compared with the stretch fabric in which the spandex distribution density is 74 w/inch, the sagging area of the latter is small, and the snap back performance is more excellent.

(4) It can be seen from the example 4 and the example 6 that, under the same conditions, the stretch fabric in which the included angle between the sinker loop of the hard yarn (nylon) and the knitting direction is 14° is compared with the stretch fabric in which the included angle between the sinker loop of the hard yarn (nylon) and the knitting direction is 7° , the sagging area of the former is small, and the snap back performance is more excellent.

(5) It can be seen from the example 1 and the example 5 that, under the same conditions, the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 11° (exceeding 10°) is compared with the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 5° , the sagging area of the former is much greater, and the snap back performance is worse.

(6) It can be seen from the example 2 and the example 4 that, under the same conditions, the stretch fabric in which the included angle between the sinker loop of the nylon yarn and the knitting direction is 4° (less than 5°) is compared with the stretch fabric in which the included angle between the sinker loop of the nylon yarn and the knitting direction is 14° , the sagging area of the former is much greater, and the motion followability is worse.

(7) It can be seen from the example 3 and the example 1 that, under the same conditions, the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 12° (exceeding 10°) and the included angle between the sinker loop of the nylon and the knitting direction is 4° (less than 5°) is compared with the stretch fabric in which the included angle between the sinker loop of the spandex and the knitting direction is 9° and the included angle between the sinker loop of the nylon and the knitting direction is 14° , the sagging area of the former is much greater, and the snap back performance is worse.

Claims

1. A stretch fabric with excellent snap back performance, wherein the stretch fabric is a warp knitted fabric formed by hard yarns and elastic yarns, wherein the included angle between an sinker loop of the elastic yarn and the knitting direction of a needle loop is $0-10^{\circ}$, and the included angle between the sinker loop of the hard yarn and the knitting direction of the needle loop is $5-85^{\circ}$.

2. The stretch fabric with excellent snap back performance according to claim 1, wherein the elastic yarn is a polyurethane fiber.

3. The stretch fabric with excellent snap back performance according to claim 2, wherein the polyurethane fiber is obtained after the reaction of polyether diol having a side chain and a diisocyanate compound with two or more diamine compounds, wherein the molar ratio of ethylenediamine contained in the diamine compound to a branched aliphatic diamine compound having 3 to 5 carbon atoms is 98: 2 to 82: 18.

4. The stretch fabric with excellent snap back performance according to claim 1 or 2, wherein the content of the elastic yarns is 50-90% by weight.

5. The stretch fabric with excellent snap back performance according to claim 1 or 2, wherein the density distribution range of the elastic yarns is 30-200 w/inch.

6. The stretch fabric with excellent snap back performance according to claim 1, wherein the hard yarn is a chemical fiber filament with an elongation of 5-50%.

EP 3 508 630 A1

7. The stretch fabric with excellent snap back performance according to claim 6, wherein the fineness of the hard yarn is 10 to 100 denier.
8. The stretch fabric with excellent snap back performance according to claim 1, wherein after the stretch fabric is made into a cylinder having a diameter of 10 cm and a height of 5 cm, the sagging area formed by the depression of the contour portion of the stretch fabric is not greater than 2 cm² under the condition of 50% elongation and 3 times/second speed expansion and contraction.
9. The stretch fabric with excellent snap back performance according to claim 1, wherein when wearing the clothes made of the stretch fabric, the clothes pressure at the middle of the thigh in a static state is measured as 1.5-2.0 kPa, and the recovery stress of the stretch fabric at the corresponding portion is 1.5-3.0 N.
10. The stretch fabric with excellent snap back performance according to claim 1, wherein the tear strength of the stretch fabric is measured as 9.8 N or more under the test conditions of JIS L 1096:2010 D method; and under the test conditions of the JIS L 1096:2010 A method, the bursting strength of the stretch fabric is measured as greater than 290 kPa.

Fig. 1

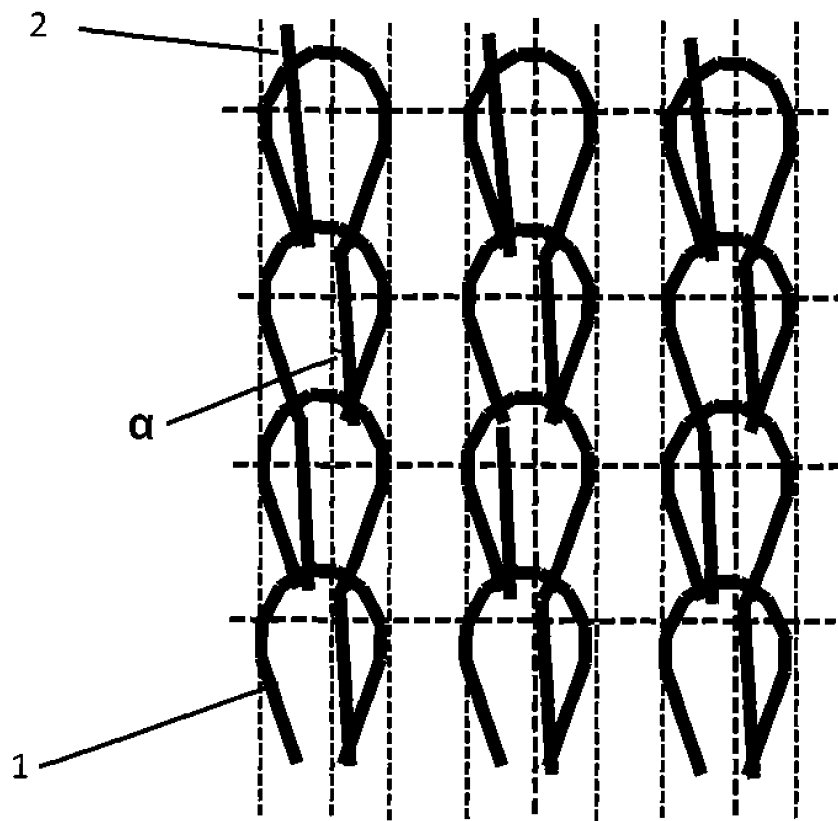


Fig. 2

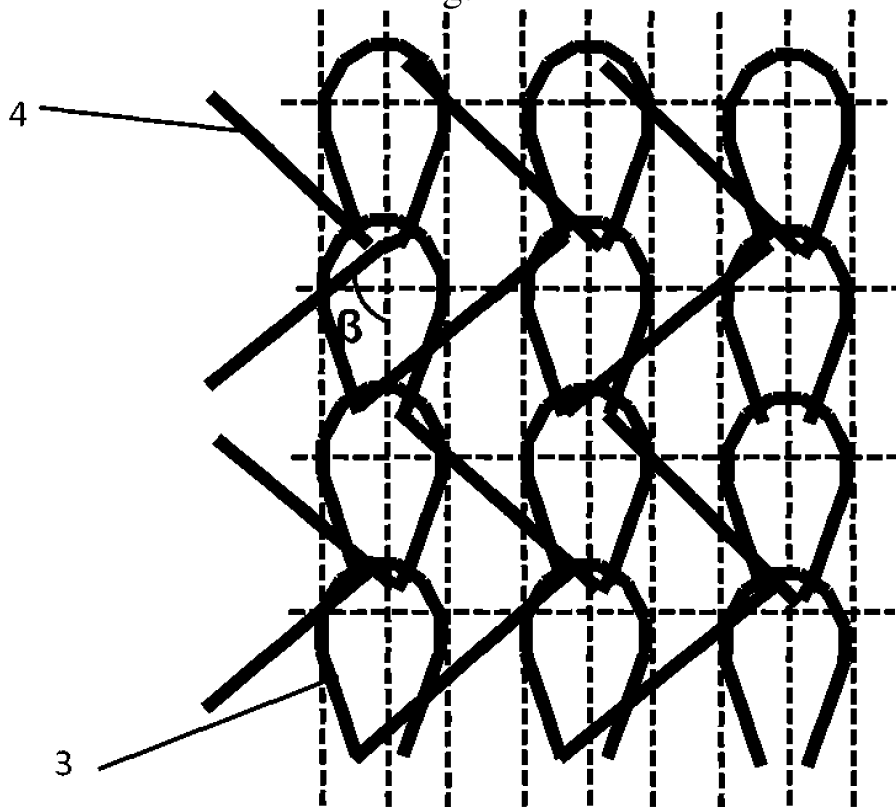


Fig. 3

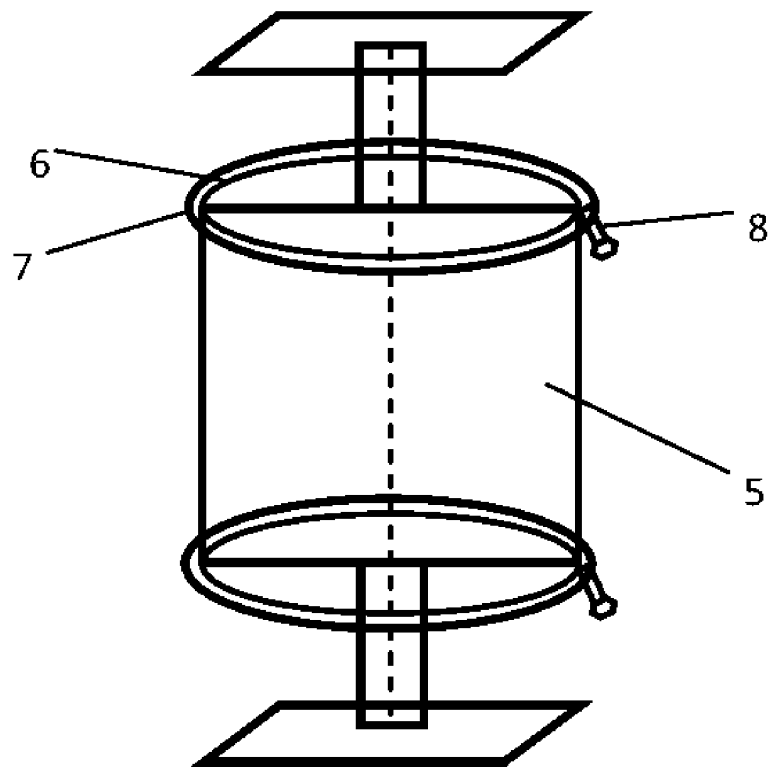
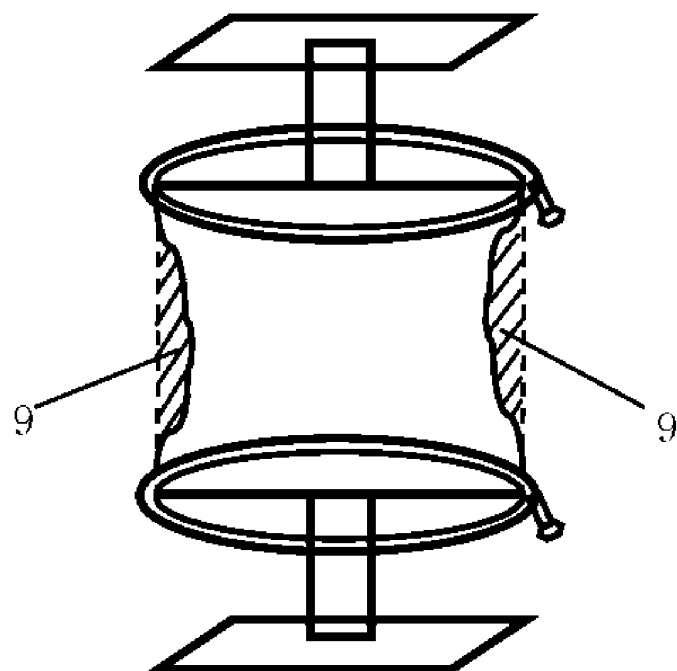


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/099560

A. CLASSIFICATION OF SUBJECT MATTER		
D04B 21/14 (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)		
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)		
CNKI, CNABS, CNTXT, VEN: 针织, 经编, 弹性, 弹力, 聚氨酯, 氨纶, 化纤, 线圈, 夹角, knitting, elastic, flexibility, polyurethane, PU, polyester, loop?, angle		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 101805956 A (TORAY FIBER RESEARCH INSTITUTE (CHINA) CO., LTD.) 18 August 2010 (18.08.2010), description, paragraphs [0002]-[0006] and [0018]-[0023]	1-10
A	CN 203805407 U (K-BOXING WARPKNITTING CO., LTD.) 03 September 2014 (03.09.2014), entire document	1-10
A	CN 203890620 U (CHANGXING SANJIN SPECIAL TEXTILE CO., LTD.) 22 October 2014 (22.10.2014), entire document	1-10
A	EP 2208816 A1 (ALOY FONT JUAN MANUEL) 21 July 2010 (21.07.2010), entire document	1-10
A	US 2006063453 A1 (KING CHRISTOPHER J) 23 March 2006 (23.03.2006), entire document	1-10
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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"O" document referring to an oral disclosure, use, exhibition or other means		
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Date of the actual completion of the international search	Date of mailing of the international search report	
30 November 2017	06 December 2017	
Name and mailing address of the ISA 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 FAN, Min Telephone No. (86-10) 62085160	

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/099560

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 101805956 A	18 August 2010	None	
CN 203805407 U	03 September 2014	None	
CN 203890620 U	22 October 2014	None	
EP 2208816 A1	21 July 2010	None	
US 2006063453 A1	23 March 2006	WO 2006036499 A2	06 April 2006
		WO 2006036499 A3	05 October 2006

REFERENCES CITED IN THE DESCRIPTION

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- CN 205077227 U [0004]
- CN 102648313 A [0005]