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(71) Applicant: **Wuhan Love God High-Level Dress&Adornments Co. Ltd**
Wuhan, Hubei 430023 (CN)

(72) Inventors:
• **ZHOU, Yongmin**
Wuhan
Hubei 430023 (CN)
• **HU, Ping**
Wuhan
Hubei 430023 (CN)
• **ZHANG, Jianwu**
Wuhan
Hubei 430023 (CN)

(74) Representative: **Zeuner Summerer Stütz**
Nußbaumstrasse 8
80336 München (DE)

(54) **MOISTURE-ABSORBING HEAT-GENERATING QUICK-DRYING MOISTURE-RETAINING THERMAL FABRIC AND MANUFACTURING METHOD THEREOF**

(57) The present invention provides a moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric and manufacturing method thereof. The fabric is woven by a first yarn, a second yarn, a third yarn and a fourth yarn. The first yarn is a regenerated cellulose fiber-type blended yarn made by blending regenerated cellulose fiber with one or more linen, wool or cashmere and cotton fiber, or is a regenerated cellulose long fiber yarn or regenerated cellulose staple fiber yarn. The second yarn is a modified polyester fiber yarn having a non-circular cross section. The third yarn is a cotton fiber-type blended yarn made by blending cotton fiber with one or two of polyester staple fiber or polyacrylonitrile fiber, or is all-cotton yarn. The fourth yarn is polyurethane fiber yarn. The fabric has a moisture-absorption heat-generation value above the national standard, and good moisture-absorption and quick-drying properties, and a thermal value meeting the national standard, and also has a comfortable resilience, and a soft, smooth feel of the surface contacting the skin. In addition, the manufacturing method has a simple process and is easy to operate.

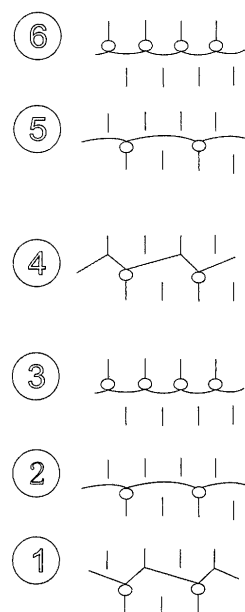


FIG.1

Description

TECHNICAL FIELD

[0001] The invention relates to the technical field of knitted dress fabric, and more particularly to a moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric and manufacturing method thereof.

BACKGROUND OF THE INVENTION

[0002] In recent years, the development trend of knitting industrial in our county focuses on an - application of new material fiber, a promotion of new spinning technology, an application of energy saving and environmental protection dyeing technology and an integration of industrial technology and information technology, etc.. As for the development trends, there are great development and progress from hardware to software for each knitting enterprise, such as new technology, new process, new device, new environmental protection dyeing accessories, new controlling means and the application of new quality standard.

[0003] With the gradually improvement on life standards, a high requirement on the comprehensive thermal-moisture conformability of knitted garment is put forward. Since a standard "moisture-absorbing thermal knitted underwear" issued by Ministry of Industry and Information Technology in December, 2010, most of knitted fabrics whose moisture-absorbing heat value meet the standard is knitted by blended yarn which mainly consisted of the moisture-absorbing thermal fiber EKS raw material produced by Japan Toyobo co., ltd. As most of the blended fibers are polyacrylonitrile raw materials, the pilling property is poor and the appearance of the garment fabric will be affected by long-time dressing. It is extremely urgent to develop a new moisture-absorbing thermal fabric with the existing natural raw material, regenerated cellulose fibers and mature new chemical fibers to break technical barriers of the Japan's raw material. At present, the knitted dress fabric mainly adopts the cellulose fibers, the protein fiber, the regenerated cellulose fiber and a mixture thereof, such as cotton, modal, rayon, wool cashmere, mulberry silk and linen. It has a function of natural moisture-absorbing, antibacterial, warm-keeping and skin protection. With the help of the introduction of spandex elastomeric yarns, the knitted dress has a better body fitting and a function of free stretching. However, these fabrics have the following defects. The wet permeability and moisture liberation are poor. After a long-time wearing, sweat will adsorbed on the fabrics and a lot of sweat can not be output timely. When the body motion is reduced or static, the sweat stick to the body will make the person feel clammy and the conformability is poor. Furthermore, evaporation rate and the amount of water vapor permeability are two characteristic indexes for the quick-drying performance of the fabric. They represent the evaporation rate and the amount of water vapor per-

meability of the whole fabric. The differences between the quick-drying performance of the inner layer of the fabric and that of the outer layer of the fabric can not be represented. In fact, a lot of moisture-absorbing quick-drying products have been developed by the developer for the knitted fabrics. The sweat permeates from the inner layer of the fabric to the outer layer of the fabric rapidly. As the sweat transfers from the inner layer to the outer layer rapidly with such method, the skin is dry and comfortable. However, since the development of these fabrics is limited by the development of sports knitted fabrics, the idea is rarely applied to the development of the knitted underwear fabric. In addition, in order to meet the requirement that the heat preservation rate of the thermal knitted fabric underwear is no less than 30%, most of the thermal knitted underwear is made by a weaving process which adopts air layer silk. Thus, the elasticity of the fabric is poor and the pilling of polyester fiber low stretch yarn will come out, so that the appearance and the performance of the underwear will be greatly affected. Except for the poor elasticity and the pilling, the moisture/gas permeability is very poor, and thus a strong muggy feeling and a clammy feeling will arise when dressing.

SUMMARY OF THE INVENTION

[0004] The object of this invention is providing a moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric. The moisture-absorbing heating value of the fabric far exceeds the national standard. Also, it has a good moisture-absorbing quick-drying performance and the heat preservation rate meets the national requirements on the thermal knitted underwear. At the same time, the fabric has a comfortable resilience, and a soft, smooth feel of the surface contacting the skin.

[0005] In order to achieve the object, the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is woven by a first yarn, a second yarn, a third yarn and a fourth yarn, wherein the first yarn is a regenerated cellulose fiber-type blended yarn made by blending regenerated cellulose fiber with linen, wool, cashmere, cotton fiber, or a mixture thereof, or is a regenerated cellulose filament yarn or regenerated cellulose staple yarn; the second yarn is a modified polyester fiber yarn having a non-circular cross section; the third yarn is a cotton fiber-type blended yarn made by blending cotton fiber with polyester staple fiber, polyacrylonitrile fiber, or mixture thereof, or is all-cotton yarn; and the fourth yarn is polyurethane fiber yarn.

[0006] Preferably, the cross section of the modified polyester fiber yarn having a non-circular cross section is a cross-shape cross section, a Y-shaped cross section or a ∞ -shaped cross section.

[0007] Preferably, the fabric is consisted of an outer layer, a middle layer and an inner layer, the outer layer is woven by the first yarn and the fourth yarn, the middle layer is woven by the second yarn and the fourth yarn, the inner layer is woven by the second yarn, the third

yarn and the fourth yarn.

[0008] Preferably, the weight percentage of the regenerated cellulose fiber in the regenerated cellulose fiber-type blended yarn is 50~80%, and the weight percentage of the cotton fiber in the cotton fiber-type blended yarn is 60~90%.

[0009] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric of the claim 1, the method comprising the following steps :

1) choosing the materials of the first yarn, the second yarn, the third yarn and the fourth yarn based on a designed fabric;

2) placing the materials on a weaving machine and reserving a slitting line for a scutching and setting of following process when weaving to obtain fabric blanks;

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, then splicing them into a continuous shape;

5) presetting the spliced fabric blanks of the car, a presetting temperature is between 170 °C and 200 °C, a speed of the car is between 5 m/min and 25m/min, an over-feeding cloth consumption is between 15 and 40%;

6) feeding water to a dye vat based on the weight of the fabric blanks of a configured vat and a liquor ratio, and after feeding the preset fabric blanks into the vat, seaming the head and the tail of the cloth to form a rope-ring shape which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products;

8) dyeing the modified polyester fiber yarn having non-circular cross section in the fabric semi-finished products with a dyeing liquor;

9) reductive cleaning the fabric semi-finished products which have been dyed with a reductive cleaning solution, a temperature of the reductive cleaning is between 85°C and 100°C, a heat preservation time is controlled between 15 min and 30min;

10) thermal washing the fabric semi-finished products, a temperature of the thermal washing is between 85°C and 98°C, a heat preservation time is

controlled between 10 min and 20min, and then cold washing for 10 ~20min by feeding water;

11) dyeing other fibers of the fabric semi-finished products once again;

12) cool washing and acid washing the fabric semi-finished products which have been dyed once again;

13) soaping the fabric semi-finished products and cool washing them once again until cleaning dye floating color;

14) applying a hydrophilic softener and a hydrophilic soft olein to the fabric semi-finished products;

15) conducting a napping treatment after drying the fabric semi-finished products;

16) re-setting the fabric semi-finished products to obtain a greige fabric, wherein the temperature of the re-setting is between 150 °C and 160 °C, a speed of the car is between 15 m/min and 25m/min, an over-feeding cloth consumption is between 25% and 50%;

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

[0010] Preferably, in the step 2), the weaving method comprising: introducing the first yarn and the fourth yarn in the form of a single knitting in which all purl stitches are used to weave to form the outer layer of the fabric; introducing the second yarn and the fourth yarn in the form of double knitting in which half of knit stitches are used at regular intervals to form a looping knitting and half of the purl stitches are used at regular intervals to form a tucking knitting; introducing the third yarn in the form of the single knitting in which the knit stitches are used to weave; wherein the looping knitting portion made by the second yarn and the fourth yarn constitutes the middle layer of the fabric, the single weaving of the third yarn together with the looping knitting portion made by the second yarn and the fourth yarn constitute the inner layer of the fabric; or introducing the first yarn and the fourth yarn in the form of the single knitting in which all knit stitches are used to weave to form the outer layer of the fabric; introducing the second yarn and the fourth yarn in the form of the double knitting in which half of the purl stitches are used at regular intervals to form the looping knitting and half of knit stitches are used at regular intervals to form the tucking knitting; introducing the third yarn in the form of the single knitting in which the purl stitches are used to weave; wherein the tucking knitting portion made by the second yarn and the fourth yarn constitutes the middle layer of the fabric; the single weaving of the third yarn together with the looping knitting made by the second yarn and the fourth yarn constitute the inner layer of the fabric.

[0011] Preferably, the liquor ratio in the step 6) is between 1:5 and 1:15.

[0012] Preferably, in the step 8), when dyeing, the temperature of the dyeing liquor is controlled between 110°C and 130°C, the heat preservation time is between 20 min and 45min, the heating rate and the cooling rate of the dyeing liquor are controlled between 0.5°C/min and 1°C/min, the dyeing liquor is a mixture of a disperse dye and a dye auxiliary agent, wherein the dye auxiliary agent includes chelating dispersant with a content of 0.5~1.5 g/L, anti-creasing agent with a content of 0.5~2 g/L, high-temperature leveling agent with a content of 0.5~1 g/L and ethylic acid with a content of 0.5~1 g/L.

[0013] Preferably, in the step 9), the reductive cleaning solution is a mixture of anti-creasing agent, sodium hyposulfite and sodium carbonate solution, wherein the content of the anti-creasing agent is 1~2 g/L, the content of the sodium hyposulfite is 0.5~1 g/L, the content of the sodium carbonate is 0.5~2 g/L.

[0014] Preferably, in the step 14), the dosage of the hydrophilic softener accounts for 0.5~2% of the weight of the fabric blanks to be dyed, the dosage of the hydrophilic soft olein accounts for 3~5% of the weight of the fabric blanks to be dyed.

[0015] Preferably, in the step 14), the acid washing is conducted on the fabric semi-finished products for 10~20 min before applying the hydrophilic softener and the hydrophilic soft olein.

[0016] The moisture-absorbing thermal, moisture-absorbing quick-drying, moisture and thermal principles of the fabric are as follows.

[0017] The moisture-absorbing and heat-generating principle is as follows. The components of the moisture-absorbing heat-generating fabric have a better hydrophily or a strong wicking and moisture transferring function. The materials of this invention mainly are the regenerated cellulose fiber enriched with a lot of hydrophilic groups and the cotton fiber, so that the fabric has a better moisture absorption performance. When the specific surface area and the specific surface energy of the modified polyester fiber yarn having a non-circular cross section, such as the cross-type cross section, the Y-type cross section or the ∞ -type cross section, are larger than that of a common polyester fiber yarn having a circular cross section, it has a strong wicking and wet permeability function, so that the water absorption rate of the fabric meets the requirements of the national standards or exceeds it. However, if only the water absorption rate of the fabric meets the requirements, the fabric can not be called as the moisture-absorbing and thermal fabric. When weaving, the first yarn whose main component is the regenerated cellulose fiber is placed on the outer layer of the fabric and the third yarn whose main component is the cotton fiber is placed on the inner layer of the fabric, so that water molecules in the fabric will transfer from inside to outside due to the different hygroscopicities after the moisture absorption. The water molecules continuously transfer and acutely move in the fabric, and thus the integral heat

and the differential heat will be produced and the kinetic energy will convert to heat energy, thereby generating heat. Finally, the fabric must have an enough height to prevent from the heat loss or have much hollowness and still air. In this invention, the outer layer of the fabric is formed by the first yarn and the fourth yarn via a full-needle single knitting method. The outer layer fabric is compact, so that it can effectively prevent from the heat loss. The main components of the inner layer of the fabric are formed by the single knitting in which half of stitches of the third yarn are used at regular intervals without the polyurethane fiber yarn of the fourth yarn, so that the fabric is sparse. In addition, a lot of micro gaps are caused by the raising and pilling in the following process and more still air exists in the fabric, so that the heat converted by the moisture-absorbing water molecular motion is not easy to be lost and the highest heating value and the average heating value of the moisture-absorbing can meet the requirements of the national standard.

[0018] The moisture-absorbing and quick-drying principle is as follows. The characteristics of the moisture-absorbing defined by the national standard are shown in the following three indexes, namely the water absorption rate, the dripping water diffusion time and the wicking height. The characteristics of the quick-drying are shown in the following two indexes, namely the evaporation rate and the moisture permeability. However, the above five indexes have a certain limitation on the quick-absorbing and quick-drying characteristic, so that they can only represent the moisture-absorbing and quick-drying performance of the whole fabric rather than the differences in the moisture-absorbing and quick-drying performance of the inner and outer layer of the fabric. The conventional moisture regains of the inner layer of the fabric is different from that of the outer layer of the fabric. The material of the inner layer is also hydrophilic and the weighted average conventional moisture regains is relatively low. The material of the outer layer is hydrophilic and the weighted average conventional moisture regains is far higher than that of the material of the inner layer. The quick-drying of the inner layer not only passes through the natural evaporation quick-drying channel of the surface layer, but also passes through the strong moisture absorption channel of the material of the outer layer, and thus the moisture absorbed by the inner layer is transferred to the outer layer quickly and diffuses rapidly via a middle wicking and moisture transferring layer, so that the quick-drying performance of the inner layer is superior to that of the outer layer.

[0019] Moisturizing principle is as follows. The middle layer of the fabric is weaved by the second yarn which is the modified polyester fiber yarn having a non-circular cross section and the fourth yarn which is polyurethane fiber yarn. As the modified polyester fiber yarn having the non-circular section has a larger specific surface area, it has a stronger wicking and moisture transferring function. The wicking and moisture transferring function is bidirectional, which not only can exhaust the moisture

from the inner layer of the fabric to the outer layer thereof, but also can exhaust the moisture from the outer layer of the fabric to the inner layer thereof. The weighted average conventional moisture regains of the material of the outer layer of the fabric is large and the material contains a lot of hydrophilic groups, so that it has a strong function of capturing the water molecules in the air. When a certain amount of water molecules exist in the air, the outer layer of the fabric will adsorb a lot of water molecules and the water molecules can further be transferred to the inner layer via the middle layer of the fabric so as to keep a balance of the moisture absorption and get the goal of moisture-retaining and anti-aging. When perspiring, the sweat will transfer to the outer layer of the fabric rapidly. Due to the hydrophilic groups in the outer layer of the fabric, the evaporation rate of the moisture is relatively low and the sufficient moisture in the outer layer creates a condition for the moisturization of the inner layer. When the skin becomes dry, the outer layer will capture the moisture from the air or from non-evaporation and non-volatilization moisture before the moisture absorption and moisture storage, and the bidirectional moisture transferring function of the middle layer of the fabric will help to transfer the moisture to the inner layer of the fabric to keep a balance of the moisture absorption, thereby retaining moisture.

[0020] Thermal principle is as follows. The hollow design of the fabric is not obvious to the improvement on the warmth retention of the fabric having the polyurethane fiber. However, the fleece design of the inner layer of the fabric very notably improves the warmth retention. After the fleece, a lot of micro gaps will be brought in the inner layer of the fabric, a lot of still air exists in the fabric and the polyurethane fiber yarn of the outer layer of the fabric is introduced, the outer layer is relatively compact, so that it can effectively prevent the air from flowing between the human body and the outer layer of the fabric, thereby greatly improving the warmth retention of the fabric via the possessing capacity of the still air. In this invention, a lot of micro gaps are brought in the fabric after the fleece of the inner layer and a lot of still air exists in the micro gaps. Moreover, the first yarn and the fourth yarn are weaved by a method of full-needle knitting. As the polyurethane fiber yarn of the fourth yarn has a good elasticity and shrinkage performance, the outer layer of the fabric is relatively compact due to the introduction of the full-needle and the fourth yarn and it can prevent the loss of the energy, the fabric can keep warm. In order to obtain the function of this invention, the design of the knitting process diagram is based on the following principles. Firstly, the moisture-absorbing and quick-drying performance of each component is made full use to the greatest extent, especially the performance of the moisture discharging from the inner layer to the outer layer. The polyurethane fiber yarn is not added to the third yarn of this invention. The single knitting in which half of the purl stitches or the knit stitches are used at regular intervals to make the structure of the fabric spars-

er after the fleece and facilitate the moisture-permeating and quick-drying of the inner layer. The outer layer of the fabric adopts the knitting in which all the knit stitches or the purl stitches of the first yarn and the fourth yarn are used, so that the fabric is compact, which facilitates the quick outside transferring and gathering of the moisture gas in the inner layer. Secondly, under the condition that without affecting the hydrophilic performance of each component, the ratio of each component are changed to optimize the textile process, reduce the weighted average moisture regain of the inner layer of the fabric to the greatest extent, increase the weighted average moisture regain of each component in the outer layer of the fabric. In this invention, half of the knit stitches and or the purl stitches of the second yarn and the fourth yarn are used at regular intervals to form the looping knitting. Half of the corresponding purl stitches or knit stitches are used at regular intervals to form the tucking knitting. The above knitting joins the design of the inner layer and the middle layer of the fabric rather than the design of the outer layer of the fabric, so that it can effectively reduce the weighted average official moisture regain of each component of the outer layer and is convenient to the moisture permeating, the moisture transporting and quick drying since the official moisture regain of the modified polyester fiber low stretch yarn is low. Thirdly, it must facilitate the fleece and napping of the inner layer and ensure that the root portion of the fleece will not fall off. This invention adjusts the design by each yarn feeding way and applies the coil index theory in the field of textile engineering, so that the napping and the loop forming coil of the third yarn becomes longer and longer and protrudes on the surface of the fabric, thereby facilitating the fleece and the napping and locking the napping. The second yarn and the fourth yarn loop forming coil of the third yarn coil root which joins the inner layer becomes smaller and caves in to avoid the linting. The third yarn can be fixed in the single knitting in which half of the needles are used and the single knitting in which half of two kinds of knitting needles are used at regular intervals. In each way, the first yarn and the fourth yarn form the single knitting in which all the needles are used and the third yarn forms the single knitting in which half of the needles are used. They correspond to the looping knitting in which half stitches of the second yarn and the fourth yarn are used at regular intervals and the tucking knitting of the double knitting in which the inner layer and the outer layer are connected. In the inner layer and the outer layer, half of the knitting needles of other disk are used at regular intervals to form the tucking knitting. The knitting needles of the double knitting which participates in the looping knitting are same with the knitting needle of the half needle single knitting of the third yarn, so that the coil formed by the looping knitting of the double knitting locks the root of the coil formed by the third yarn firmly, thereby creating a condition for the fleece of the subsequent process. Fourthly, the fabric is comfortable and has elasticity. To make the fabric has a comfortable elasticity, the design

for the structure of the fabric must meets the following requirements. The polyurethane fiber yarn is not introduced into the yarn-feeding way of the third yarn except for the fleece and the napping. The polyurethane fiber yarn is introduced or guided to other yarn feeding way. The polyurethane fiber yarn has a good tensile performance and restorability. The polyurethane fiber yarn is not introduced in the yarn feeding way of the third yarn which has been conduct with the napping and the fleece to facilitate the napping in the subsequent process, so that it can ensure that the fabric has enough elasticity and the fleece and the napping of the inner layer will not be affected.

[0021] At the same time, in the preparation method, after the dyeing liquor containing the disperse dye and the auxiliary agent are used to dye the modified polyester fiber, the reductive cleaning process is conducted after the middle and dark color are dyed. The main object is removing the dye floating color adhere to the modified polyester fiber after the high-temperature sublimation and the floating color of other disperse dye adhere to other materials, so that it can improve the colorfastness of the whole fabric. After the reductive cleaning, the thermal washing and the cool washing are conducted to prepare for the dyeing of the regenerated cellulose fibre, the cotton fiber and other fibers. The reactive dye or other dye and the auxiliary agent are adopted to dye the regenerated cellulose fiber, the cotton fiber and other fiber according to the components of the fabric blanks which have not been dyed and the dye process curve. After the dyeing, the cool washing and the acid washing are conducted. The cool water is added slowly to the vat to reduce the temperature. At the same time, the water is released. After the releasing of the water, the acid washing is conducted under the normal temperature according to the water level required by the liquor ratio. The object is mainly neutralizing the residual alkali on the cloth. After the acid washing, the soaping agent is used to soap to remove all the dye floating color to the greatest extent until the dye floating color are cleaned. Then, the cool water is added slowly. After the water is released completely, a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added according to the required liquor ratio. The hydrophilic softener and the hydrophilic soft olein are added to the cleaned fabric semi-finished products by soaping and cool washing the floating color. The cleaned fabric semi-finished products are kept in the vat. The hydrophilic softener and the hydrophilic soft olein are added to the vat. The fabric semi-finished products are soaked circularly under the normal temperature. Before adding the hydrophilic softener and the hydrophilic soft olein, the weak acid is used to acid wash the fabric semi-finished products for 10~20min. As the hydrophilic softener and the hydrophilic soft olein will have a better effect under the weak acidity, the PH value of the dye liquor is adjusted to 4.5~6 and the dye liquor exhibits the weak acidity. The adding of the hydrophilic softener aims at the hydrophilic

soft finishing of the modified polyester yarn having a non-circular section or the polyester staple fiber. The adding of the hydrophilic soft olein aims at the hydrophilic soft finishing of the cotton fiber in the third yarn and the first yarn or the linen, the wool or the cashmere and the regenerated cellulose fiber. The surface of the cloth being treated with the hydrophilic softener has a soft feel, a good hydrophilic effect and the fluffy cotton fiber to facilitate the napping and the fleece of the subsequent process. A tensile shrinkage drying machine is used to dry the fabric semi-finished products which have been conducted with hydrophilic treatment. The raising machine is used to nap the dried fabric semi-finished product. After the napping, the fabric has a uniform delicate touch. The napping process directly relates to the quality of the fabric and the achievement of the heat preservation rate of the fabric. Finally, the repeated setting is conducted to the fabric semi-finished product which has been napped. The temperature of the repeated setting is no more than 160° C to avoid forming the floating color caused by the sublimation and dissociation of the disperse dye molecules on the polyester fiber which will reduce the dye colorfastness of the fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG 1 is a knitting process diagram of the fabric of the first embodiment;

FIG 2 is an arrangement diagram of knitting needles of the fabric of the first embodiment;

FIG 3 is a triangle arrangement diagram of the knitting needles of the fabric of the first embodiment;

FIG.4 is a knitting process diagram of the fabric of the second embodiment;

FIG.5 is an arrangement diagram of knitting needles of the fabric of the second embodiment;

FIG.6 is a triangle arrangement diagram of the knitting needles of the fabric of the second embodiment;

FIG.7 is a knitting process diagram of the fabric of the third embodiment;

FIG.8 is an arrangement diagram of knitting needles of the fabric of the third embodiment;

FIG.9 is a triangle arrangement diagram of the knitting needles of the fabric of the third embodiment;

FIG 10 is a knitting process diagram of the fabric of the fourth embodiment;

FIG 11 is an arrangement diagram of knitting needles of the fabric of the fourth embodiment;

FIG.12 is a triangle arrangement diagram of the knitting needles of the fabric of the fourth embodiment; 5

FIG 13 is a knitting process diagram of the fabric of the fifth embodiment;

FIG.14 is an arrangement diagram of knitting needles of the fabric of the fifth embodiment; 10

FIG.15 is a triangle arrangement diagram of the knitting needles of the fabric of the fifth embodiment. 15

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0023] The preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric of this invention is further illustrated in more detail in the light of the drawings and embodiments. 20

Example 1

[0024] A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is weaved by four yarns. The first yarn is the regenerated cellulose fiber-type blended yarn J40S lenzing modal/cotton 50/50 blended yarn made by the cotton fiber and the regenerated cellulose fiber. The weight percentage of the regenerated cellulose fiber accounts for 50%. The second yarn is the modified polyester fiber yarn COOLDRY75D/72F having a cross-shaped cross section produced by Shanghai Haitianying textile technology Co., Ltd. The third yarn is 20S pure cotton high proportion distributed carded yarn. The fourth yarn is 30D polyurethane fibre yarn produced by Hangzhou Asahikasei Spandex Co., Ltd. 25 30 35

[0025] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric comprises the following steps: 40

1) Choosing the above four yarn materials based on a designed fabric, and preparing the required number of material tubing head of the above four materials based on the type of the machine; 45

2) placing the material on the weaving machine, and reserving a slitting line for a scotching and setting of the following process to obtain a fabric blank when weaving. The weaving is conducted according to the knitting process diagram shown in FIG.1. The knitting needles are arranged according to FIG.2. A triangle arrangement of the knitting needles is arranged according to FIG.3. ①②③④⑤⑥ in FIG.1 and FIG.3 are numbers of yarn feeding ways. There are six way knitting shown in FIG. 1. The label 1, 2 in an upper row and a lower row of FIG.2 respectively 50 55

represent No. 1 needle and No.2 needle according to the heights of the butt of the knitting needles. An arrangement of upper dial knitting needles is applied to the upper row. An arrangement of lower cylinder knitting needles is applied to the lower row. A triangle arrangement of the upper dial knitting needles are applied to the upper row table in FIG.3. A triangle arrangement of the lower cylinder knitting needles is applied to the lower row table in FIG.3. In the figure, "∧" and "∨" are a stitch cam. "└┐" is tucking cam. "-" is floating cam;

The weaving is conducted according to FIGS.1-3. A complete organization is finished by six way knitting. The first way is in the form of the double knitting in which half of knit stitches of No.1 needle are used to form the looping knitting and half of purl stitches of No.2 needle are used to form the tucking knitting. The second way is in the form of the single knitting in which half knit stitches of No. 1 needle are used to form the looping knitting. The third way is in the form of the single knitting in which all the purl stitches are applied. The fourth way is in the form of the double knitting in which half of knit stitches of No. 1 needle are used to form the looping knitting and half of the purl stitches of No. 1 needle are used to form the tucking knitting. The fifth way repeats the knitting of the second way. The sixth way repeats the knitting of the third way. Both the yarn in the first way and the yarn in the fourth way are the modified polyester fibre yarn COOLDRY75D/72F having a cross-shaped cross section produced by Shanghai Haitianying textile technology Co., Ltd and 30D polyurethane fiber yarn produced by Hangzhou Asahikasei Spandex Co., Ltd. The yarn in the second way and the yarn in the fifth way are 20S pure cotton high proportion distributed carded yarn. The yarn in the third way and the yarn in the sixth yarn are J40S lenzing modal/cotton 50/50 blended yarn and 30D polyurethane fibre yarn produced by Hangzhou Asahikasei Spandex Co., Ltd. 35 40

The obtained fabric blanks is consisted of the outer layer, the middle layer and the inner layer. The outer layer is weaved by the first yarn and the fourth yarn. The middle layer is weaved by the second yarn and the fourth yarn. The inner layer is weaved by the second yarn, the third yarn and the fourth yarn. As shown in FIG.1, the looping knitting portion of the knit stitches of No.1 needle of the first way and the fourth way and the single knitting portion of the knit stitches of No. 1 needle of the second way and the fifth way constitute the inner layer. The coil index of the knit stitch looping knitting of the first way and the fourth way is zero. The knit stitch inner layer coil formed by the first way and the fourth way is small due to the elastic contraction of the polyurethane fiber filament yarn and the dividing of the purl stitch tucking knitting. The coil index of the knit stitch single

knitting of the second way and the fifth way is one. The knit stitch inner layer coil is bigger without the above two acting forces. It is more obvious under the action of the elastic contraction of the polyurethane fibre yarn of the double knitting of the third way and the six way, and thus facilitates the fleece of the following dyeing and finishing process. The inner layer is the moisture-absorbing quick-drying layer of the fabric. The middle layer of the fabric is formed by the purl stitch tucking knitting portion of the double knitting of the first way and the fourth way. The middle layer is the wicking bidirectional moisture transporting layer of the fabric. The outer layer of the fabric is formed by the purl stitch single knitting portion of the third way and the sixth way. The outer layer is a layer of the fabric which can absorb moisture, store moisture and release moisture.

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, configuring the vat according to the volume of the dyeing vat, numbering the vats and filling a process sheet, and then splicing them into a continuous shape required by the operation of the setting machine via a sewing machine;

5) presetting the spliced fabric blanks of the car, a presetting temperature is 195°C. a speed of the car is 20 m/min, an over-feeding cloth consumption of the cloth is 35%;

6) feeding water to the dye vat based on the weight of the fabric blanks of the configured vat until reaches to the water level required by a liquor ratio of 1: 12, sending them into the vat and seaming the heads of the preset blanks based on the capacity of each tube of the dyeing vat to form a shape of rope-ring which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products, namely immersing the fabric blanks into the vat in which oxygen bleaching agent and de-oiling treatment agent are filled for oxygen bleaching and de-oiling dyeing and finishing pretreatment. In the oxygen bleaching agent and the de-oiling treatment agent, the content of hydrogen peroxide produced by Wuhan Chengguang Chemical Co., Ltd. is 4g/L, the content of the Yashihua NF anti-creasing agent produced by Shanghai Yayun Fine Chemical Co., Ltd. is 1g/L, the content of refining agent produced by Shanghai Xinze Chemical Co., Ltd. is 0.5 g/L, the content of the sodium hydroxide NaOH produced by Xinjiang Tianye Chemical Co., Ltd. is 1g/L and the content of the de-oiling agent

DM-1140 produced by Guangdong Demei Chemical Co., Ltd. is 1g/L. The temperature of the water of the dyeing and finishing treatment is 98°C. The heat preservation time is 40 min. The heating rate and the cooling rate are controlled between 0.5°C/min and 1°C/min. After the treatment, the ethylic acid de-oxidates and neutralizes the residual alkali on the surface of the cloth. The content of oxyrase produced by Zhejiang Chuanhua Chemical Co., Ltd. is 0.2g/L and the content of the ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. is 1g/L.

8) high-temperature dyeing the modified polyester fiber yarn COOLDRY75D/72F having a cross-shaped cross section of the pretreated fabric semi-finished products with the dyeing liquor. The dyeing liquor is formed by dissolving the disperse dye and the dye auxiliary agent produced by Zhejiang Runtu Chemical Co., Ltd. in water. The disperse dye is a mixture of disperse red 3B whose weight accounts for 0.02% of the weight of the fabric blanks to be dyed, disperse yellow SE-RGFL whose weight accounts for 0.6% of the weight of the fabric blanks to be dyed and disperse blue 2BLN whose weight accounts for 0.01 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant, anti-creasing agent, high-temperature leveling agent and ethylic acid. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The high-temperature leveling agent is high-temperature leveling agent DM-2108 produced by Guangdong Demei Chemical Co., Ltd. and the content of the high-temperature leveling agent DM-2108 is 0.5g/L. The ethylic acid is produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 0.5 g/L. When dyeing, the temperature of the dye liquor is controlled at 130°C. The heat preservation time is 30min. When dyeing, the heating rate and the cooling rate are controlled at 0.5 °C/min.

9) reductive cleaning the fabric semi-finished products which have been dyed with a reductive cleaning solution. The reductive cleaning solution is the aqueous solution consisted of Yashihua NF anti-creasing agent produced by Shanghai Yayun Refining Chemical Co., Ltd., the sodium hyposulfite produced by Guangzhou Zhongcheng Chemical Co., Ltd. and sodium carbonate produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. The content of the anti-creasing agent is 1g/L, the content of the sodium hyposulfite is 0.8g/L and the content of the sodium carbonate is 1g/L. When conducting the reductive cleaning, the temperature is controlled at 90°C and

the heat preservation time is controlled at 20min.

10) after releasing the reductive cleaning solution, conducting the thermal washing by feeding water until reaches to the required level defined by the liquor ratio. The temperature is controlled at 90°C and the heat preservation time is controlled at 10min. After the thermal washing, the water is released. Then, the cool water is introduced until reaches to the required water level defined by the liquor ratio. The fabric is cool washed in the vat for 10min for the subsequent process.

11) dyeing other fibers of the fabric semi-finished products once again. The dye liquor formed by dissolving reactive dye and dye auxiliary agent in the water is used to dye the J40S lenzing modal/cotton 50/50 blended yarn and 20S pure cotton high proportion distributed carded yarn in the fabric semi-finished products. The reactive dye is a set of reactive dye produced by Shanghai Dye Eighth Factory. The components of the reactive dye is a mixture of the reactive brilliant red M-3BE whose weight accounts for 0.048% of the weight of the fabric blanks to be dyed, the reactive yellow M-3RE whose weight accounts for 0.94% of the weight of the fabric blanks to be dyed and the reactive black KN-B whose weight accounts for 0.02 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant and anti-creasing agent. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The above reactive dye and the auxiliary agent are dissolved in the water and are poured into dye vats after being stirred evenly under a normal temperature by dye mixer. Then, the water is added to further dilute uniformly by stirring. Under the normal temperature, the dye and the auxiliary agent thereof are added to the vats in several times. The adding time of the dye and the auxiliary agent thereof is controlled within 20min. At the same time, the cloth is treated for 20min in the dye liquor under the normal temperature. After the dye liquor in the fabric distributes uniformly, the sodium sulfate anhydrous which acts as the accelerating auxiliary agent is added to the dye liquor under the normal temperature. The sodium sulfate anhydrous is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium sulfate anhydrous is 35g/L. The sodium sulfate anhydrous is directly added to the subsidiary vat. After adding the water and stirring uniformly under the normal temperature, the sodium sulfate anhydrous is added to the vat uniformly in several times. The adding time is controlled within

30min. Finally, the sodium carbonate which acts as color fixing agent is added under the normal temperature. The sodium carbonate is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium carbonate is 10g/L. The sodium carbonate is added at twice. The adding time for each time is controlled at 20min. The sodium carbonate is slowly added to the vat after directly being added to the dye subsidiary vat and adding water to dilute uniformly. After all the materials are added, the temperature is slowly increased. The speed is controlled between 0.5°C/min and 1°C/min. The heat preservation is conducted after the temperature is increased to 60°C. After conducting the heat preservation for 40 min, color matching and color recovery are conducted until the color matches with the color of the sample.

12) cool washing and acid washing the fabric semi-finished products which has been dyed once again, reducing the temperature by adding cool water to the vat slowly and releasing the water at the same time. The cooling rate is controlled at 0.7°C/min. When the temperature of the water is reduced to 40°C, the water is stopped to be added and then is released. After finishing the releasing of the water, a cylinder of water is added based on the water level required by the liquor ratio and the acid washing is conducted under the normal temperature for neutralizing the residual alkali on the cloth. The antacid of the acid washing is ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 2 g/L.

13) soaping the fabric semi-finished products and cool washing them once again, wherein when soaping, a cylinder of water is added based on the liquor ratio after the water being conducted with the acid washing under the normal temperature. The soaping agent is added via the dye auxiliary vat. The soaping agent is a mixture of cleaning agent and chelating dispersant. The cleaning agent is the cleaning agent AR-812 produced by Jiangsu Haian Petroleum Chemical Plant Technology Development Co., Ltd. and the content of the cleaning agent is 2g/L. The chelating dispersant is argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the chelating dispersant is 1g/L. The material is added and the temperature is increased slowly at the same time. The heating rate is controlled at 1°C/min. After the temperature is increased to 98°C, the heat preservation is conducted for 10 min. Then, the cool water is added to reduce the temperature slowly. The cooling rate is controlled at 1°C/min. The water is released when the temperature of the water is reduced to 40°C and then a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added based on

the liquor ratio.

14) applying hydrophilic softener and hydrophilic soft olein to the cleaned fabric semi-finished products. The ethylic acid whose content is 0.5g/L is directly added and the cleaned fabric semi-finished products are kept in the vat. The circulation soaking is conducted for 15min under the normal temperature. The hydrophilic softener and the hydrophilic soft olein are added again and the fabric is soaked circularly for 20min under the normal temperature. The hydrophilic softener is the Dibaoshu DPS produced by Suzhou Tongye Chemical Co., Ltd. and the usage of the hydrophilic softener is 1% of the weight of the fabric blanks to be dyed. The hydrophilic soft olein is the hydrophilic soft olein SJ12 produced by Guangzhou Guangjian Refining Chemical Co., Ltd. and the usage of the hydrophilic soft olein is 4% of the weight of the fabric blanks to be dyed.

15) drying the fabric semi-finished products which has treated by the hydrophilic softener and the hydrophilic soft olein and then placing the dried fabric semi-finished products on a raising machine for napping. The principle of the napping is as follows. The light pulling is conducted at the first time of the napping and then the napping is gradually deepened time after time. The times of the napping is 4~6 preferably. 4~6 of the raising machines are used to perform the napping on-line and continuously. After the napping, the fabric is uniformly and has delicate touch.

16) re-setting the fabric semi-finished products to obtain a greige fabric, the temperature of the re-setting is 150°C, the speed of the car is 20 m/min, the over-feeding cloth consumption of the cloth is 50%, and moisture-absorbing heat-generating quick-drying moisture-retaining thermal greige fabric is obtained.

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

[0026] The fabric obtained from the embodiment 1 is sent to National Knitting Quality Supervisor & Inspection Center for inspecting the heat preservation rate of the fabric according to the standard GB/T 11048-1989 (Method A), inspecting the moisture-absorbing and thermal heating value according to the standard FZ/T 73036-2010 and inspecting the moisture-absorbing performance and quick-drying performance according to the standard GB/T 21655.1-2008. The results are shown as follows.

① The heat preservation rate is 39.08% which meets the requirement of the national standard which is equal to or greater than 30%;

② The highest moisture-absorbing thermal heating

value is 6.4°C, which meets the requirement of the national standard which is equal to or greater than 4.0°C;

③ The average moisture-absorbing thermal heating value is 3.3°C, which meets the requirement of the national knitting standard which is equal to or greater than 3.0°C;

④ The water absorption rate is 426%, which meets the requirement of the national standard which is equal to or greater than 200%;

⑤ The dropping diffusion time is 1.3 seconds, which meets the requirement of the national standard which is less than 3 seconds;

⑥ The wicking height is 160mm, which meets the requirement of the national standard which is equal to or greater than 100mm.

Example 2

[0027] A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is weaved by four yarns. The first yarn is the regenerated cellulose staple yarn J45S100% lenzing modal. The second yarn is CLEANCOOL fibre low stretch yarn of the modified polyester fibre yarn 75D/72F having a cross-shaped cross section and nanometer sliver ion produced by Shanghai Sinotextiles Corporation Limited. The third yarn is 20S pure cotton high proportion distributed carded yarn. The fourth yarn is 20D and 40D polyurethane fibre yarn produced by Korea Xiaoxing Spandex Limited Corporation (Jiaxing).

[0028] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric comprises the following steps:

1) Choosing the above four yarn materials based on a designed fabric, and preparing the required number of material tubing head of the above four materials based on the type of the machine;

2) placing the material on the weaving machine, and reserving a slitting line for a scotching and setting of the following process to obtain a fabric blank when weaving. The weaving is conducted according to the knitting process diagram shown in FIG.4. The knitting needles are arranged according to FIG.5. A triangle arrangement of the knitting needles is arranged according to FIG6. ①②③④⑤⑥⑦⑧⑨⑩ in FIG4 and FIG.6 are numbers of yarn feeding ways. There are ten way knitting shown in FIG.4. The label 1, 2 in an upper row and a lower row of FIG.5 respectively represent No.1 needle and No.2 needle according to the heights of the butt of the knitting needles. An arrangement of upper dial knitting needles.

dles is applied to the upper row. An arrangement of lower cylinder knitting needles is applied to the lower row. A triangle arrangement of the upper dial knitting needles are applied to the upper row table in FIG.6. A triangle arrangement of the lower cylinder knitting needles is applied to the lower row table in FIG.6. In the figure, "^" and "v" are a stitch cam. "└┐" is tucking cam. "-" is floating cam;

The weaving is conducted according to FIGS.4-6. A complete organization is finished by ten way knitting. The first way is in the form of the single knitting in which half of knit stitches of No. 1 needle is used. The second way is in the form of the double knitting in which half of the knit stitches of No.2 needles are used to form the looping knitting and half of the purl stitches of No.1 needle are used to form the tucking knitting. The third way is in the form of the double knitting in which half of knit stitches of No. 1 needle is used to form the looping knitting and the half of purl stitches of No.1 needle is used to form the tucking knitting. The fourth way and the fifth way are in the form of the single knitting in which all stitches are applied. The sixth way repeats the weaving of the first way. The seventh way is in the form of the double knitting in which half of the knit stitches of No.2 needle are used to form the looping knitting and half of the purl stitches of No.2 needle are used to form the tucking knitting. The eighth way is in the form of the double knitting in which half of the knit stitches of No. 1 needle are used to form the looping knitting and half of the purl stitches of No.2 needle are used to form the tucking knitting. The ninth way and the tenth way repeat the single knitting of the fourth way and the fifth way. The yarns of the first way and the sixth way are 20S pure cotton high proportion distributed carded yarn. The yarns of the second way, the third way, the seventh way and the eighth way are CLEANCOOL fibre low stretch yarn of the modified polyester fibre yarn 75D/72F produced by Shanghai Sinotextiles Corporation Limited and the covering yarn of 20D polyurethane fibre yarn produced by Korea Xiaoxing Spandex Limited Corporation. The yarns of the fourth way, the fifth way, the ninth way and the tenth way are J45S100% lenzing modal and 40D polyurethane fibre yarn produced by Korea Xiaoxing Spandex Limited Corporation (Jiaxing).

The obtained fabric blanks is consisted of the outer layer, the middle layer and the inner layer. The outer layer is weaved by the first yarn and the fourth yarn. The middle layer is weaved by the second yarn and the fourth yarn. The inner layer is weaved by the second yarn, the third yarn and the fourth yarn. As shown in FIG.4, the knit stitch single knitting portion of the first way and the sixth way and the knit stitch looping knitting portion of the third way and the eighth way constitute the inner layer. The inner layer is the moisture-absorbing and quick-drying layer of the

fabric. The knit stitch looping knitting portion of the second way and the seventh way forms the inner layer of the fabric in theory. However, as the coil index is 4 and the coil contains polyurethane fiber, as well as, the yarns of the second way and the seventh way and the 20S yarns used in the first way and the sixth way are too thin and are pulled too long so as to tightly hide in the middle of the fabric, the double knitting in which half of the knit stitches of the second way and the seventh way form the looping knitting and half of the purl stitches of the second way and the seventh way are used to form the tucking knitting together with the knitting in which half of the purl stitches of the third way and the eighth way are used to form the tucking knitting form the middle layer of the fabric. The middle layer is wicking bidirectional moisture permeating antibacterial layer. The single knitting portion of the fourth way, the fifth way, the ninth way and the tenth way, in which all the purl stitches are used, forms the outer layer. The outer layer is a layer of the fabric which can absorb moisture, store moisture and release moisture.

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, configuring the vat according to the volume of the dyeing vat, numbering the vats and filling a process sheet, and then splicing them into a continuous shape required by the operation of the setting machine via a sewing machine;

5) presetting the spliced fabric blanks of the car, a presetting temperature is 200°C, a speed of the car is 18 m/min, an over-feeding cloth consumption of the cloth is 40%;

6) feeding water to the dye vat based on the weight of the fabric blanks of the configured vat until reaches to the water level required by a liquor ratio of 1: 10, sending them into the vat and seaming the heads of the preset blanks based on the capacity of each tube of the dyeing vat to form a shape of rope-ring which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products, namely immersing the fabric blanks into the vat in which treating agent is filled for the dyeing and finishing pretreatment. In the treating agent, the content of de-oiling agent DM-1140 produced by Guangdong Demei Chemical Co., Ltd. is 1g/L, the content of Yashihua NF anti-creasing agent produced by Shanghai Yayun Fine Chemical Co., Ltd. is 1g/L, the content of the refining agent produced by Shanghai Xinze Chemical Co., Ltd. is 0.5

g/L, the content of the sodium carbonate produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. is 3g/L. The temperature of the water of the dyeing and finishing treatment is 98°C. The heat preservation time is 20min. After the treatment, the ethylic acid deoxidates and neutralizes the residual alkali on the surface of the cloth. The content of the ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. is 0.5g/L. The temperature of the water is 30°C. The heat preservation time is 20min.

8) high-temperature dyeing the CLEANCOOL fibre low stretch yarn of the modified polyester fibre yarn 75D/72F having a cross-shaped cross section and nanometer sliver ion of the pretreated fabric semi-finished products with the dyeing liquor. The dyeing liquor is formed by dissolving the disperse dye and the dye auxiliary agent which are produced by Zhejiang Runtu Chemical Co., Ltd. in water. The disperse dye is a mixture of disperse red 3B whose weight accounts for 0.8% of the weight of the fabric blanks to be dyed, disperse yellow SE-RGFL whose weight accounts for 0.06% of the weight of the fabric blanks to be dyed and disperse blue 2BLN whose weight accounts for 0.017 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant, anti-creasing agent, high-temperature leveling agent and ethylic acid. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The high-temperature leveling agent is high-temperature leveling agent DM-2108 produced by Guangdong Demei Chemical Co., Ltd. and the content of the high-temperature leveling agent DM-2108 is 0.5g/L. The ethylic acid is produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 0.5 g/L. When dyeing, the temperature of the dye liquor is controlled at 120°C. The heat preservation time is 35min. The heating rate and the cooling rate is controlled at 0.8°C/min.

9) reductive cleaning the fabric semi-finished products in which the modified polyester fibre yarn has been treated with high-temperature dyeing by reductive cleaning solution. The reductive cleaning solution is the aqueous solution consisted of Yashihua NF anti-creasing agent produced by Shanghai Yayun Refining Chemical Co., Ltd., the sodium hyposulfite produced by Guangzhou Zhongcheng Chemical Co., Ltd. and sodium carbonate produced by Hubei Yingcheng Chemical Co., Ltd. The content of the anti-creasing agent is 2g/L, the content of the sodium hyposulfite is 1g/L and the content of the

sodium carbonate is 1.5g/L. When conducting the reductive cleaning, the temperature is controlled at 98°C and the heat preservation time is controlled at 20min.

10) after releasing the reductive cleaning solution, conducting the thermal washing by feeding water until reaches to the required level defined by the liquor ratio. The temperature is controlled at 98°C and the heat preservation time is controlled at 15min. The heating rate and the cooling rate are controlled at 1 ° C/min. After the thermal washing, the water is released. Then, the cool water is introduced until reaches to the required water level defined by the liquor ratio. The fabric is cool washed in the vat for 10min for the subsequent process.

11) dyeing other fibers of the fabric semi-finished products once again. The dye liquor formed by dissolving reactive dye and dye auxiliary agent in the water is used to dye the J45S100% lenzing modal and 20S pure cotton high proportion distributed carded yarn in the fabric semi-finished products. The reactive dye is a set of dye produced by Shanghai Dye Eighth Factory. The components of the reactive dye is a mixture of the reactive brilliant red M-3BE whose weight accounts for 0.08% of the weight of the fabric blanks to be dyed, the reactive yellow M-3RE whose weight accounts for 0.4% of the weight of the fabric blanks to be dyed and the reactive black KN-B whose weight accounts for 0.02 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant and anti-creasing agent. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The above reactive dye and the auxiliary agent are dissolved in the water and are poured into dye vats after being stirred evenly under a normal temperature by dye mixer. Then, the water is added to further dilute uniformly by stirring. Under the normal temperature, the dye and the auxiliary agent thereof are added to the vats in several times. The adding time of the dye and the auxiliary agent thereof is controlled within 20min. At the same time, the cloth is treated for 20min in the dye liquor under the normal temperature. After the dye liquor in the fabric distributes uniformly, the sodium sulfate anhydrous which acts as the accelerating auxiliary agent is added to the dye liquor under the normal temperature. The sodium sulfate anhydrous is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium sulfate anhydrous is 50g/L. The sodium sulfate anhydrous is directly added to the subsidiary vat. After adding the water and

stirring uniformly under the normal temperature, the sodium sulfate anhydrous is added to the vat uniformly in several times. The adding time is controlled within 30min. Finally, the sodium carbonate which acts as color fixing agent is added under the normal temperature. The sodium carbonate is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium carbonate is 15g/L. The sodium carbonate is added in twice. The adding time for each time is controlled at 20min. The sodium carbonate is slowly added to the vat after directly being added to the dye subsidiary vat and adding water to dilute uniformly. After all the materials are added, the temperature is slowly increased. The speed is controlled between 0.5°C/min and 1°C/min. The heat preservation is conducted after the temperature is increased to 60°C. After conducting the heat preservation for 40 min, color matching and color recovery are conducted until the color matches with the color of the sample.

12) cool washing and acid washing the fabric semi-finished products which has been dyed once again, reducing the temperature by adding cool water to the water vat slowly and releasing the water at the same time. The cooling rate is controlled at 0.5-1°C/min. When the temperature of the water is reduced to 40°C, the water is stopped to be added and then is released. After finishing the releasing of the water, a cylinder of water is added based on the water level required by the liquor ratio and the acid washing is conducted under the normal temperature for neutralizing the residual alkali on the cloth. The antacid of the acid washing is ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 3 g/L.

13) soaping the fabric semi-finished products and cool washing them once again, wherein when soaping, a cylinder of water is added based on the liquor ratio after the water being conducted with the acid washing under the normal temperature. The soaping agent is added via the dye auxiliary vat. The soaping agent is a mixture of cleaning agent and chelating dispersant. The cleaning agent is the cleaning agent AR-812 produced by Jiangsu Haian petroleum chemical plant technology development Co., Ltd. and the content of the cleaning agent is 3g/L. The chelating dispersant is argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the chelating dispersant is 1g/L. The material is added and the temperature is increased slowly at the same time. The heating rate is controlled at 1°C/min. After the temperature is increased to 98°C, the heat preservation is conducted for 10 min. Then, the cool water is added to reduce the temperature slowly. The cooling rate is controlled at 1°C/min. The water is released when the tempera-

ture of the water is reduced to 40°C and then a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added according to the liquor ratio.

14) applying hydrophilic softener and hydrophilic soft olein to the cleaned fabric semi-finished products. The ethylic acid whose content is 1g/L is directly added and the cleaned fabric semi-finished produces are kept in the vat. The circulation soaking is conducted for 20min under the normal temperature. The hydrophilic softener and the hydrophilic soft olein are added again and the fabric is soaked circularly for 30min under the normal temperature. The hydrophilic softener is the hydrophilic softener DP-9992 produced by Zhangjiagang Debao Chemical Co., Ltd. and the usage of the hydrophilic softener is 2% of the weight of the fabric blanks to be dyed. The hydrophilic soft olein is the hydrophilic soft olein RS produced by Huizhou Huaweixing Chemical Co., Ltd. and the usage of the hydrophilic soft olein is 5% of the weight of the fabric blanks to be dyed.

15) drying the fabric semi-finished products which has treated by the hydrophilic softener and the hydrophilic soft olein and then placing the dried fabric semi-finished products on a raising machine for napping. The principle of the napping is as follows. The light pulling is conducted at the first time of the napping and then the napping is gradually deepened time after time. The times of the napping is 4~6 preferably. 4~6 of the raising machines are used to perform the napping on-line and continuously. After the napping, the fabric is uniformly and has delicate touch.

16) re-setting the fabric semi-finished products to obtain a greige fabric, the temperature of the re-setting is 160°C, the speed of the car is 20 m/min, the over-feeding cloth consumption is 40%, and moisture-absorbing heat-generating quick-drying moisture-retaining thermal greige fabric is obtained.

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

[0029] The fabric obtained from the embodiment 2 is sent to National Knitting Quality Supervisor & Inspection Center for inspecting the heat preservation rate of the fabric according to the same national standard of embodiment 1. The results are shown as follows.

① The heat preservation rate is 32.35% which meets the requirement of the national standard which is equal to or greater than 30%;

② The highest moisture-absorbing thermal heating value is 7.6°C, which meets the requirement of the

national standard which is equal to or greater than 4.0°C;

③ The average moisture-absorbing thermal heating value is 4.6°C, which meets the requirement of the national knitting standard which is equal to or greater than 3.0°C;

④ The water absorption rate is 321%, which meets the requirement of the national standard which is equal to or greater than 200%;

⑤ The dropping diffusion time is 2.6 seconds, which meets the requirement of the national standard which is less than 3 seconds;

⑥ The wicking height is 126mm, which meets the requirement of the national standard which is equal to or greater than 100mm.

Example 3

[0030] A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is weaved by four yarns. The first yarn is the regenerated cellulose fibre-type blended yarn J40S80S wool 30/bleached degumming linen 20/super-fine lenzing modal 50 compact blended yarn made by blending the wool and the regenerated cellulose fiber, wherein the weight percentage of the regenerated cellulose fiber is 50%. The second yarn is CLEANCOOL fiber low stretch yarn of the modified polyester fiber yarn 75D/72F having a cross-shaped cross section and nanometer sliver ion produced by Shanghai Sinotextiles Corporation Limited. The third yarn is cotton fiber-type blended yarn J40S milk protein fiber 30/combed cotton 70 Siro compact blended yarn made by blending the polyacrylonitrile fiber and the cotton fiber, wherein the weight percentage of the cotton fiber is 70%. The fourth yarn is 30D and 40D polyurethane fiber yarn produced by Invista Fibers (Shanghai) Co. Ltd.

[0031] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric comprises the following steps:

1) Choosing the above four yarn materials based on a designed fabric, and preparing the required number of material tubing head of the above four materials based on the type of the machine;

2) placing the material on the weaving machine, and reserving a slitting line for a scotching and setting of the following process to obtain a fabric blank when weaving. The weaving is conducted according to the knitting process diagram shown in FIG7. The knitting needles are arranged according to FIG.8. A triangle arrangement of the knitting needles is placed according to FIG.9. ○, 1 ○, 2 ○, 3 ○, 4 ○, 5 ○, 6 ○, 7 ○, 8 ○, 9 ○, 10 ○, 11 ○, 12 in FIG.7 and FIG.9 are

numbers of yarn feeding ways. There are twelve way knitting shown in FIG.8. The label 1, 2 in an upper row and a low row of FIG.9 respectively represent No.1 needle and No.2 needle which are called according to the heights of the butt of the knitting needles. An arrangement of upper dial knitting needles is applied to the upper row. An arrangement of lower cylinder knitting needles is applied to the lower row. A triangle arrangement of the upper dial knitting needles are applied to the upper row table in FIG.9. A triangle arrangement of the lower cylinder knitting needles is applied to the lower row table in FIG.9. In the figure, "∧" and "∨" are a stitch cam. "T" is tucking cam. "-" is floating cam;

The weaving is conducted according to FIGS.7-9. A complete organization is finished by twelve way knitting. The first way is in the form of the single knitting in which half of the purl stitches of the No.1 needle are used. The second way is in the form of the single knitting in which all the knit stitches are used. The third way is in the form of the double knitting in which half of the purl stitches of No.2 needle are used to form the looping knitting and half of the knit stitches of No. 1 needle are used to form the tucking knitting. The fourth way is in the form of the single knitting in which half of the purl stitches of No.2 needle are used. The fifth way is in the form of the single knitting in which all the knit stitches are used. The sixth way is in the form of the double knitting in which half of the knit stitches of No.1 needle are used to form the looping knitting and half of the knit stitches of No.2 needle are used to form the tucking knitting. The seventh way and the eighth way repeat the knitting of the first way and the second way. The ninth way is in the form of the double knitting in which half of the purl stitches of No.2 needle are used to form the looping knitting and half of the knit stitches of No.2 needle are used to form the tucking knitting. The tenth way and the eleventh way repeat the knitting of the fourth way and the fifth way. The twelfth way is in the form of the double knitting in which half of the purl stitches of No.1 needle are used to form the looping knitting and half of the knit stitches of No.1 needle are wind to form the tucking knitting. The yarns of the first way, the fourth way, the seventh way and the eleventh way are J40S and milk protein fiber 30/combed cotton 70 Siro compact blended yarn double yarns. The yarns of the second way, the fifth way, the eighth way and the eleventh way are J40S80S wool 30/bleached degumming linen 20/super-fine lenzing modal 50 compact blended yarn and 40D polyurethane fiber yarn produced by Invista Fibers (Shanghai) Co. Ltd. The yarns of the third way, the sixth way, the ninth way and the twelfth way are CLEANCOOL fiber low stretch yarn of the modified polyester fiber yarn 75D/72F and the covering yarn of the 30D polyurethane fiber yarn produced by Invista Fibers (Shanghai) Co. Ltd.

The obtained fabric blanks is consisted of the outer layer, the middle layer and the inner layer. The outer layer is weaved by the first yarn and the fourth yarn. The middle layer is weaved by the second yarn and the fourth yarn. The inner layer is weaved by the second yarn, the third yarn and the fourth yarn. As shown in FIG.7, the purl stitch single knitting portion of the first way, the fourth way, the seventh way and the tenth way and purl stitch looping knitting portion of the third way, the sixth way, the ninth way and the twelfth way constitute the inner layer. The coil index of the purl stitch looping knitting of the third way, the sixth way, the ninth way and the twelfth way is zero. The purl stitch inner layer coil formed by the third way, the sixth way, the ninth way and the twelfth way is small due to the elastic contraction of the polyurethane fiber yarn and the dividing of the knit stitch tucking knitting. The coil index of the purl stitch single knitting of the first way, the fourth way, the seventh way and the tenth way is four. The purl stitch inner layer coil is large without the above two acting forces. It is more obvious under the action of the elastic contraction of the polyurethane fiber yarn of the knit stitch single knitting of the second way, the fifth way, the eighth way and the eleventh way, and thus facilitates the fleece of the following dyeing and finishing pretreatment. The inner layer is the moisture-absorbing and quick-drying layer of the fabric. The middle layer is formed by the knit stitch tucking knitting portion of the third way, the sixth way, the ninth way and the twelfth way. The middle layer is the wicking bidirectional moisture transporting layer of the fabric. The outer layer of the fabric is formed by the knit stitch single looping knitting of the second way, the fifth way, the eighth way and the eleventh way. The outer layer is a layer of the fabric which can absorb moisture, store moisture and release moisture.

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse ;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, configuring the vat according to the volume of the dyeing vat, numbering the vats and filling a process sheet, and then splicing them into a continuous shape required by the operation of the setting machine via a sewing machine;

5) presetting the whole spliced fabric blanks of the car, a presetting temperature is 180 °C, a speed of the car is 15 m/min, an over-feeding cloth consumption of the cloth is 35%;

6) feeding water to the dye vat based on the weight of the fabric blanks of the configured vat until reaches to the water level required by a liquor ratio of 1: 15, sending them into the vat and seaming the heads of

the preset blanks based on the capacity of each tube of the dyeing vat to form a shape of rope-ring which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products, namely the pretreatment of the fabric blanks are divided into three steps. First, the fabric blanks are soaked in the vat having the wool treating agent for conduct the dyeing and finishing pretreatment on the cotton components. In the wool treating agent, the content of the de-oiling agent PCF produced by Clariant Textile Dye Auxiliary Agent (China) Co., Ltd. is 0.5g/L, the content of the scouring and dyeing one-bath enzyme produced by Wuhan Xinhuyang biology Co., Ltd. is 3g/L. The temperature of the water of the dyeing and finishing pre-treatment is 60°C. The heat preservation time is 40min. Then, the linum, the cotton fiber and superfine lenzing modal of the fabric blanks are pretreated. In the pretreatment agent, the content of the sodium carbonate produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. is 1 G/L (it mainly is used to adjust PH value of the dye liquor to 8.0. If the PH value is too low, it will affect the pretreatment effects of the linum and the cotton fiber. If the PH value is too high, the effective content of the wool as the wool can not resist alkali), the content of the hydrogen peroxide produced by Wuhan Chengguang Chemical Co., Ltd. is 8G/L, the content of the refining agent DM-1361 produced by Guangdong Demei Chemical Co., Ltd. is 0.2G/L, the content of the de-oiling agent DM-1133 produced by Guangdong Demei Chemical Co., Ltd. is 0.8G/L, and the content of the anti-creasing agent produced by Clariant Textile Dye Auxiliary Agent (China) Co., Ltd. is 2G/L. The temperature of the water of the dyeing and finishing pretreatment is 80°C. The heat preservation time is 40min. Finally, the ethylic acid whose content is 0.5g/L to neutralize the residual alkali under the normal temperature for 20min.

8) high-temperature dyeing the CLEANCOOL fiber low stretch yarn of the modified polyester fiber yarn 75D/72F of the pretreated fabric semi-finished products with dyeing liquor. The dyeing liquor is formed by dissolving the disperse dye and dye auxiliary agent produced by Nippon Kayaku Co Ltd in water. The disperse dye is a mixture of disperse red AQ-LE whose weight accounts for 0.015% of the weight of the fabric blanks to be dyed, disperse blue AQ-LE whose weight accounts for 0.025% of the weight of the fabric blanks to be dyed and disperse yellow AQ-LE whose weight accounts for 0.013 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant, anti-creasing agent, high-temperature leveling agent and ethylic acid. In the dye liquor, the chelating disper-

sant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The high-temperature leveling agent is high-temperature leveling agent DM-2108 produced by Guangdong Demei Chemical Co., Ltd. and the content of the high-temperature leveling agent DM-2108 is 0.5g/L. The ethylic acid is produced by Jiangsu Sopu Chemcial Co., Ltd. and the content of the ethylic acid is 0.5 g/L. When dyeing, the temperature of the dye liquor is controlled at 110° C. The heat preservation time is 25min. When dyeing, the heating rate and the cooling rate is controlled at 0.5 ° C/min.

9) reductive cleaning the fabric semi-finished products in which the modified polyester fiber yarn has been treated with high-temperature dyeing by reductive cleaning solution. The reductive cleaning solution is the aqueous solution consisted of Yashihua NF anti-creasing agent produced by Shanghai Yayun Refining Chemical Co., Ltd., the sodium hyposulfite produced by Guangzhou Zhongcheng Chemical Co., Ltd. and sodium carbonate produced by Hubei Yingcheng Chemical Co., Ltd. The content of the anti-creasing agent is 1g/L, the content of the sodium hyposulfite 0.5g/L and the content of the sodium carbonate is 0.5g/L. When conducting the reductive cleaning, the temperature is controlled at 85 °C and the heat preservation time is controlled at 15min.

10) after releasing the reductive cleaning solution, conducting the thermal washing by feeding water until reaches to the required level defined by the liquor ratio. The temperature is controlled at 95° C and the heat preservation time is controlled at 10min. The heating rate and the cooling rate are controlled at 0.8 C/min. After the thermal washing, the water is released. Then, the cool water is introduced until reaches to the required water level defined by the liquor ratio. The fabric is cool washed in the vat for 15min for the subsequent process.

11) dyeing other fibers of the fabric semi-finished products once again. The dye liquor formed by dissolving reactive dye and dye auxiliary agent in the water is used to dye J40S80S wool 30/bleached degumming linen 20/super-fine Lenzing modal 50 compact blended yarn and milk protein fiber 30/combed cotton 70 Siro compact blended yarn in the fabric semi-finished products. The reactive dye is a set of reactive dye produced by Nippon Kayaku Co Ltd. The component of the reactive dye is a mixture of the reactive blue CN-MG whose weight accounts for 0.024% of the weight of the fabric blanks to be dyed,

the reactive red CN-3B whose weight accounts for 0.0134% of the weight of the fabric blanks to be dyed and the reactive yellow CN-EX whose weight accounts for 0.028 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant and anti-creasing agent. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The above reactive dye and the auxiliary agent are dissolved in the water and are poured into dye vats after being stirred evenly under a normal temperature by dye mixer. Then, the water is added to further dilute uniformly by stirring. Under the normal temperature, the dye and the auxiliary agent thereof are added to the vats in several times. The adding time of the dye and the auxiliary agent thereof is controlled within 20min. At the same time, the cloth is treated for 20min in the dye liquor under the normal temperature. After the dye liquor in the fabric distributes uniformly, the sodium sulfate anhydrous which acts as the accelerating auxiliary agent is added to the dye liquor under the normal temperature. The sodium sulfate anhydrous is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium sulfate anhydrous is 8g/L. The sodium sulfate anhydrous is directly added to the subsidiary vat. After adding the water and stirring uniformly under the normal temperature, the sodium sulfate anhydrous is added to the vat uniformly in several times. The adding time is controlled within 20min. Finally, the sodium carbonate which acts as color fixing agent is added under the normal temperature. The sodium carbonate is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium carbonate is 1g/L. The sodium carbonate is added at twice. The adding time for each time is controlled at 10min. The sodium carbonate is slowly added to the vat after directly being added to the dye subsidiary vat and adding water to dilute uniformly. After all the materials are added, the temperature is slowing increased. The speed is controlled between 0.5 ° C/min and 1 ° C/min. The heat preservation is conducted after the temperature is increased to 110° C. After conducting the heat preservation for 30 min, color matching and color recovery are conducted until the color matches with the color of the sample.

12) cool washing and acid washing the fabric semi-finished products which has been dyed once again, reducing the temperature by adding cool water to the water vat slowly and releasing the water at the same time. The cooling rate is controlled at 0.5-1° C/min. When the temperature of the water is reduced

to 40° C, the water is stopped to be added and then is released. After finishing the releasing of the water, a cylinder of water is added based on the water level required by the liquor ratio and the acid washing is conducted under the normal temperature for neutralizing the residual alkali on the cloth. The antacid of the acid washing is ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 0.5 g/L.

13) soaping the fabric semi-finished products and cool washing them once again, wherein when soaping, a cylinder of water is added based on the liquor ratio after the water being conducted with the acid washing under the normal temperature. The soaping agent is added via the dye auxiliary vat. The soaping agent is a mixture of cleaning agent and chelating dispersant. The cleaning agent is the cleaning agent AR-812 produced by Jiangsu Haian petroleum chemical plant technology development Co., Ltd. and the content of the cleaning agent is 1g/L. The chelating dispersant is argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the chelating dispersant is 1g/L. The material is added and the temperature is increased slowly at the same time. The heating rate is controlled at 1° C/min. After the temperature is increased to 85° C, the heat preservation is conducted for 10 min. Then, the cool water is added slowly to reduce the temperature. The cooling rate is controlled at 1° C/min. The water is released when the temperature of the water is reduced to 40° C and then a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added according to the liquor ratio.

14) applying hydrophilic softener and hydrophilic soft olein to the cleaned fabric semi-finished products. The ethylic acid whose content is 0.8g/L is directly added and the cleaned fabric semi-finished products are kept in the vat. The circulation soaking is conducted for 20min under the normal temperature. The hydrophilic softener and the hydrophilic soft olein are added again and the fabric is soaked circularly for 20min under the normal temperature. The hydrophilic softener is the Dibaoshu DPS produced by Suzhou Tongye Chemical Co., Ltd. and the usage of the hydrophilic softener is 1% of the weight of the fabric blanks to be dyed. The hydrophilic soft olein is the hydrophilic soft olein RS produced by Huizhou Huaweixing Chemical Co., Ltd. and the usage of the hydrophilic soft olein is 5% of the weight of the fabric blanks to be dyed.

15) drying the fabric semi-finished products which has treated by the hydrophilic softener and the hydrophilic soft olein and then placing the dried fabric semi-finished products on a raising machine for napping.

The principle of the napping is as follows. The light pulling is conducted at the first time of the napping and then the napping is gradually deepened time after time. The times of the napping is 4~6 preferably. 4~6 of the raising machines are used to perform the napping on-line and continuously. After the napping, the fabric is uniformly and has delicate touch

16) re-setting the fabric semi-finished products to obtain a greige fabric, the temperature of the re-setting is 160° C, the speed of the car is 20 m/min, the over-feeding cloth consumption of the cloth is 50%, and moisture-absorbing heat-generating quick-drying moisture-retaining thermal greige fabric is obtained.

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

[0032] The fabric obtained from the embodiment 3 is sent to National Knitting Quality Supervisor & Inspection Center for inspecting the heat preservation rate of the fabric according to the same national standard of embodiment 1. The results are shown as follows.

① The heat preservation rate is 42.08% which meets the requirement of the national standard which is equal to or greater than 30%;

② The highest moisture-absorbing thermal heating value is 7.1° C, which meets the requirement of the national standard which is equal to or greater than 4.0°C;

③ The average moisture-absorbing thermal heating value is 3.9° C, which meets the requirement of the national knitting standard which is equal to or greater than 3.0°C;

④ The water absorption rate is 319%, which meets the requirement of the national standard which is equal to or greater than 200%;

⑤ The dropping diffusion time is 0.7 seconds, which meets the requirement of the national standard which is less than 3 seconds;

⑥ The wicking height is 145mm, which meets the requirement of the national standard which is equal to or greater than 100mm.

Example 4

[0033] A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is weaved by four yarns. The first yarn is regenerated cellulose fiber-type blended yarn J32S cotton fibre/Jutecell30/70 blended yarn which is blended by the cotton fiber and the regen-

erated cellulose fiber. The weight percentage of the regenerated cellulose fiber is 70%. The second yarn is the modified polyester fiber yarn J40SCOOLDRY staple yarn having a cross-shaped cross section produced by Shanghai Haitianyingjie Textile Technology Co., Ltd. The third yarn is the cotton fiber-type blended yarn J32S60/40 cotton/COOLDRY blended yarn which is blended by polyester staple fibre and the cotton fiber. The weight percentage of the cotton fiber is 60%. The fourth yarn is 30D polyurethane fibre yarn produced by Hangzhou Asahikasei Spandex Co., Ltd.

[0034] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric comprises the following steps:

1) Choosing the above four yarn materials based on a designed fabric, and preparing the required number of material tubing head of the above four materials based on the type of the machine;

2) placing the material on the weaving machine, and reserving a slitting line for a scotching and setting of the following process to obtain a fabric blank when weaving. The weaving is conducted according to the knitting process diagram shown in FIG.10. The knitting needles are arranged according to FIG 11. A triangle arrangement of the knitting needles is placed according to FIG.12. ①②③④⑤⑥ in FIG.10 and FIG 12 are numbers of yarn feeding ways. There are six way knitting shown in FIG.10. The label 1, 2 in an upper row and a lower row of FIG 11 respectively represent No.1 needle and No.2 needle which are called according to the heights of the butt of the knitting needles. An arrangement of upper dial knitting needles is applied to the upper row. An arrangement of lower cylinder knitting needles is applied to the lower row. A triangle arrangement of the upper dial knitting needles are applied to the upper row table in FIG.12. A triangle arrangement of the lower cylinder knitting needles is applied to the lower row table. In the figure, "∧" and "∨" are a stitch cam. "II" is tucking cam. "-" is floating cam;

The weaving is conducted according to FIGS.10-12. A complete organization is finished by six way knitting. The first way is in the form of the single knitting in which half of the purl stitches of No.1 needle are used. The second way is in the form of the single knitting in which all the knit stitches are used. The third way is in the form of the double knitting in which half of the purl stitches of No.2 needles are used to form the looping knitting and half of the knit stitches of No.1 needles are used to form the tucking knitting. The fourth way is in the form of the single knitting in which half of the purl stitches of No.2 needles are used. The fifth way is in the form of the single knitting in which all the knit stitches are used. The sixth way is in the form of the double knitting in which half of the purl stitches of No.1 needle are used to form the

looping knitting and half of the knit stitches of No.2 needle are used to form the tucking knitting. The first way and the fourth way is double yarn feeding knitting of J32S40/60COOLDRY/cotton blended yarn. The yarns in the second way and the fifth way are J32S cotton fibre/Jutecell30/70 blended yarn and 30D polyurethane fiber yarn. The yarns in the third way and the sixth way are J40SCOOLDRY staple yarn and 30D polyurethane fiber yarn.

The obtained fabric blanks is consisted of the outer layer, the middle layer and the inner layer. The outer layer is weaved by the first yarn and the fourth yarn. The middle layer is weaved by the second yarn and the fourth yarn. The inner layer is weaved by the second yarn, the third yarn and the fourth yarn. As shown in FIG 10, the purl stitch single knitting portion of the first way and the fourth way and the purl stitch looping knitting portion of the third way and the sixth way constitute the inner layer. As the coil index of the purl stitch looping knitting of the third way and the sixth way is zero and due to the elastic contraction of the polyurethane fiber yarn and the dividing of the knit stitch tucking knitting, the purl stitch inner layer coil formed by the third way and the sixth way is small. As the coil index of the purl stitch single knitting of the first way and the fourth way is four and the above two acting forces is absence, the purl stitch inner layer coil is large. The effect is more obvious under the action of the elastic contraction of the polyurethane fiber yarn of the second way and the fifth way, and thus facilitates the fleece of the following dyeing and finishing pretreatment. The inner layer is the moisture-absorbing and quick-drying layer of the fabric. The middle layer is formed by the knit stitch tucking knitting portion of the third way and the sixth way. The middle layer is the wicking bidirectional moisture transporting layer of the fabric. The outer layer of the fabric is formed by the knit stitch single knitting portion of the second way and the fifth way. The outer layer is a layer of the fabric which can absorb moisture, store moisture and release moisture.

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, configuring the vat according to the volume of the dyeing vat, numbering the vats and filling a process sheet, and then splicing them into a continuous shape required by the operation of the setting machine via a sewing machine;

5) presetting the spliced fabric blanks of the car, a presetting temperature is 190°C, a speed of the car is 15 m/min, an over-feeding cloth consumption of the cloth is 25%;

6) feeding water to the dye vat based on the weight of the fabric blanks of the configured vat until reaches to the water level required by a liquor ratio of 1: 8, sending them into the vat and seaming the heads of the preset blanks based on the capacity of each tube of the dyeing vat to form a shape of rope-ring which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products, namely immersing the fabric blanks into the vat in which oxygen bleaching agent and de-oiling treatment agent are filled for oxygen bleaching and dyeing and finishing pretreatment. In the oxygen bleaching agent, the content of hydrogen peroxide produced by Wuhan Chengguang Chemical Co., Ltd. is 3g/L, the content of the Yuzhongbao DXB-626 produced by Guangdong Demei Chemical Co., Ltd. is 1g/L, the content of the refining agent produced by Guangdong Demei Chemical Co., Ltd. is 0.5 g/L, the content of sodium hydrate NaOH produced by Xinjiang Tianye Chemical Co., Ltd. is 1g/L. The treating agent is used to conduct dyeing and finishing pretreatment. The temperature of the water of the dyeing and finishing pretreatment is 98°C. The heat preservation time is 40min. The heating rate and the cooling rate are controlled at 0.5~1°C/min. After the treatment, the oxyrase produced by Zhejiang Chuanhua Chemical Co., Ltd. and the ethylic acid produced by Jiangsu Sopa Chemical Co., Ltd. are used to deoxidize and neutralize the residual alkali on the cloth. The content of the oxyrase is 0.1g/L and the content of the ethylic acid is 0.5g/L.

8) high-temperature dyeing J40SCOODRY staple yarn having a cross-shaped cross section of the pre-treated fabric semi-finished products with the dyeing liquor. The dyeing liquor is formed by dissolving the disperse dye and dye auxiliary agent which are produced by Zhejiang Runtu Chemical Co., Ltd. in water. The disperse dye is a mixture of disperse red S-5BL whose weight accounts for 0.024% of the weight of the fabric blanks to be dyed, disperse organ S-4RL whose weight accounts for 0.84% of the weight of the fabric blanks to be dyed and disperse blue S-3BG whose weight accounts for 0.264 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant, anti-creasing agent, high-temperature leveling agent and ethylic acid. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The high-temperature leveling agent is the high-temperature leveling agent DM-2108 produced by Guangdong Demei Chemical

Co., Ltd. and the content of the high-temperature leveling agent DM-2108 is 0.8g/L. The ethylic acid is produced by Jiangsu Sopa Chemical Co., Ltd. and the content of the ethylic acid is 1 g/L. When dyeing, the temperature of the dye liquor is controlled at 120°C. The heat preservation time is 45min. When dyeing, the heating rate and the cooling rate is controlled at 0.5°C/min.

9) reductive cleaning the fabric semi-finished products in which the modified polyester fibre yarn has been treated with high-temperature dyeing by reductive cleaning solution. The reductive cleaning solution is the aqueous solution consisted of Yuzhongbao DXB-626 produced by Guangdong Demei Chemical Co., Ltd., the sodium hyposulfite produced by Guangzhou Zhongcheng Chemical Co., Ltd. and sodium carbonate produced by Hubei Yingcheng Chemical Co., Ltd. The content of the anti-creasing agent is 1.5g/L, the content of the sodium hyposulfite 1g/L and the content of the sodium carbonate is 2g/L. When conducting the reductive cleaning, the temperature is controlled at 100°C and the heat preservation time is controlled at 25min.

10) after releasing the reductive cleaning solution, conducting the thermal washing by feeding water until reaches to the required level defined by the liquor ratio. The temperature is controlled at 98°C and the heat preservation time is controlled at 20min. After the thermal washing, the water is released. Then, the cool water is introduced until reaches to the required water level defined by the liquor ratio. The fabric is cool washed in the vat for 10min for the subsequent process.

11) dyeing other fibres of the fabric semi-finished products once again. The dye liquor formed by dissolving reactive dye and dye auxiliary agent in the water is used to dye J32S cotton fibre/Jutecell30/70 blended yarn in the fabric semi-finished products and the cotton blended yarn in J32S40/60COOLDRY/cotton blended yarn. The reactive dye is a set of reactive dye produced by Shanghai Dye Eighth Factory. The reactive dye is a mixture of the reactive brilliant red M-3BE whose weight accounts for 0.23% of the weight of the fabric blanks to be dyed, the reactive yellow M-3RE whose weight accounts for 1.08% of the weight of the fabric blanks to be dyed and the reactive black KN-B whose weight accounts for 0.37 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant and anti-creasing agent. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining

Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The above reactive dye and the auxiliary agent are dissolved in the water and are poured in dye vats after being stirred evenly under a normal temperature by dye mixer. Then, the water is added to further dilute uniformly by stirring. Under the normal temperature, the dye and the auxiliary agent thereof are added to the vats in several times. The adding time of the dye and the auxiliary agent thereof is controlled within 20min. At the same time, the cloth is treated for 20min in the dye liquor under the normal temperature. After the dye liquor in the fabric distributes uniformly, the sodium sulfate anhydrous which acts as the accelerating auxiliary agent is added to the dye liquor under the normal temperature. The sodium sulfate anhydrous is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium sulfate anhydrous is 60g/L. The sodium sulfate anhydrous is directly added to the subsidiary vat. After adding the water and stirring uniformly under the normal temperature, the sodium sulfate anhydrous is added to the vat uniformly in several times. The adding time is controlled within 30min. Finally, the substitution alkali which acts as color fixing agent is added under the normal temperature. The substitution alkali is produced by Zhejiang Chuanhua Chemical Co., Ltd. and the content of substitution alkali is 3g/L. The sodium carbonate is added at twice. The adding time for each time is controlled at 20min. The sodium carbonate is slowly added to the vat after directly being added to the dye subsidiary vat and adding water to dilute uniformly. After all the materials are added, the temperature is slowly increased. The speed is controlled between 0.5°C/min and 1°C/min. The heat preservation is conducted after the temperature is increased to 60°C. After conducting the heat preservation for 45 min, color matching and color recovery are conducted until the color matches with the color of the sample.

12) cool washing and acid washing the fabric semi-finished products which has been dyed once again, reducing the temperature by adding cool water to the water vat slowly and releasing the water at the same time. The cooling rate is controlled at 0.5°C/min. When the temperature of the water is reduced to 40°C, the water is stopped to be added and then is released. After finishing the releasing of the water, a cylinder of water is added based on the water level required by the liquor ratio and the acid washing is conducted under the normal temperature for neutralizing the residual alkali on the cloth. The antacid of the acid washing is ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 3 g/L.

13) soaping the fabric semi-finished products and

cool washing them once again, wherein when soaping, a cylinder of water is added based on the liquor ratio after the water being conducted with the acid washing under the normal temperature. The soaping agent is added via the dye auxiliary vat. The soaping agent is a mixture of cleaning agent and chelating dispersant. The cleaning agent is the cleaning agent 209 produced by Nantong Zhanyi Chemical Co., Ltd. The content of the cleaning agent is 2g/L. The chelating dispersant is argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the chelating dispersant is 1g/L. The material is added and the temperature is increased slowly at the same time. The heating rate is controlled at 1°C/min. After the temperature is increased to 98°C, the heat preservation is conducted for 10 min. Then, the cool water is added slowly to reduce the temperature. The cooling rate is controlled at 1°C/min. The water is released when the temperature of the water is reduced to 40°C and then a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added according to the liquor ratio.

14) applying hydrophilic softener and hydrophilic soft olein to the cleaned fabric semi-finished products. The ethylic acid whose content is 0.75g/L is directly added and the cleaned fabric semi-finished products are kept in the vat. The circulation soaking is conducted for 15min under the normal temperature. The hydrophilic softener and the hydrophilic soft olein are added again and the fabric is soaked circularly for 25min under the normal temperature. The hydrophilic softener is the Dibaoshu DPS produced by Suzhou Tongye Chemical Co., Ltd. and the usage of the hydrophilic softener is 1% of the weight of the fabric blanks to be dyed. The hydrophilic soft olein is the hydrophilic soft olein SJ12 produced by Guangzhou Guangjian Refining Chemical Co., Ltd. and the usage of the hydrophilic soft olein is 4% of the weight of the fabric blanks to be dyed.

15) drying the fabric semi-finished products which has treated by the hydrophilic softener and the hydrophilic soft olein and then placing the dried fabric semi-finished products on a raising machine for napping. The principle of the napping is as follows. The light pulling is conducted at the first time of the napping and then the napping is gradually deepened time after time. The times of the napping is 4~6 preferably. 4~6 of the raising machines are used to perform the napping on-line and continuously. After the napping, the fabric is uniformly and has delicate touch.

16) re-setting the fabric semi-finished products to obtain a greige fabric, the temperature of the re-setting is 155°C, the speed of the car is 18 m/min, the over-

feeding cloth consumption of the cloth is 50%, and moisture-absorbing heat-generating quick-drying moisture-retaining thermal greige fabric is obtained.

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils. 5

[0035] The fabric obtained from the embodiment 4 is sent to National Knitting Quality Supervisor & Inspection Center for inspecting the heat preservation rate of the fabric according to the same national standard of embodiment 1. The results are shown as follows. 10

① The heat preservation rate is 35.28% which meets the requirement of the national standard which is equal to or greater than 30%; 15

② The highest moisture-absorbing thermal heating is 6.6°C, which meets the requirement of the national standard which is equal to or greater than 4.0°C; 20

③ The average moisture-absorbing thermal heating value is 3.5°C, which meets the requirement of the national knitting standard which is equal to or greater than 3.0°C; 25

④ The water absorption rate is 376%, which meets the requirement of the national standard which is equal to or greater than 200%; 30

⑤ The dropping diffusion time is 0.9 seconds, which meets the requirement of the national standard which is less than 3 seconds; 35

⑥ The wicking height is 172mm, which meets the requirement of the national standard which is equal to or greater than 100mm. 40

Example 5

[0036] A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric is weaved by four yarns. The first yarn is the regenerated cellulose filament yarn 120D viscose filament yarn. The second yarn is modified polyester fibre yarn SUPERCOOL75D/72F polyester fiber low stretch yarn having Y-type cross section and grafting the hydrophilic group. The second yarn is produced by Shanghai Guida Technology Co., Ltd. The third yarn is the cotton fibre-type blended fiber J32S20/80SUPERCOOL/cotton blended yarn which is blended by the polyester fiber and the cotton fiber. The weight percentage of the cotton fiber is 80%. The fourth yarn is 30D polyurethane fiber yarn produced by Hangzhou Asahikasei Spandex Co., Ltd. 45

[0037] A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric comprises the following steps: 50

1) Choosing the above four yarn materials based on a designed fabric, and preparing the required number of material tubing head of the above four materials based on the type of the machine;

2) placing the material on the weaving machine, and reserving a slitting line for a scotching and setting of the following process to obtain a fabric blank when weaving. The weaving is conducted according to the knitting process diagram shown in FIG. 13. The knitting needles are arranged according to FIG. 14. A triangle arrangement of the knitting needles is placed according to FIG. 15. ①②③④⑤⑥⑦⑧⑨⑩ in FIG. 13 and FIG. 15 are numbers of yarn feeding ways. There are ten way knitting shown in FIG. 13. The label 1, 2 in an upper row and a lower row of FIG. 14 respectively represent No.1 needle and No.2 needle which are called according to the heights of the butt of the knitting needles. An arrangement of upper dial knitting needles is applied to the upper row. An arrangement of lower cylinder knitting needles is applied to the lower row. A triangle arrangement of the upper dial knitting needles are applied to the upper row table in FIG. 15. A triangle arrangement of the lower cylinder knitting needles is applied to the lower row table. In the figure, "Λ" and "∨" are a stitch cam. "II" is tucking cam. "-" is floating cam; 55

The weaving is conducted according to FIGS. 13-15. A complete organization is finished by ten way knitting. The first way is in the form of the single knitting in which half of the purl stitches of No.1 are used. The second way is in the form of the double knitting in which the purl stitches of No.2 needle are used to form the looping knitting and half of the knit stitches of No.1 needle are used to form the tucking knitting. The third way and the fourth way are in the form of the single knitting in which all the knit stitches are used. The fifth way is in the form of the double knitting in which half of the purl stitch of No.1 needle are used to form the looping knitting and half of the knit stitches of No.2 needle are used to form the tucking knitting. The sixth way is in the form of the single knitting in which half of the purl stitches of No.1 are used. The seventh way is in the form of the double knitting in which half of the purl stitches of No.2 needle are used to form the looping knitting and half of the knit stitches of No.2 needle are used to form the tucking knitting. The eighth way and the ninth way are in the form of the single knitting in which all the knit stitches are used. The tenth way is in the form of the double knitting in which half of the purl stitches of No.1 needle are used to form the looping knitting and half of the knit stitches of No. 1 needle are used to form the tucking knitting. The first way and the sixth way are double yarn feeding knitting formed by J32S20/80SUPERCOOL/cotton blended yarn. The yarns in the second way, the fifth way, the seventh way are SUPERCOOL75D/72F polyester fiber low

stretch yarn and 30D polyurethane fiber yarn. The yarns in the third way, the fourth way, the eighth way and the ninth way are 120D viscose filament yarn and 30D polyurethane fiber yarn.

The obtained fabric blanks is consisted of the outer layer, the middle layer and the inner layer. The outer layer is weaved by the first yarn and the fourth yarn. The middle layer is weaved by the second yarn and the fourth yarn. The inner layer is weaved by the second yarn, the third yarn and the fourth yarn. As shown in FIG. 13, the purl stitch single knitting portion of the first way and the sixth way and the purl stitch looping knitting of the fifth way and the tenth way constitute the inner layer of the fabric. The coil index of the looping knitting of the first way and the sixth way is three. The coil is larger. The coil index of the looping knitting of the fifth way and the tenth way is zero. The formed coil is smaller, and thus it facilitates the subsequent fleece and napping of the inner layer fabric. The inner layer is the moisture-absorbing and quick-drying layer of the fabric. The purl stitch looping knitting portion of the second way and the seventh way forms the inner layer of the fabric in theory. However, as the coil index is 4 and the coil contains polyurethane fiber as well as the yarns of the second way and the seventh way and the yarns used in the first way and the sixth way are too thin and are pulled too long so as to hide tightly in the middle of the fabric, the double knitting portion of the second way and the seventh way and the knitting portion of the fifth way and the tenth way form the middle layer of the fabric. The middle layer is wicking bidirectional moisture permeating antibacterial layer. The single knitting portion of the third way, the fourth way, the eighth way and the ninth way forms the outer layer of the fabric. The outer layer is a layer of the fabric which can absorb moisture, store moisture and release moisture.

3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse;

4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, configuring the vat according to the volume of the dyeing vat, numbering the vats and filling a process sheet, and then splicing them into a continuous shape required by the operation of the setting machine via a sewing machine;

5) presetting the whole spliced fabric blanks of the car, a presetting temperature is 195°C. a speed of the car is 18 m/min, an over-feeding cloth consumption of the cloth is 15%;

6) feeding water to the dye vat based on the weight of the fabric blanks of the configured vat until reaches to the water level required by a liquor ratio of 1: 10,

sending them into the vat and seaming the heads of the preset blanks based on the capacity of each tube of the dyeing vat to form a shape of rope-ring which allows a continuous running of the dye vat;

7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products, namely immersing the fabric blanks into the vat in which oxygen bleaching agent is filled for oxygen bleaching dyeing and finishing pretreatment. In the oxygen bleaching agent, the content of hydrogen peroxide produced by Wuhan Chengguang Chemical Co., Ltd. is 3g/L, the content of the Yuzhognbao DXB-626 anti-creasing agent produced by Guangdong Demei Chemical Co., Ltd. is 1g/L, the content of the refining agent DM-1361 produced by Guangdong Demei Chemical Co., Ltd. is 0.5 g/L, and the content of the sodium hydroxide NaOH produced by Xinjiang Tianye Chemical Co., Ltd. is 0.75g/L. The treating agent in the vat is used to conduct the dyeing and finishing pretreatment. The temperature of the water of the dyeing and finishing pretreatment is 98°C. The heat preservation time is 40min. The heating speed is controlled between 0.5°C/min and 1°C/min. After the treatment, the ethylic acid is used to deoxidize and neutralize the residual alkali on the surface of the cloth. The content of oxyrase produced by Zhejiang Chuanhua Chemical Co., Ltd. is 0.1g/L and the content of the ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. is 0.5g/L.

8) high-temperature dyeing the modified polyester fibre yarn SUPERCOOL75D/72F polyester fibre low stretch yarn of the pretreated fabric semi-finished products with dyeing liquor. The dyeing liquor is formed by dissolving the disperse dye and dye auxiliary agent produced by Zhejiang Runtu Chemical Co., Ltd. in water. The disperse dye is a mixture of disperse red S-5BL whose weight accounts for 0.02% of the weight of the fabric blanks to be dyed, disperse orange S-4RL whose weight accounts for 0.7% of the weight of the fabric blanks to be dyed and disperse blue S-3BG whose weight accounts for 0.22 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant, anti-creasing agent, high-temperature leveling agent and ethylic acid. In the dyeing liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The high-temperature leveling agent is high-temperature leveling agent DM-2108 produced by Guangdong Demei Chemical Co., Ltd. and the content of the high-temperature leveling agent DM-2108 is 0.5g/L.

The ethylic acid is produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 1 g/L. When dyeing, the temperature of the dye liquor is controlled at 130°C. The heat preservation time is 35min. When dyeing, the heating rate and the cooling rate are controlled at 0.5°C/min.

9) reductive cleaning the fabric semi-finished products in which the modified polyester fibre yarn has been treated with high-temperature dyeing by reductive cleaning solution. The reductive cleaning solution is the aqueous solution consisted of the Yuzhognbao DXB-626 produced by Guangdong Demei Chemical Co., Ltd., the sodium hyposulfite produced by Guangzhou Zhongcheng Chemical Co., Ltd. and sodium carbonate produced by Hubei Yingcheng Chemical Co., Ltd. The content of the anti-creasing agent is 1g/L, the content of the sodium hyposulfite 1g/L and the content of the sodium carbonate is 2g/L. When conducting the reductive cleaning, the temperature is controlled at 95°C and the heat preservation time is controlled at 20min.

10) after releasing the reductive cleaning solution, conducting the thermal washing by feeding water until reaches to the required level defined by the liquor ratio. The temperature is controlled at 98°C and the heat preservation time is controlled at 20min. After the thermal washing, the water is released. Then, the cool water is introduced until reaches to the required water level defined by the liquor ratio. The fabric is cool washed in the vat for 10min for the subsequent process.

11) dyeing other fibers of the fabric semi-finished products once again. The dye liquor formed by dissolving reactive dye and dye auxiliary agent in the water is used to dye 120D viscose filament yarn in the fabric semi-finished products and the cotton fiber in J32S20/80SUPERCOOL/ cotton blended yarn. The reactive dye is a set of reactive dye produced by Shanghai Dye Eighth Factory. The reactive dye is a mixture of the reactive brilliant red M-3BE whose weight accounts for 0.275% of the weight of the fabric blanks to be dyed, the reactive yellow M-3RE whose weight accounts for 1.26% of the weight of the fabric blanks to be dyed and the reactive black KN-B whose weight accounts for 0.43 % of the weight of the fabric blanks to be dyed. The selected dye auxiliary agent includes chelating dispersant and anti-creasing agent. In the dye liquor, the chelating dispersant is Argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the Argaprep ARSK is 1g/L. The anti-creasing agent is Yashihua NF produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the anti-creasing agent is 1g/L. The above reactive dye and the auxiliary agent are dissolved in the water and are

poured into dye vats after being stirred evenly under a normal temperature by dye mixer. Then, the water is added to further dilute uniformly by stirring. Under the normal temperature, the dye and the auxiliary agent thereof are added to the vats in several times. The adding time of the dye and the auxiliary agent thereof is controlled within 20min. At the same time, the cloth is treated for 20min in the dye liquor under the normal temperature. After the dye liquor in the fabric distributes uniformly, the sodium sulfate anhydrous which acts as the accelerating auxiliary agent is added to the dye liquor under the normal temperature. The sodium sulfate anhydrous is produced by Hubei Yingcheng Shuanghuan Chemical Co., Ltd. and the content of the sodium sulfate anhydrous is 70g/L. The sodium sulfate anhydrous is directly added to the subsidiary vat. After adding the water and stirring uniformly under the normal temperature, the sodium sulfate anhydrous is added to the vat uniformly in several times. The adding time is controlled within 30min. Finally, the substitution alkali which acts as color fixing agent is added under the normal temperature. The substitution alkali is produced by Zhejiang Chuanhua Chemical Co., Ltd. and the content of the sodium carbonate is 3.2g/L. The sodium carbonate is added at twice. The adding time for each time is controlled at 20min. The sodium carbonate is slowly added to the vat after directly being added to the dye subsidiary vat and adding water to dilute uniformly. After all the materials are added, the temperature is slowly increased. The speed is controlled between 0.5°C/min and 1°C/min. The heat preservation is conducted after the temperature is increased to 60°C. After conducting the heat preservation for 45 min, color matching and color recovery are conducted until the color matches with the color of the sample.

12) cool washing and acid washing the fabric semi-finished products which has been dyed once again, reducing the temperature by adding cool water to the water vat slowly and releasing the water at the same time. The cooling rate is controlled at 1°C/min. When the temperature of the water is reduced to 40°C, the water is stopped to be added and then is released. After finishing the releasing of the water, a cylinder of water is added based on the water level required by the liquor ratio and the acid washing is conducted under the normal temperature for neutralizing the residual alkali on the cloth. The antacid of the acid washing is ethylic acid produced by Jiangsu Sopo Chemical Co., Ltd. and the content of the ethylic acid is 3 g/L.

13) soaping the fabric semi-finished products and then cool washing them once again, wherein when soaping, a cylinder of water is added based on the liquor ratio after the water being conducted with the

acid washing under the normal temperature. The soaping agent is added via the dye auxiliary vat. The soaping agent is a mixture of cleaning agent and chelating dispersant. The cleaning agent is the cleaning agent 209 produced by Nantong Zhanyi Chemical Co., Ltd. and the content of the cleaning agent is 2g/L. The chelating dispersant is argaprep ARSK produced by Shanghai Yayun Refining Chemical Co., Ltd. and the content of the chelating dispersant is 1g/L. The material is added and the temperature is increased slowly at the same time. The heating rate is controlled at 1°C/min. After the temperature is increased to 98°C, the heat preservation is conducted for 10 min. Then, the cool water is added to reduce the temperature. The cooling rate is controlled at 1°C/min. The water is released when the temperature of the water is reduced to 40°C and then a cylinder of water is added for cool washing. After the cool washing, a cylinder of water is added according to the liquor ratio.

14) applying hydrophilic softener and hydrophilic soft olein to the cleaned fabric semi-finished products. The ethylic acid whose content is 0.8g/L is directly added and the cleaned fabric semi-finished products are kept in the vat. The circulation soaking is conducted for 15min under the normal temperature. The hydrophilic softener and the hydrophilic soft olein are added again and the fabric is soaked circularly for 25min under the normal temperature. The hydrophilic softener is the hydrophilic softener DP-9992 produced by Zhangjiagang Debao Chemical Co., Ltd. and the usage of the hydrophilic softener is 0.5% of the weight of the fabric blanks to be dyed. The hydrophilic soft olein is the hydrophilic soft olein RS produced by Huizhou Huaweixing Chemical Co., Ltd. and the usage of the hydrophilic soft olein is 4% of the weight of the fabric blanks to be dyed.

15) drying the fabric semi-finished products which has treated by the hydrophilic softener and the hydrophilic soft olein and then placing the dried fabric semi-finished products on a raising machine for napping. The principle of the napping is as follows. The light pulling is conducted at the first time of the napping and then the napping is gradually deepened time after time. The times of the napping is 4~6 preferably. 4~6 of the raising machines are used to perform the napping on-line and continuously. After the napping, the fabric is uniformly and has delicate touch.

16) re-setting the fabric semi-finished products to obtain a greige fabric, the temperature of the re-setting is 160°C, the speed of the car is 20 m/min, the over-feeding cloth consumption of the cloth is 40%, and moisture-absorbing heat-generating quick-drying moisture-retaining thermal greige fabric is obtained.

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

[0038] The fabric obtained from the embodiment 5 is sent to National Knitting Quality Supervisor & Inspection Center for inspecting the heat preservation rate of the fabric according to the same national standard of embodiment 1. The results are shown as follows.

① The heat preservation rate is 32.58% which meets the requirement of the national standard which is equal to or greater than 30%;

② The highest moisture-absorbing thermal heating value is 6.8°C, which meets the requirement of the national standard which is equal to or greater than 4.0°C;

③ The average moisture-absorbing thermal heating value is 3.7°C, which meets the requirement of the national knitting standard which is equal to or greater than 3.0°C;

④ The water absorption rate is 326%, which meets the requirement of the national standard which is equal to or greater than 200%;

⑤ The dropping diffusion time is 0.5 seconds, which meets the requirement of the national standard which is less than 3 seconds;

⑥ The wicking height is 183mm, which meets the requirement of the national standard which is equal to or greater than 100mm.

Claims

1. A moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric, **characterized in that** the fabric is woven by a first yarn, a second yarn, a third yarn and a fourth yarn; the first yarn is a regenerated cellulose fiber-type blended yarn made by blending regenerated cellulose fiber with linen, wool, cashmere, cotton fiber, or a mixture thereof, or is a regenerated cellulose filament yarn or regenerated cellulose staple yarn; the second yarn is a modified polyester fiber yarn having a non-circular cross section; the third yarn is a cotton fiber-type blended yarn made by blending cotton fiber with polyester staple fiber, polyacrylonitrile fiber, or mixture thereof, or is all-cotton yarn; and the fourth yarn is polyurethane fiber yarn.
2. The fabric of claim 1, **characterized in that** the cross section of the modified polyester fiber yarn having a non-circular cross section is a cross-shaped cross

section, a Y-shaped cross section or a ∞ -shaped cross section.

3. The fabric of claim 1 or 2, **characterized in that** the fabric is consisted of an outer layer, a middle layer and an inner layer, the outer layer is woven by the first yarn and the fourth yarn, the middle layer is woven by the second yarn and the fourth yarn, the inner layer is woven by the second yarn, the third yarn and the fourth yarn. 5
4. The fabric of claim 1 or 2, **characterized in that** the weight percentage of the regenerated cellulose fiber in the regenerated cellulose fiber-type blended yarn is 50~80%. 10
5. The fabric of claim 1 or 2, **characterized in that** in the weight percentage of the cotton fiber in the cotton fiber-type blended yarn is 60~90%. 15
6. A preparation method of the moisture-absorbing heat-generating quick-drying moisture-retaining thermal fabric of the claim 1, the method comprising the following steps: 20
 - 1) choosing the materials of the first yarn, the second yarn, the third yarn and the fourth yarn based on a designed fabric; 25
 - 2) placing the materials on a weaving machine and reserving a slitting line for a scutching and setting of following process when weaving to obtain fabric blanks; 30
 - 3) slitting the obtained fabric blanks along the slitting line, conducting full inspection and sending to warehouse; 35
 - 4) packaging and uncoiling the qualified fabric blanks for loading to a cloth car, then splicing them into a continuous shape; 40
 - 5) presetting the spliced fabric blanks of the car, a presetting temperature is between 170 °C and 200°C, a speed of the car is between 5 m/min and 25m/min, an over-feeding cloth consumption is between 15 and 40%; 45
 - 6) feeding water to a dye vat based on the weight of the fabric blanks of a configured vat and a liquor ratio, and after feeding the preset fabric blanks into the vat, seaming the head and the tail of the cloth to form a rope-ring shape which allows a continuous running of the dye vat; 50
 - 7) conducting a dyeing and finishing pretreatment on the fabric blanks in the vat to obtain fabric semi-finished products; 55
 - 8) dyeing the modified polyester fiber yarn having non-circular cross section in the fabric semi-finished products with a dyeing liquor;
 - 9) reductive cleaning the fabric semi-finished products which have been dyed with a reductive cleaning solution, a temperature of the reductive

cleaning is between 85°C and 100°C, a heat preservation time is controlled between 15 min and 30min;

10) thermal washing the fabric semi-finished products, a temperature of the thermal washing is between 85°C and 98°C, a heat preservation time is controlled between 10 min and 20min, and then cold washing for 10 ~20min by feeding water;

11) dyeing other fibers of the fabric semi-finished products once again;

12) cool washing and acid washing the fabric semi-finished products which have been dyed once again;

13) soaping the fabric semi-finished products and cool washing them once again until cleaning dye floating color;

14) applying a hydrophilic softener and a hydrophilic soft olein to the fabric semi-finished products;

15) conducting a napping treatment after drying the fabric semi-finished products;

16) re-setting the fabric semi-finished products to obtain a greige fabric, wherein the temperature of the re-setting is between 150 °C and 160 °C, a speed of the car is between 15 m/min and 25m/min, an over-feeding cloth consumption is between 25% and 50%;

17) full-inspecting the obtained greige fabric and sending it to the warehouse in coils.

7. The method of claim 6, **characterized in that** in the step 2), the weaving method comprising:

introducing the first yarn and the fourth yarn in the form of a single knitting in which all purl stitches are used to weave to form the outer layer of the fabric; introducing the second yarn and the fourth yarn in the form of double knitting in which half of knit stitches are used at regular intervals to form a looping knitting and half of the purl stitches are used at regular intervals to form a tucking knitting; introducing the third yarn in the form of the single knitting in which the knit stitches are used to weave; wherein the looping knitting portion made by the second yarn and the fourth yarn constitutes the middle layer of the fabric, the single weaving of the third yarn together with the looping knitting portion made by the second yarn and the fourth yarn constitute the inner layer of the fabric; or introducing the first yarn and the fourth yarn in the form of the single knitting in which all knit stitches are used to weave to form the outer layer of the fabric; introducing the second yarn and the fourth yarn in the form of the double knitting in which half of the purl stitches are used at regular intervals to form the looping knitting and half

of knit stitches are used at regular intervals to form the tucking knitting; introducing the third yarn in the form of the single knitting in which the purl stitches are used to weave; wherein the tucking knitting portion made by the second yarn and the fourth yarn constitutes the middle layer of the fabric; the single weaving of the third yarn together with the looping knitting made by the second yarn and the fourth yarn constitute the inner layer of the fabric.

8. The method of claim 6 or 7, **characterized in that** the liquor ratio in the step 6) is between 1:5 and 1:15. 5

9. The method of claim 6 or 7, **characterized in that** in the step 8), when dyeing, the temperature of the dyeing liquor is controlled between 110°C and 130°C, the heat preservation time is between 20 min and 45min, the heating rate and the cooling rate of the dyeing liquor are controlled between 0.5°C/min and 1°C/min. 15 20

10. The method of claim 6 or 7, **characterized in that** in the step 8), the dyeing liquor is a mixture of a disperse dye and a dye auxiliary agent, wherein the dye auxiliary agent includes chelating dispersant with a content of 0.5~1.5g/L, anti-creasing agent with a content of 0.5~2g/L, high-temperature leveling agent with a content of 0.5~1g/L and ethylic acid with a content of 0.5~1 g/L. 25 30

11. The method of claim 6 or 7, **characterized in that** in the step 9), the reductive cleaning solution is a mixture of anti-creasing agent, sodium hyposulfite and sodium carbonate solution, wherein the content of the anti-creasing agent is 1~2g/L, the content of the sodium hyposulfite is 0.5~1g/L, the content of the sodium carbonate is 0.5~2g/L. 35 40

12. The method of claim 6 or 7, **characterized in that** in the step 13), the soaping agent used in the soaping step is a mixture of cleaning agent and chelating dispersant, the content of the cleaning agent is 1~3g/L, the content of the chelating dispersant is 1~2g/L. 45

13. The method of claim 6 or 7, **characterized in that** in the step 14), the dosage of the hydrophilic softener accounts for 0.5~2% of the weight of the fabric blanks to be dyed, the dosage of the hydrophilic soft olein accounts for 3~5% of the weight of the fabric blanks to be dyed. 50

14. The method of claim 6 or 7, **characterized in that** in the step 14), the acid washing is conducted on the fabric semi-finished products for 10~20min before applying the hydrophilic softener and the hydrophilic soft olein. 55

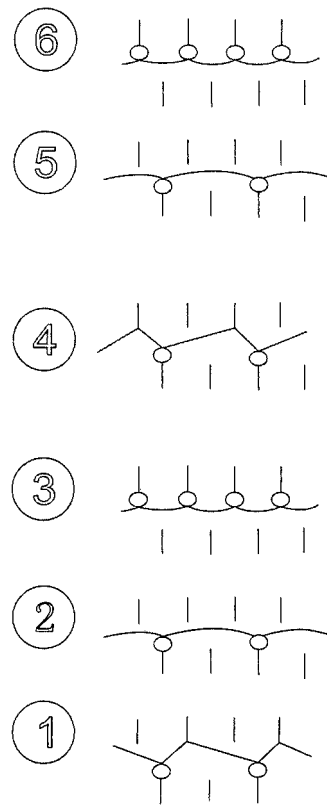


FIG.1

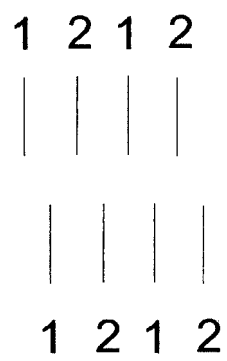


FIG.2

①	②	③	④	⑤	⑥

FIG.3

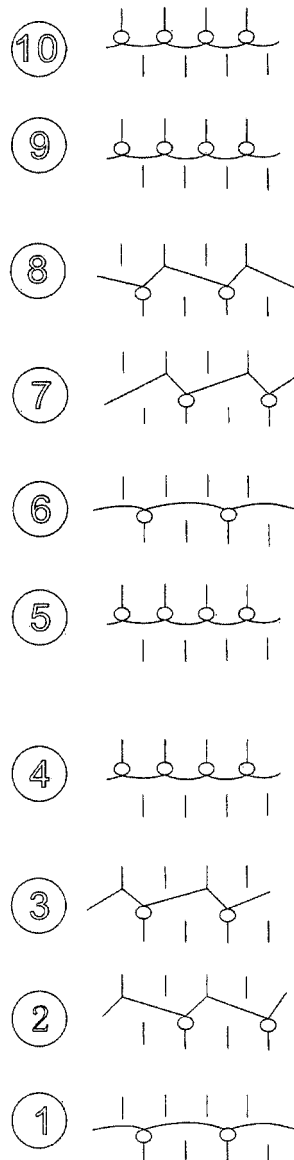


FIG.4

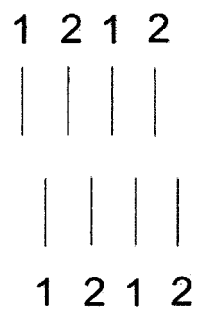


FIG.5

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
—	—	—	∇	∇	—	□	□	∇	∇
—	□	□	∇	∇	—	—	—	∇	∇

∧	—	∧	—	—	∧	—	∧	—	—
—	∧	—	—	—	—	∧	—	—	—

FIG.6

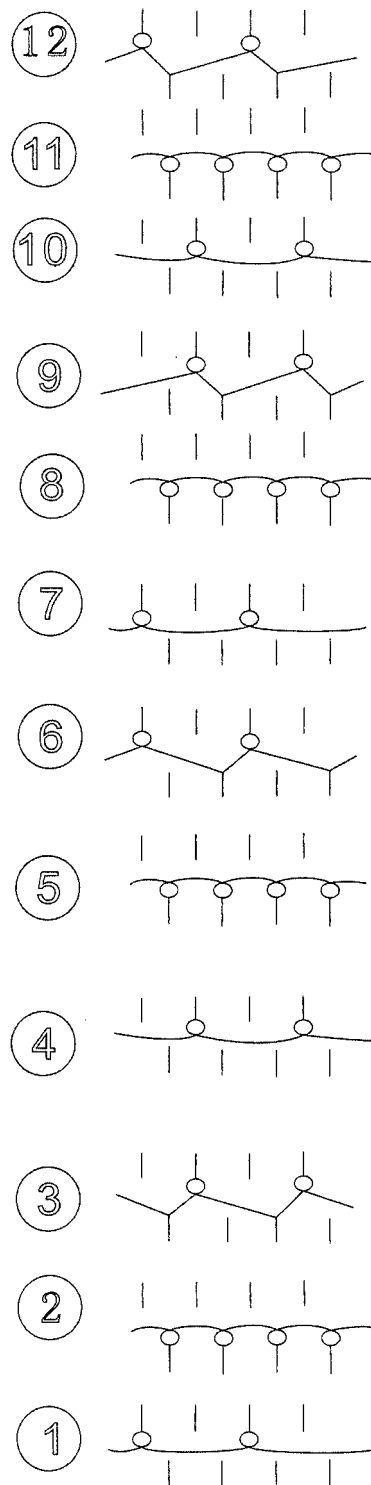


FIG.7

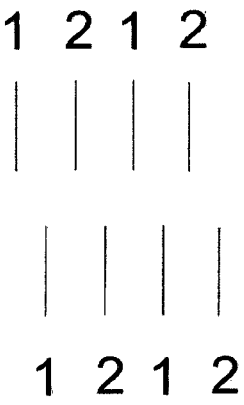


FIG.8

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
—	—	∨	∨	—	—	—	—	∨	∨	—	—
∨	—	—	—	—	∨	∨	—	—	—	—	∨
—	∧	⊐	—	∧	—	—	∧	—	—	∧	⊐
—	∧	—	—	∧	⊐	—	∧	⊐	—	∧	—

FIG.9

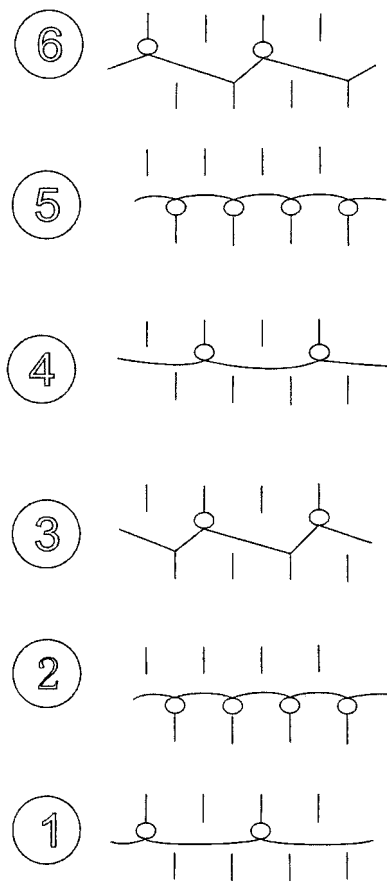


FIG.10

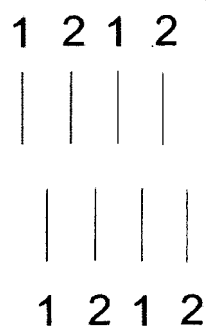


FIG.11

①	②	③	④	⑤	⑥
—	—	∨	∨	—	—
∨	—	—	—	—	∨

—	^	⌈	—	^	—
—	^	—	—	^	⌈

FIG.12

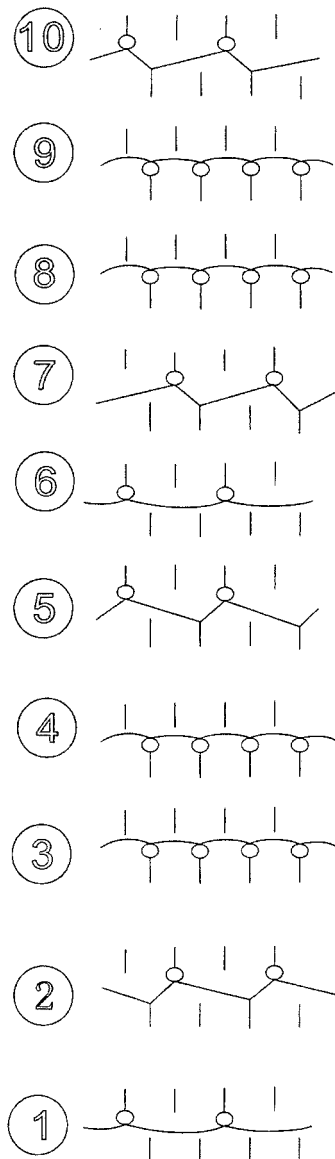


FIG.13

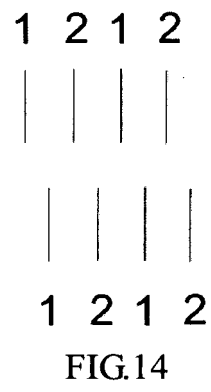


FIG.14

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
—	∨	—	—	—	—	∨	—	—	—
∨	—	—	—	∨	∨	—	—	—	∨

—	⌈	^	^	—	—	—	^	^	—
—	—	^	^	⌈	—	⌈	^	^	⌈

FIG.15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/070619

A. CLASSIFICATION OF SUBJECT MATTER

D04B 1/14 (2006.01) i; D04B 1/04 (2006.01) i; D06P 3/82 (2006.01) i; D06C 11/00 (2006.01) i; D06C 7/02 (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)

D04B; D06P; D06C

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: moisture absorption, quick drying, moisture retention, warmth retention, regenerated cellulose fiber, polyester, polyacrylonitrile, moisture, heat, dry, warm, hemp, flax, wool, cashmere, cotton, cellulose, viscose, polyeaster, PET, dacron, acrylic, spandex, polyurethane, fabric, cloth, mix, blend, yarn

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 103952845 A (WUHAN LOVEGOD HIGH-LEVEL DRESS & ADORNMENTS CO., LTD.), 30 July 2014 (30.07.2014), claims 1-14	1-14
A	CN 102505310 A (QINGDAO XUEDA GROUP), 20 June 2012 (20.06.2012), description, particular embodiments, and figures 1-3	1-14
A	CN 103015016 A (QINGDAO XUEDA GROUP), 03 April 2013 (03.04.2013), the whole document	1-14
A	CN 102943341 A (WUHAN LOVEGOD HIGH-LEVEL DRESS & ADORNMENTS CO., LTD.), 27 February 2013 (27.02.2013), the whole document	1-14
A	WO 2006125083 A3 (MCKINNON LAND LLC et al.), 01 February 2007 (01.02.2007), the whole document	1-14

☐ 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	
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"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	"&" document member of the same patent family

Date of the actual completion of the international search 03 February 2015 (03.02.2015)	Date of mailing of the international search report 18 March 2015 (18.03.2015)
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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/070619

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 103952845 A	30 July 2014	None	
CN 102505310 A	20 June 2012	CN 102505310 B	14 May 2014
CN 103015016 A	03 April 2013	None	
CN 102943341 A	27 February 2013	CN 102943341 B	12 March 2014
WO 2006125083 A3	01 February 2007	WO 2006125083 A2	23 November 2006
		US 2007004302 A1	04 January 2007

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