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(54) **CIRCULAR KNITTED FABRIC**

(57) [Problem]

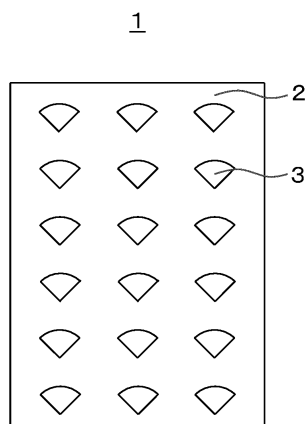
Provided is a circular knitted fabric that has a good balance in elongation between a wale direction and a course direction, and also a knitted pattern.

[Solution Means]

A circular knitted fabric having a 1×1 rib jacquard knitted structure as a basic structure, in which non-elastic fiber yarn and elastic fiber yarn are fed as a full set and are plate-knitted, knit-loops account for 10 to 90% of all

structures, and at least any one of a tuck and a welt is included so that a knitted pattern is formed on a knitted fabric surface due to a difference between structures by location, elongation in each of a wale direction and a course direction is 100 to 280% under a load condition of 14.7 N/2.54 cm, and an elongation ratio, that is, (elongation in wale direction)/(elongation in course direction), is 0.5 to 2.0 under the load condition of 14.7 N/2.54 cm.

Fig. 4



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Description

Technical Field

- 5 **[0001]** The present invention relates to a circular knitted fabric which has a 1×1 rib jacquard knitted structure as a basic structure and is plate-knitted by non-elastic fiber yarn and elastic fiber yarn.

Background Art

- 10 **[0002]** A circular knitted fabric using elastic yarn has conventionally been known. For example, a circular knitted fabric is known in which in rib knitting (fraise knitting), interknitting is performed such that cotton yarn or synthetic fiber-blended yarn, and covered elastic yarn are lined up alternately through knitting, and then a moisturizing property, hygroscopicity, and a moderate fitting property are provided.

- 15 **[0003]** Also, it is known that by knitting the entire circular knitted fabric with cotton yarn or synthetic fiber-blended yarn, and plate-knitting a part with elastic yarn, a circular knitted fabric as a thin-fabric single knit that is excellent in hygiene, and excellent in followability, etc. for the motion of a wearer is obtained. This circular knitted fabric is widely used for casual wear or sportswear.

- 20 **[0004]** Meanwhile, in the circular knitted fabric, due to the configuration of the structure, although elastic yarn is not used, the elasticity in the course direction (a horizontal direction, that is, a cylinder circumferential direction) is larger than that in the wale direction (a vertical direction, that is, a cylinder axial direction). When elastic yarn is used for a part of the knitting courses of such a circular knitted fabric, the elasticity in the course direction where elasticity is originally excellent is further increased. However, in such a circular knitted fabric, the elasticity in the wale direction does not increase so much, and thus the balance in elongation between the wale direction and the course direction is not good.

- 25 **[0005]** On the other hand, as disclosed in Patent Literatures 1 to 3, attempts to increase the elasticity in the wale direction and the course direction have been made. In a circular knitted fabric in these literatures, elastic yarn is used for some loops, and the loops are continuous in the wale direction. Therefore, elasticity occurs between courses to which elastic yarn has been fed so that elasticity in the wale direction also increases. As a whole, elasticity in three directions of the wale direction, the course direction, and the diagonal direction increases.

30 Citation List

Patent Literature

[0006]

- 35 [Patent Literature 1] Japanese Utility Model Publication No. 59-035595
 [Patent Literature 2] Japanese Utility Model Publication No. 61-011265
 [Patent Literature 3] Japanese Patent Laid-Open Publication No. 61-037377

40 Disclosure of the Invention

Technical Problem

- 45 **[0007]** However, for the balance of elongation between the wale direction and the course direction, a circular knitted fabric that had conventionally been known was not sufficient, and there was still room for improvement. Also, it was also required to form a knitted pattern (that is, a pattern formed during knitting) on the circular knitted fabric.

- [0008]** Therefore, an object of the present invention is to provide a circular knitted fabric that is good in balance of elongation between a wale direction and a course direction and has a knitted pattern, and a method of manufacturing the same.

50 Solution to Problem

- [0009]** The circular knitted fabric of the present invention is a circular knitted fabric having a 1×1 rib jacquard knitted structure as a basic structure. In the circular knitted fabric, non-elastic fiber yarn and elastic fiber yarn are fed as a full set and are plate-knitted. Knit-loops account for 10 to 90% of all structures, and at least any one of a tuck and a welt is included so that a knitted pattern is formed on a knitted fabric surface due to a difference between structures by location. Elongation in each of a wale direction and a course direction is 100 to 280% under a load condition of 14.7 N/2.54 cm, and an elongation ratio, that is, (elongation in wale direction)/(elongation in course direction), is 0.5 to 2.0 under the load

condition of 14.7 N/2.54 cm.

[0010] Also, in the circular knitted fabric, it is preferable that a finished knitting density is 105 courses or more/2.54 cm and 48 wales or more /2.54 cm.

[0011] Also, in the circular knitted fabric, it is preferable that fineness of the elastic fiber yarn is 11 to 110 dtex, fineness of the non-elastic fiber yarn is 11 to 110 dtex, and the fineness of the elastic fiber yarn:the fineness of the non-elastic fiber yarn is 1:0.3 to 1:4.5.

[0012] Also, a method of manufacturing the circular knitted fabric of the present invention is a method of manufacturing a circular knitted fabric in which a 1×1 rib jacquard knitted structure is knitted as a basic structure, in which non-elastic fiber yarn and elastic fiber yarn are fed as a full set and plate-knitted. Knit-loops account for 10 to 90% of all structures, and at least any one of a tuck and a welt is formed so that a knitted pattern is formed on a knitted fabric surface due to a difference between structures by location. In feeding each of the non-elastic fiber yarn and the elastic fiber yarn, while tension of yarn to be supplied is monitored, an amount of fed yarns is adjusted such that the tension is kept constant.

Advantageous Effects of Invention

[0013] The circular knitted fabric of the present invention is obtained by plate-knitting elastic fiber yarn fed as a full set, and has the above-described elongation and elongation ratio. Thus, the elongation in the wale direction and the course direction is high, and the balance in elongation between both directions is good.

[0014] Also, in the circular knitted fabric of the present invention, in addition to a knit-loop, at least any one of a tuck and a welt is included. Thus, it is possible to form various knitted patterns according to a difference in the structure. The surface is uniform in a portion with a high ratio of knit-loops, whereas a transparency feeling occurs and a change occurs on the surface in a portion with a low ratio of knit-loops. Therefore, the ratio of knit-loops is arbitrarily changed depending on locations, so that the circular knitted fabric has an excellent design with a change on the surface.

[0015] Also, in the circular knitted fabric of the present invention, knit-loops account for 10 to 90% of all structures, and the rest is occupied by characteristic portions by tucks and welts. Thus, the circular knitted fabric is stabilized and the degree of freedom of the knitted pattern is high.

[0016] Also, in the method of manufacturing the circular knitted fabric of the present invention, since non-elastic fiber yarn and elastic fiber yarn are fed as a full set and are plate-knitted, it is possible to manufacture the circular knitted fabric that is good in balance of elongation between a wale direction and a course direction. Also, since in addition to a knit-loop, at least any one of a tuck and a welt is formed, it is possible to manufacture the circular knitted fabric having various knitted patterns according to a difference in the structure. Then, in feeding each of the non-elastic fiber yarn and the elastic fiber yarn, while tension of yarn to be supplied is monitored, an amount of fed yarns is adjusted such that the tension is kept constant. Thus, the knit-loop, the tuck and the welt may be freely formed.

Brief Description of the Drawings

[0017]

FIG. 1 is a view illustrating a 1×1 rib knitted structure, and in this drawing, all structures are knit-loops.

FIG. 2 is a view illustrating a tuck.

FIG. 3 is a view illustrating a welt.

FIG. 4 is a view of a circular knitted fabric when viewed in a direction perpendicular to the surface thereof.

Best Mode for Carrying Out the Invention

[0018] An embodiment of the present invention will be described. The embodiment described below is merely an example, and those appropriately modified in a range not departing from the effect of the present invention shall be included in the scope of the present invention.

[0019] In the following description, a numerical range is expressed as "lower limit value to upper limit value," but the lower limit value and the upper limit value are naturally included in the numerical range. Also, in the following description, in some cases, three things "A and B," "only A," and "only B" are collectively expressed as "A and/or B."

[0020] Also, a portion formed by tuck knitting is expressed as a "tuck," and a portion formed by welt knitting is expressed as a "welt." Also, a knit-loop, a tuck and a welt are collectively referred to as a "structure." That is, the expression "structure" includes a knit-loop, a tuck and a welt. Meanwhile, in the expressions such as a "1×1 rib knitted structure," a "1×1 rib jacquard knitted structure," a "basic structure," and a "ground structure," the "structure" means a wide range of knitted structures composed of combinations of a knit-loop, a tuck and a welt.

[0021] First, the configuration of a circular knitted fabric of the embodiment will be described.

[0022] The circular knitted fabric of the embodiment is a circular knitted fabric having a 1×1 rib jacquard knitted

structure as a basic structure, and is a kind of double knit. The 1×1 rib jacquard knitted structure is a structure in which in the 1×1 rib knitted structure, a part of the structures is formed by a structure (specifically, at least any one of a tuck and a welt) other than a knit-loop, and may be realized by jacquard knitting.

[0023] The 1×1 rib jacquard knitted structure is composed of front-back ground structures in two layers. In the front-back ground structures in the two layers, yarns in the ground structures are entwined with each other and connected, and connecting yarn that connects the ground structures in the two layers is not used. Since no connecting yarn is used, the elongation of the circular knitted fabric is hardly impaired, and knitting is easy, and also a problem such as displacement of the ground structures in the two layers also hardly occurs.

[0024] The circular knitted fabric of the embodiment is plate-knitted (also referred to as plating yarn-knitting) in which non-elastic fiber yarn and elastic fiber yarn are fed as a full set. Therefore, in the circular knitted fabric of the embodiment, all structures in the front-back ground structures in the two layers are composed of non-elastic fiber yarn and elastic fiber yarn. Therefore, the elastic fiber yarns are continuously lined up in the wale direction and the course direction, and the elongation of the circular knitted fabric in both directions increases.

[0025] The knitted structure of the circular knitted fabric of the embodiment includes knit-loops. Also, in addition to the knit-loop, at least any one of a tuck and a welt is included. That is, the knitted structure may include a knit-loop and a tuck, may include a knit-loop and a welt, or may include a knit-loop, a tuck, and a welt. All of the knit-loop, the tuck, and the welt are composed of non-elastic fiber yarn and elastic fiber yarn.

[0026] FIG. 1 illustrates a 1×1 rib knitted structure in the circular knitted fabric of the embodiment. In this drawing, all structures are knit-loops. Also, as illustrated in the drawing, all structures are composed of non-elastic fiber yarn 4 and elastic fiber yarn 5. Also, FIG. 2 illustrates a tuck, and FIG. 3 illustrates a welt. In each of FIG. 2 and FIG. 3, the structure around the center of the drawing becomes a tuck or a welt.

[0027] Then, in the circular knitted fabric of the embodiment, a difference between the structures by location forms a knitted pattern on the knitted fabric surface. That is, at the position of the tuck or the welt, the knitted fabric is transparent or the knitted fabric surface becomes a concave portion unlike at the position of the knit-loop. Thus, when the portion of the knit-loop is combined with the portion of the tuck and/or the welt, the portion of the tuck and/or the welt becomes a transparent portion (transmissive portion) or a concave portion, and a knitted pattern is formed on the knitted fabric surface by the transmissive portion or the concave portion. The knitted pattern has an excellent design with a bulky feeling or a transparency feeling.

[0028] FIG. 4 illustrates a circular knitted fabric 1 as an example. In the circular knitted fabric 1, thin fabric portions 3 in which a plurality of tucks and/or welts is gathered are regularly formed within a thick fabric portion 2 composed of knit-loops. Such thin fabric portions 3 become a knitted pattern on the knitted fabric surface.

[0029] Also, as an example, on one side surface of the circular knitted fabric (for example, the back surface of the fabric, that is, the surface on the dial side at the time of knitting), all structures are constituted by knit-loops, and on the other side surface (for example, the front surface of the fabric, that is, the surface on the cylinder side at the time of knitting), in addition to the knit-loops, tucks and/or welts are formed.

[0030] Meanwhile, in knitting the circular knitted fabric, while the basic structure such as an interlock structure or a rib (fraise) structure is knitted, semi-jacquard knitting or full-jacquard knitting may be performed using a computer or a mechanical mechanism during the knitting so that the structure may be changed. When such knitting is performed, a predetermined knitted pattern is repeated in the vertical direction or the horizontal direction on the circular knitted fabric. The range as a basis of this repetition is referred to as an "effective pattern range." Therefore, the "effective pattern range" is repeated in the vertical direction or the horizontal direction to form the entire circular knitted fabric.

[0031] Further, in FIG. 4, one effective pattern range is formed by one thin fabric portion 3 and its surrounding thick fabric portion 2, and this effective pattern range is repeated in the vertical direction and the horizontal direction to form the entire circular knitted fabric 1.

[0032] In the circular knitted fabric of the embodiment, knit-loops account for 10 to 90% in all structures. That is, the number of knit-loops is 10 to 90% with respect to the total number of structures as the sum of the number of knit-loops, the number of tucks, and the number of welts. Then, the rest is occupied by tucks and/or welts. When this is expressed in another way, (the number of knit-loops) : (the number of tucks and/or welts) is 9:1 to 1:9. Meanwhile, this ratio is a ratio in one effective pattern range.

[0033] When knit-loops account for 10 to 90% in all structures, the circular knitted fabric becomes stable, and also, the degree of freedom of the knitted pattern increases.

[0034] Also, it is more preferable that knit-loops account for 20% or more, or further 35% or more in all structures.

[0035] Also, in the circular knitted fabric of the embodiment, it is preferable that the finished knitting density is 105 courses or more /2.54 cm and 48 wales or more /2.54 cm. The finished knitting density of the circular knitted fabric is the same as the knitting density of clothing or the like completed by sewing the circular knitted fabric. Meanwhile, due to a load, etc. during sewing, the knitting density of clothing or the like after sewing may be partially slightly different from the finished knitting density of the circular knitted fabric.

[0036] The circular knitted fabric of the embodiment has sufficient elongation in the wale direction and the course

direction, at such a knitting density. Then, the clothing completed from the circular knitted fabric becomes comfortable to wear.

[0037] Next, yarns used for the circular knitted fabric of the embodiment will be described. First, elastic fiber yarn will be described.

[0038] The fineness of the elastic fiber yarn used for the circular knitted fabric of the embodiment is 11 to 110 dtex (decitex). When the fineness of the elastic fiber yarn falls within this range, run hardly occurs in the circular knitted fabric, and the circular knitted fabric has sufficient elongation in the wale direction and the course direction. Also, when the fineness of the elastic fiber yarn is 110 dtex or less, a phenomenon called "stitch return" (that is, a phenomenon in which elastic fiber yarn comes closer to the outer periphery side of loops than non-elastic fiber yarn and appears on the knitted fabric surface, and the appearance of the circular knitted fabric is impaired. In a good product, non-elastic fiber yarn comes closer to the outer periphery side of loops than elastic fiber yarn and appears on the knitted fabric surface) hardly occurs in the circular knitted fabric.

[0039] It is more preferable that the fineness of the elastic fiber yarn is 15 to 33 dtex. When the fineness of the elastic fiber yarn falls within this range, run and stitch return further hardly occur, and the circular knitted fabric has sufficient elongation in the wale direction and the course direction.

[0040] Also, it is preferable that the elongation at break in the elastic fiber yarn is 400% to 1200%, because elasticity is excellent. Also, the elongation at break is breaking strength measured by a method of an elongation rate standard test in JIS-L-1013-1998. Also, it is preferable that the elasticity of the elastic fiber yarn is not impaired at a temperature around 195°C that is a temperature at the time of presetting.

[0041] Specifically, the elastic fiber yarn is polyurethane-based elastic fiber yarn. As for the polyurethane-based elastic fiber yarn, polyether-based urethane elastic yarn is preferable, but, polyether ester-based elastic yarn, etc. may be used.

[0042] As for the polyurethane-based elastic fiber yarn, for example, those that have been dry-spun or melt-spun may be used. Also, there is no limitation in the polymer of the polyurethane-based elastic fiber yarn or the spinning method.

[0043] Next, non-elastic fiber yarn used for the circular knitted fabric of the embodiment will be described.

[0044] The fineness of the non-elastic fiber yarn used for the circular knitted fabric of the embodiment is 11 to 110 dtex. When the fineness of the non-elastic fiber yarn falls within this range, run hardly occurs in the circular knitted fabric, and the circular knitted fabric has sufficient elongation in the wale direction and the course direction. Also, when the fineness is 11 dtex or more, stitch return hardly occurs in the circular knitted fabric.

[0045] It is more preferable that the fineness of the non-elastic fiber yarn is 17 to 33 dtex. When the fineness of the non-elastic fiber yarn falls within this range, run and stitch return further hardly occur, and the circular knitted fabric has sufficient elongation in the wale direction and the course direction.

[0046] The non-elastic fiber yarn used for the circular knitted fabric of the embodiment may be either filament yarn or spun yarn. It is desirable that the filament yarn is composed of synthetic fiber, etc. such as viscose rayon, cuprammonium rayon, acetate fiber, polyamide fiber, polyester fiber, polytrimethylene terephthalate fiber, acryl fiber, polypropylene fiber, or vinyl chloride fiber. The form of the fiber may be any one of unprocessed raw yarn, false twisted yarn, yarn-dyed yarn and the like, or may be composite yarn of these. It is desirable to use, as for the spun yarn, short fiber composed of natural fiber such as cotton, wool, or hemp, or synthetic fiber such as viscose rayon, cuprammonium rayon, acetate fiber, polyamide fiber, polyester fiber, acryl fiber, polypropylene fiber, or vinyl chloride fiber, and these may be either a single one or a blended one.

[0047] Also, as for the non-elastic fiber yarn used for the circular knitted fabric of the embodiment, it is desirable to use at least two types of non-elastic yarns which are different in luster and/or fineness. When two types of non-elastic yarns which are different in fineness are used as the non-elastic fiber yarn, it is preferable that the fineness ratio is 1:0.5 to 1:4.

[0048] Also, in regard to the yarns used for the circular knitted fabric of the embodiment, the fineness of elastic fiber yarn:the fineness of non-elastic fiber yarn is 1:0.3 to 1:4.5. As for a more preferable ratio, the fineness of elastic fiber yarn:the fineness of non-elastic fiber yarn is 1:0.5 to 1:1.5. Also, in a more preferable form, under the condition that the fineness of the elastic fiber yarn is 11 to 110 dtex, and the fineness of the non-elastic fiber yarn is 11 to 110 dtex, the fineness of elastic fiber yarn:the fineness of non-elastic fiber yarn is 1:0.3 to 1:4.5 (or 1:0.5 to 1:1.5).

[0049] Also, the total fineness of the yarns used for the circular knitted fabric of the embodiment (that is, the fineness as the sum of the fineness of non-elastic fiber yarn and the fineness of elastic fiber yarn) is preferably 22 to 310 dtex, and more preferably 22 to 122 dtex.

[0050] Next, descriptions will be made on features other than the above in the circular knitted fabric of the embodiment.

[0051] The circular knitted fabric of the embodiment has elongation of 100 to 280% in each of the wale direction and the course direction under a load condition of 14.7 N/2.54 cm, and then, under a load condition of 14.7 N/2.54 cm, the elongation ratio, that is (elongation in wale direction)/(elongation in course direction), is 0.5 to 2.0.

[0052] When the elongation is 100% or more, clothing using the circular knitted fabric fits the body, does not give a feeling of tension, and thus becomes comfortable to wear. Also, when the elongation is 100% or more, an extra force is not required when the clothing using the circular knitted fabric is worn or taken off. Also, when the elongation is 280%

or less, the stretching fatigue of elastic fiber yarn is suppressed, the durability is maintained, and the strength of the fabric is secured. Also, when the elongation ratio is 0.5 to 2.0, the clothing using the circular knitted fabric becomes excellent in comfort of wearing, etc.

[0053] Under a load condition of 14.7 N/2.54 cm, it is more preferable that the elongation in each of the wale direction and the course direction ranges from 120 to 250%. Also, under a load condition of 14.7 N/2.54 cm, it is more preferable that the elongation ratio ranges from 0.8 to 1.2. When the elongation or the elongation ratio falls within this range, the effect such as comfort of wearing the clothing using the circular knitted fabric is further increased.

[0054] Here, the elongation in the present invention is elongation when measurement is performed on a test piece with a width of 2.54 cm in accordance with an elongation rate test B method (a constant load method) of JIS-L-1096. Also, the load condition of 14.7 N/2.54 cm is reproduction of a load condition applied to clothing when an average person wears the clothing and performs motions in daily life. Meanwhile, 14.7 N/2.54 cm means that a load of 14.7 N is applied to the test piece with a width of 2.54 cm.

[0055] Also, in the circular knitted fabric of the embodiment, it is preferable that the elongation in each of the wale direction and the course direction is 120 to 300% under a load condition of 22.1 N/2.54 cm, and the elongation ratio, that is, (elongation in wale direction)/(elongation in course direction), is 0.5 to 2.0 under a load condition of 22.1 N/2.54 cm. Under a load condition of 22.1 N/2.54 cm, it is more preferable that the elongation in each of the wale direction and the course direction ranges from 140 to 270%. Also, under a load condition of 22.1 N/2.54 cm, it is more preferable that the elongation ratio ranges from 0.8 to 1.2.

[0056] Here, the load condition of 22.1 N/2.54 cm is reproduction of a load condition applied to clothing when an average person performs a motion of pulling the clothing to the maximum. Meanwhile, 22.1 N/2.54 cm means that a load of 22.1 N is applied to the test piece with a width 2.54 cm.

[0057] Next, descriptions will be made on an example of an apparatus of manufacturing the circular knitted fabric of the embodiment, and a manufacturing method thereof.

[0058] The apparatus of manufacturing the circular knitted fabric of the embodiment is realized by a combination of a circular knitting machine capable of performing jacquard knitting that makes a change in a knit-loop, a tuck or a welt at each stitch position, and capable of performing high-density knitting, with an electrical control-type yarn feeding device capable of changing the amount of fed yarns for each structure type.

[0059] The circular knitting machine is a circular knitting machine having two rows of needle beds on the cylinder side and the dial side (so-called double knit circular knitting machine), in which positions of knitting needles on the cylinder side and knitting needles on the dial side are shifted by half a pitch of a knitting needle row (in which so-called "rib encounter" occurs). Also, the circular knitting machine has an electrical control-type needle selection mechanism configured to perform jacquard knitting. Also, the number of gauges of the circular knitting machine is preferably 32 to 40 gauges, more preferably 36 to 40 gauges so as to enable high-density knitting.

[0060] Here, the amounts of fed yarns required for forming a knit-loop, a tuck and a welt are different from each other. Therefore, in order to perform jacquard knitting that makes a change in the knit-loop, the tuck and the welt, the yarn feeding device that can supply an appropriate amount of yarn for each structure is used.

[0061] Specifically, the yarn feeding device has a monitoring device (for example, a load cell) that monitors the tension of yarn supplied toward the circular knitting machine. Also, the yarn feeding device has a control device that performs a control to keep yarn tension constant by adjusting the amount of fed yarns on the basis of the yarn tension detected by the monitoring device. When the yarn tension is kept constant through the control, even if the structure is changed, an appropriate amount of yarn may be stably supplied to the structure. Such a yarn feeding device is used for feeding both non-elastic fiber yarn and elastic fiber yarn.

[0062] Such a manufacturing apparatus of the circular knitting machine is used to knit the above circular knitted fabric of the embodiment. Here, non-elastic fiber yarn and elastic fiber yarn are fed as a full set, aligned, and then plate-knitted. Also, front-back ground structures in two layers in the circular knitted fabric are knitted by two rows of needle beds on the dial side and the cylinder side of the circular knitting machine, respectively. Here, jacquard knitting is performed, so that in addition to a knit-loop, a tuck and/or a welt are formed. As an example, knitting needles on the dial side knit knit-loops at all stitch positions, and knitting needles on the cylinder side are regularly controlled to knit knit-loops at predetermined stitch positions, and to knit tucks and/or welts at separate predetermined stitch positions.

[0063] Here, as an example of a method of knitting the circular knitted fabric having a transparency feeling, the fineness ratio of yarns fed from an odd-numbered feeder and an even-numbered feeder is increased (for example, the ratio of the fineness of yarn fed from the other side feeder to the fineness of yarn fed from one side feeder is set to be 40% or less or 140% or more). Then, when the entire circular knitted fabric is knitted with high-fineness yarn and a portion to become a transmissive portion is knitted with small-fineness yarn, it is possible to obtain the circular knitted fabric having the transparency feeling, in which a transmissive portion is partially formed.

[0064] Also, as another example of the method of knitting the circular knitted fabric having a transparency feeling, by regularly combining tucks, welts, and knit-loops in accordance with a design to be expressed, it is possible to obtain the circular knitted fabric that uses a unique transparency feeling of the tucks and has a transparency feeling as a whole.

In order to realize these examples, it is important to use the circular knitting machine having the above electrical control-type needle selection mechanism, and the electrical control-type yarn feeding device.

[0065] During this knitting, the above yarn feeding device monitors the tension of non-elastic fiber yarn and elastic fiber yarn to be fed while adjusting the amount of fed yarns such that the tension may be kept constant. Accordingly, feeding yarn is properly performed for each structure.

[0066] For the completed gray fabric, for example, opening, scouring, presetting (dry-heat setting), dyeing, finishing such as a resin processing, drying, and final setting are performed. The knitting density of the circular knitted fabric completed through these processes is the above-described finished knitting density.

[0067] The completed circular knitted fabric becomes a product such as clothing through processes such as cutting or sewing. Examples of the clothing may include innerwear, casual wear, and sportswear. The clothing, as a whole, may be composed of the circular knitted fabric, or for only a part of the clothing, the circular knitted fabric may be used.

[0068] Next, Examples and Comparative Examples will be described.

[0069] Circular knitted fabrics in Examples and Comparative Examples below were evaluated. Evaluation items and evaluation methods are as below in (1) to (3).

(1) Evaluation of Elongation

[0070] As for a test piece for wale-direction elongation, three test pieces each of which was 16 cm in the vertical direction (wale direction) and 2.54 cm in the horizontal direction (course direction) were prepared. Also, as for a test piece for course-direction elongation, three test pieces each of which was 2.54 cm in the vertical direction and 16 cm in the horizontal direction were prepared. For the measurement, a constant speed extension-type tensile tester (Autograph, manufactured by Shimadzu Corporation, AG-500D) was used. A chuck jig having a tooth-shaped test piece gripping portion was used, and then, an upper grip length was 2.5 cm, a lower grip length was 3.5 cm, a chuck interval was 10 cm, and a test piece gripping pressure was 490 kPa. Then, the tensile speed was set as 30 cm/min, and the elongation at a load of 14.7 N was measured. After the measurement, an average elongation value of the three test pieces was calculated.

(2) Elongation Ratio

[0071] Calculation was performed by the following formula on the basis of the above measurement result of the elongation rate.

$$\text{elongation ratio} = (\text{elongation in wale direction}) / (\text{elongation in course direction})$$

(3) Evaluation of Run

[0072] A notch was made in the vertical direction at the final-knitted edge of the circular knitted fabric, and a stitch near the notch was pulled by a fingernail. Then, the presence/absence of occurrence of run was evaluated with naked eyes. The evaluation results are indicated by ○ and × as follows.

○: there is no run occurring at the notch

×: there is run occurring at the notch

(4) Evaluation of Knitted Pattern

[0073] The presence/absence of a knitted pattern based on a difference between a knit-loop, a tuck, and a welt was evaluated.

(5) Evaluation of Knitting Quality

[0074] The knitting quality (mainly, presence/absence of stitch return) was evaluated with naked eyes. The evaluation results are indicated by ○ and × as follows.

○: knitting quality is good

×: knitting quality is not good

(Example 1)

[0075] As a knitting machine, a double knit circular knitting machine M-LEC7BSD (38-inch diameter, 36 gauge) manufactured by Precision Fukuhara Works, Ltd. was used. Also, as a yarn feeding device, E-COMPACT ATTIVO and SPINI manufactured by LGL of Italy was used. By using this yarn feeding device, nylon filament yarn of 22 dtex 20f and polyurethane yarn of 22 dtex (manufactured by Asahi Kasei Corporation, ROICA (registered trademark) C805) were simultaneously fed from the same feeder to needles on both sides of the dial and the cylinder so that the nylon filament yarn appeared on the both side surfaces of a knitted fabric and the polyurethane yarn was disposed inside. Then, a circular knitted fabric (double knit) having a 1×1 rib jacquard knitted structure as a basic structure was knitted. Also, the nylon filament yarn and the polyurethane yarn were fed as a full set. Also, knit-loops accounted for 50% in all structures.

[0076] The knitted circular knitted fabric was scoured, and then, an aqueous solution (4.0 % by weight of benzene sulfonic acid sodium, 1.0 % by weight of tartaric acid as non-volatile acid, and 0.1 % by weight of EDTA as a chelating agent) was produced. After immersion in the room temperature treatment liquid for 5 sec, dry-heat setting was performed at a temperature of 195°C for 1 min. Then, by using 0.3% o.w.f. (on weight fabric) of Aminyl Yellow FD-3 RL (manufactured by Sumitomo Chemical Co., Ltd.), 0.3% o.w.f. of Aminyl RedFD-GL (manufactured by Sumitomo Chemical Co., Ltd.), and 0.3% o.w.f. of Aminyl BlueFD-GL (manufactured by Sumitomo Chemical Co., Ltd.) as dyes, dyeing was performed by a jet dyeing machine at 100°C according to a normal formulation. Then, final setting was performed to obtain the circular knitted fabric in which the finishing density was 130 courses/2.54 cm, and 73 wales/2.54 cm.

(Example 2)

[0077] Knitting and processes were performed in the same manner as in Example 1 except that the ratio of knit-loops was set as 26%.

(Example 3)

[0078] Knitting and processes were performed in the same manner as in Example 1 except that the ratio of knit-loops was set as 80%.

(Comparative Example 1)

[0079] The 1×1 rib knitting in Example 1 was changed into interlock knitting (knitting in which 1×1 rib knitting is double-layered, which is also called smooth knitting). The ratio of knit-loops was 100%. Except for these, knitting and processes were performed in the same manner as in Example 1.

(Comparative Example 2)

[0080] Plate-knitting with nylon filament yarn and polyurethane yarn was not performed, but knitting was performed by using only covering yarn in which polyurethane yarn of 22 dtex was covered with nylon filament yarn of 77 dtex36f. Except for these, knitting and processes were performed in the same manner as in Example 1.

[0081] Results of the above evaluations on Examples and Comparative Examples are noted in Table 1 and Table 2. Also, in Table 1 and Table 2, in items such as "1×1 rib knitting," "polyurethane yarn as full set" and "plate-knitting," ○ means that matters described for the item were performed, and × means that the matters were not performed.

[Table 1]

	Example 1	Example 2	Example 3
1×1 Rib knitting	○	○	○
Polyurethane yarn as full set	○	○	○
Plate-knitting	○	○	○
Ratio of knit-loops	50%	26%	80%
Elongation in course direction	186%	155%	196%
Elongation in wale direction	205%	140%	205%
Elongation ratio	1.10	0.90	1.05

(continued)

	Example 1	Example 2	Example 3
Run	○	○	○
Knitted pattern	Presence	Presence	Presence
Knitting quality	○	○	○

[Table 2]

	Comparative Example 1	Comparative Example 2
1×1 Rib knitting	×	○
Polyurethane yarn as full set	○	○
Plate-knitting	○	×
Ratio of knit-loops	100%	50%
Elongation in course direction	197%	107%
Elongation in wale direction	223%	118%
Elongation ratio	1.13	1.10
Run	○	×
Knitted pattern	Absence	Presence
Knitting quality	×	○

Reference Signs List

[0082]

1: circular knitted fabric

2: thick fabric portion

3: thin fabric portion

4: non-elastic fiber yarn

5: elastic fiber yarn

Claims

1. A circular knitted fabric having a 1×1 rib jacquard knitted structure as a basic structure, wherein non-elastic fiber yarn and elastic fiber yarn are fed as a full set and are plate-knitted, knit-loops account for 10 to 90% of all structures, and at least any one of a tuck and a welt is included so that a knitted pattern is formed on a knitted fabric surface due to a difference between structures by location, elongation in each of a wale direction and a course direction is 100 to 280% under a load condition of 14.7 N/2.54 cm, and an elongation ratio, that is, (elongation in wale direction)/(elongation in course direction), is 0.5 to 2.0 under the load condition of 14.7 N/2.54 cm.
2. The circular knitted fabric according to Claim 1, wherein a finished knitting density is 105 courses or more /2.54 cm and 48 wales or more/2.54 cm.
3. The circular knitted fabric according to Claim 1 or 2, wherein fineness of the elastic fiber yarn is 11 to 110 dtex, and

fineness of the non-elastic fiber yarn is 11 to 110 dtex, and

the fineness of the elastic fiber yarn: the fineness of the non-elastic fiber yarn is 1:0.3 to 1:4.5.

5 4. The circular knitted fabric according to any one of Claims 1 to 3, wherein as for the non-elastic fiber yarn, at least two types of non-elastic yarns are used.

5. The circular knitted fabric according to Claim 4, wherein as for the non-elastic fiber yarn, the two types of non-elastic yarns which are different in fineness are used, and a fineness ratio is 1:0.5 to 1:4.

10 6. A method of manufacturing a circular knitted fabric in which a 1×1 rib jacquard knitted structure is knitted as a basic structure, wherein non-elastic fiber yarn and elastic fiber yarn are fed as a full set and plate-knitted; knit-loops account for 10 to 90% of all structures, and at least any one of a tuck and a welt is formed so that a knitted pattern is formed on a knitted fabric surface due to a difference between structures by location; and
15 in feeding each of the non-elastic fiber yarn and the elastic fiber yarn, while tension of yarn to be supplied is monitored, an amount of fed yarns is adjusted such that the tension is kept constant.

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Fig. 1

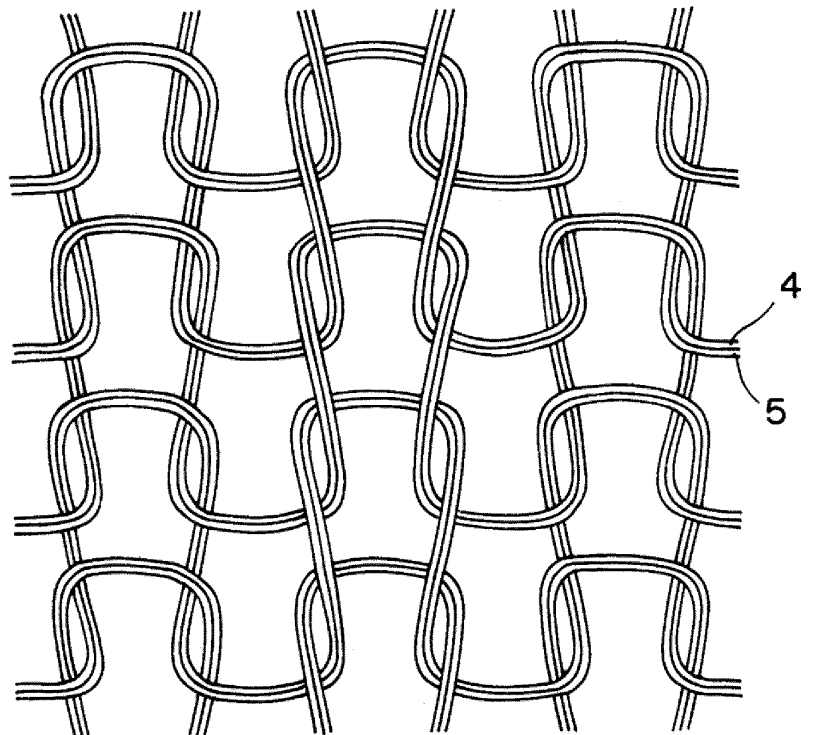


Fig. 2

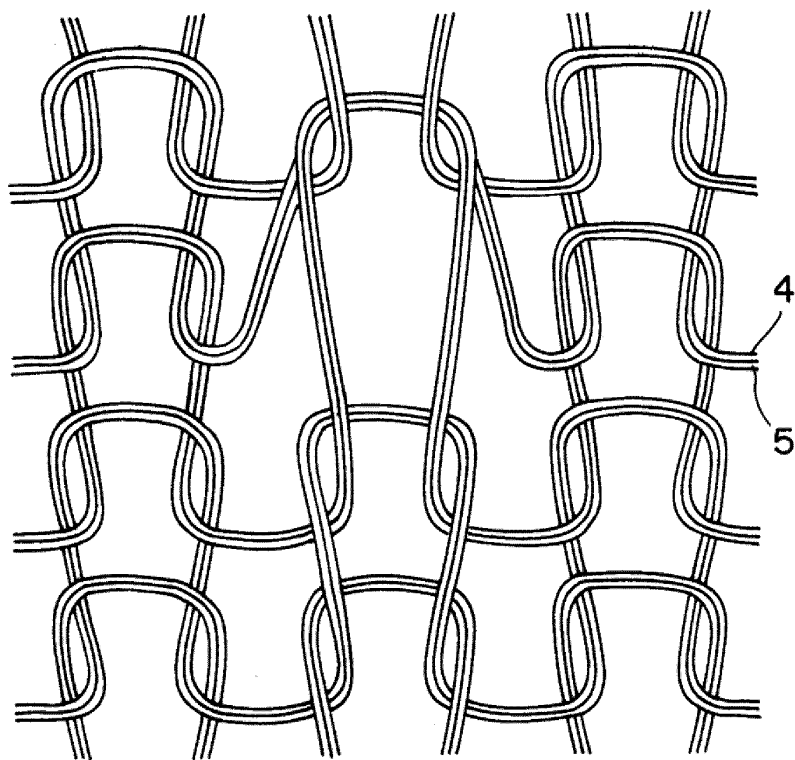


Fig. 3

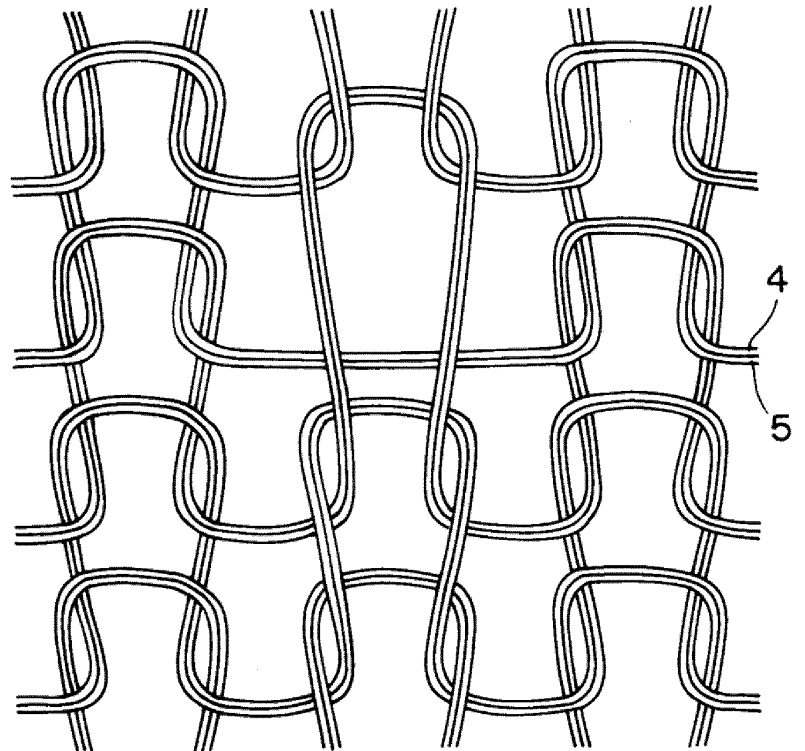
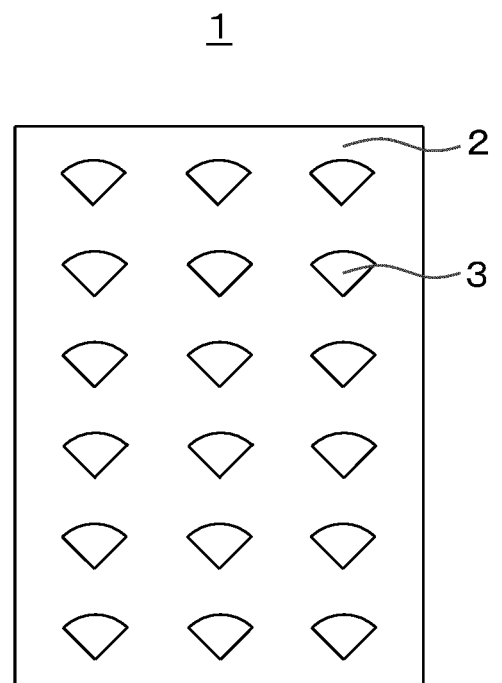


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/023065

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. D04B1/18 (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)

Int.Cl. D04B1/18

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2019

Registered utility model specifications of Japan 1996-2019

Published registered utility model applications of Japan 1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3046511 U (TAKASAGO AMIMONO KK) 10 March 1998, entire text (Family: none)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 55509/1979 (Laid-open No. 155807/1980) (FUKUSKE CORPORATION) 10 November 1980, entire text (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search
05 September 2019 (05.09.2019)Date of mailing of the international search report
17 September 2019 (17.09.2019)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/023065

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-68206 A (TOKO, INC.) 04 March 2004, claims, fig. 1-4 (Family: none)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 128010/1972 (Laid-open No. 82084/1974 (ASAHI KASEI INDUSTRY CO., LTD.) 16 July 1974, entire text (Family: none)	1-6
A	JP 2011-511170 A (SIPRA PATENTENTWICKLUNGS- UND BETEILIGUNGSGESELLSCHAFT MBH) 07 April 2011, claims, fig. 2 & WO 2009/092352 A2 & EP 2247778 A2 & TW 200942658 A	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 038755/1974 (Laid-open No. 128480/1975 (GUNZE LIMITED) 22 October 1975, entire text (Family: none)	1-6
A	JP 42-21025 Y1 (FUJII SPINNING CO., LTD.) 05 December 1967, entire text (Family: none)	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 024000/1973 (Laid-open No. 119585/1974 (GUNZE LIMITED) 14 October 1974, entire text (Family: none)	1-6
A	JP 2013-241718 A (NISSHINBO TEXTILE INC.) 05 December 2013, table 1 (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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