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(54) **GARMENT HAVING ANTISTATIC CAPABILITY**

(57) Provided is a garment that has an antistatic capability and exhibits washing durability without, when producing a woven or knitted fabric, using a conductive fiber at a part that becomes a wearing part of the woven or knitted fabric, and without applying an antistatic treatment to the woven or knitted fabric, but rather by incorporating a conductive fiber into a sewing thread. The garment according to the present invention has a conductive

fiber incorporated in a sewing thread (linking thread), and has a frictional charge amount of 0.8 μ C or less per garment. The garment preferably has an electric resistance value of $1 \times 10^4 \Omega$ - $5 \times 10^8 \Omega$ per 1 cm length of the conductive fiber in a fiber axis direction thereof, and the sewing thread preferably includes the conductive fiber in an amount of 30 - 100 mass%.

EP 3 366 151 A1

Description

TECHNICAL FIELD

[0001] A sewing thread (linking thread) used in sewing clothing items in the present invention is a thread in which a synthetic fiber having an antistatic capability and capable of being dyed is used, and the present invention also relates to a garment having the antistatic capability by using the thread.

BACKGROUND ART

[0002] Due to a recent improvement of an air conditioning installation, temperature is kept comfortable in a working room, while humidity is set to be low. In the winter, humidity is also low both in and out of a room.

[0003] Static electricity tends to accumulate in a heat-retention clothing for the winter season as a wearer moves, and electrostatic discharge emerged at the time of undressing leads to an uncomfortable feeling. Though suppressing static electricity by antistatic treatment to clothing items is conventionally known, the antistatic function is deteriorated by repeating washing. Further, though there is also a suppression method by incorporating a fiber having the antistatic capability into a woven or knitted fabric, a fiber having the antistatic capability is a colored fiber containing carbon, titanium oxide or metallic materials, and even when the fiber is dyed, a woven or knitted fabric having a brilliant color can not be obtained. Therefore, a development of a woven or knitted fabric which keeps the antistatic capability without deteriorating a quality of clothing items is required.

[0004] In Patent Document 1, a sewing machine thread manufactured by twisting at least one composite yarn which has a structure of covering a thermoplastic fiber as a core part with a conductive fiber as a sheath part is described. However, due to a covering with the sheath part consisting of the conductive fiber, it lacks homochromy after dying.

[0005] In Patent Document 2, a method for obtaining an antistatic clothing by sewing together woven fabrics containing the conductive fiber with a thread containing the conductive fiber is described. However, the antistatic capability of a knitted fabric containing the conductive fiber is conventionally known.

PRIOR ART DOCUMENT

PATENT DOCUMENTS

[0006]

Patent Document 1: JP2010-255157 A

Patent Document 2: JP 2015-030934 A

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0007] The objective of the present invention is to provide a garment having an antistatic capability and washing durability not by using a conductive fiber or incorporating a few amount of the conductive fiber in a part which becomes a wearing part when manufacturing a woven or knitted fabric, or not by applying an antistatic treatment on the woven or knitted fabric, but by incorporating the conductive fiber in a sewing thread.

MEANS FOR SOLVING PROBLEM

[0008] A summary of the present invention is as follows;

The garment of the present invention is the one in which each woven or knitted fabric part is sewn with a sewing thread containing a conductive fiber, a content of the conductive fiber in the sewing thread is 30 mass% - 100 mass%, a content of the conductive fiber in each woven or knitted fabric part is 1 mass % or less, and a frictional charge amount is $0.8\mu\text{C/garment}$ or less.

[0009] In the garment of the present invention, it is preferable that an electric resistance value is $1 \times 10^4 \Omega$ - $5 \times 10^8 \Omega$ per 1 cm length of the conductive fiber in a fiber axis direction.

[0010] In the garment of the present invention, it is preferable that a content of the sewing thread with respect to a total mass of the garment is 2 mass% - 8 mass%.

[0011] In the garment of the present invention, it is preferable that a content of the conductive fiber with respect to a total mass of the garment is 2 mass% - 8 mass%.

[0012] In the garment of the present invention, it is preferable that the sewing thread is used in at least one part among a shoulder part, a sleeve part, a collar part, a side part, an armhole part, a hem part and a cuff part.

[0013] In the garment of the present invention, it is preferable that the sewing thread is a spun yarn.

[0014] In the garment of the present invention, it is preferable that a single fiber fineness of the conductive fiber is 1 dtex - 15 dtex.

[0015] In the garment of the present invention, it is preferable that a fiber length of a single fiber of the conductive fiber contained in the spun yarn is 30 mm - 200 mm.

[0016] In the spun yarn in the garment of the present invention, it is preferable that a yarn count of a single spun yarn has a metric count of 20 - 110, the number of fuzz which is 1 mm or longer in a single spun yarn is 130/m or more, and the spun yarn is two-folded yarn or three-folded yarn.

[0017] In the spun yarn in the garment of the present invention, the number of fuzz which is 3 mm or longer is 10/m or more, and the number of fuzz which is 5 mm or longer is 1/m or more in the single spun yarn.

[0018] In the garment of the present invention, it is preferable that the conductive fiber contains 5 mass% - 9 mass% of carbon black or 10 mass% - 25 mass% of conductive titanium oxide.

[0019] In the garment of the present invention, it is preferable that the conductive fiber is a sheath-core type acrylic fiber containing a conductive material in a core part.

[0020] It is preferable that the garment of the present invention is a sweater or a fleece.

[0021] The sewing thread of the present invention contains 30 mass% - 100 mass% of the conductive fiber.

EFFECT OF THE INVENTION

[0022] Since the sewing thread contains the conductive fiber, a garment in which static electricity does not accumulate when wearing and undressing the garment, a frictional charge amount in undressing is $0.8\mu\text{C/garment}$ or less, and then an uncomfortable feeling due to static electricity decreases can be commercially provided, even if the conductive fiber is less contained in the woven or knitted fabric part.

MODE(S) FOR CARRYING OUT THE INVENTION

[0023] The garment of the present invention is the one in which each woven or knitted fabric part is sewn with a sewing thread containing a conductive fiber, a content of the conductive fiber in the sewing thread is 30 mass% - 100 mass%, a content of the conductive fiber in each woven or knitted fabric part is 1 mass % or less, and a frictional charge amount is $0.8\mu\text{C/garment}$ or less.

[0024] Normally, a garment is formed by joining a front body, a back body, sleeves and a collar with a sewing thread.

[0025] In the present invention, woven or knitted fabric parts mean parts composing a garment; for example, a front body, a back body, sleeves and a collar.

[0026] A sewing thread is often referred to as "a linking thread" and sewing is often referred to as "linking". The present invention also includes these meaning of terms.

[0027] Regarding parts to be sewn, a part where a front body and a back body are sewn means a "side part" and a "shoulder part", a part where the bodies and a sleeve are sewn means an "armhole part", a part where the bodies and a collar are sewn means a "collar part", a part where a sleeve is sewn to be a tubular shape means a "sleeve part", a part where a tip end of the sleeve is folded and sewn means a "cuff part", and a lower end of bodies means a "hem part".

[0028] In a case that a content of the conductive fiber with respect to a sewing thread is 30 mass% or more, corona discharge from the conductive fiber is sufficiently performed in wearing. Therefore, static electricity is hard to accumulate in the garment, and an uncomfortable feeling due to an electric discharge in undressing can be decreased. In this regard, a content of the conductive fiber with respect to the sewing thread is preferably 50 mass% or more, more preferably 80 mass% or more, and most preferably 100 mass%. Since the electricity in a sheath-core type conductive fiber is eliminated by corona discharge, increasing a fiber cross-section leads to a capability improvement. Therefore, an increase of a mixture rate of the conductive fiber in a spun yarn has an influence on the effectiveness.

[0029] Further, in a case that a content of the conductive fiber with respect to each woven or knitted fabric part is 1 mass% or less, it is preferable since a color of the conductive fiber does not have an influence on a garment. More preferably, a content of the conductive fiber in each woven or knitted fabric part is 0 mass%, i.e. the conductive fiber is not contained.

[0030] In a case that a frictional charge amount in the garment is $0.8\mu\text{C/garment}$ or less, an uncomfortable feeling due to static electricity emerged when undressing the garment can be decreased.

[0031] From the above standpoint, the frictional charge amount is more preferably $0.7\mu\text{C/garment}$ or less, and further more preferably $0.6\mu\text{C/garment}$ or less.

[0032] $0.6\mu\text{C/garment}$ or less of a frictional charge amount is a standard for an antistatic workwear prescribed in JIS T8118 (year 2001).

[0033] The conductive fiber used in the sewing thread is not limited in particular, as far as a frictional charge amount of a garment becomes $0.8 \mu\text{C/garment}$ or less.

[0034] Examples of the conductive fiber are; chemical fibers containing conductive materials in the fiber, a fiber in which a surface is coated with conductive materials, and metallic fibers.

[0035] Among them, chemical fibers with good dyeing affinity and durability, and containing the conductive material in the fiber are preferable. Further, conductive fibers in which a conductive material is contained in an acrylic fiber able to be dyed with cationic dye, which has a good chromogenic nature, are more preferable.

[0036] In the sewing thread of the garment in the present invention, it is preferable that an electric resistance value of the contained conductive fiber is $1 \times 10^4 \Omega$ - $5 \times 10^8 \Omega$, and 30 mass% - 100 mass% of the conductive fiber is contained.

[0037] In a case that an electric resistance value of the conductive fiber of $1 \times 10^4 \Omega$ or more, it is preferable since conductivity is high and a mixture rate in the spun yarn can be lowered, and in a case that an electric resistance value of the conductive fiber is $5 \times 10^8 \Omega$ or less, it is preferable in light of cost.

[0038] From the above standpoint, an electric resistance value of the conductive fiber is more preferably $1 \times 10^5 \Omega$ - $5 \times 10^7 \Omega$.

[0039] A preferable content of the sewing thread in a garment is 2 mass% - 8 mass%, though it changes according to a structure such as a size of a product, and presence or absence of sleeves.

[0040] In a case that a content of the sewing thread containing the conductive fiber in the garment is 2 mass% or more, it is preferable in light of a high electric discharge effect of static electricity and in light of decreasing an uncomfortable feeling in undressing. In a case that a content of the sewing thread containing the conductive fiber in the garment is 8 mass% or less, it is preferable in light of effectiveness for cost reduction of sewing products in total. From the above standpoint, a content of the sewing thread containing the conductive fiber in a garment is more preferably 3 mass% - 6 mass%.

[0041] In the garment of the present invention, it is preferable that a content of the conductive fiber with respect to a total mass of the garment is 2 mass% - 8 mass%.

[0042] In a case that a content of the conductive fiber with respect to the total mass of the garment is 2 mass% or more, it is preferable in light of decreasing an uncomfortable feeling in undressing since the electric discharge effect of static electricity is high. In a case that a content of the conductive fiber with respect to a total mass of the garment is 8 mass% or less, it is preferable in light of effects of cost reduction of sewing product in total. From the above standpoint, a content of the conductive fiber with respect to a total mass of the garment is more preferably 3 mass% - 6 mass%.

[0043] It is preferable that the sewing thread is used in at least one part among a shoulder part, a side part, an armhole part, a sleeve part, a collar part, and a hem part.

[0044] The sewing thread is not limited to the one used for sewing the garment and included in the garment, and the sewing thread may be sewn to the garment apart from the sewing thread for sewing the garment.

[0045] Among them, the sewing thread is preferably used in at least a sleeve part, a side part, a shoulder part and an armhole part, more preferably used also in a collar part or a cuff part, and further more preferably used in all the sewn parts.

[0046] The sewing thread is often used at a side part, a shoulder part, a sleeve part and a collar part, and it is effective to be used where a movable region is large, such as a side part, a shoulder part and a sleeve part.

[0047] In the garment of the present invention, it is preferable that the sewing thread to be used is a spun yarn.

[0048] The sewing thread is composed of a spun yarn, thereby the conductive fiber can be distributed not only on a surface of the thread but also in a whole thread, and a content of the conductive fiber with respect to the sewing thread can be changed depending on its frictional charge amount. Further, since a short fiber is used, the number of end parts in the conductive fiber increases, and corona discharge can be effectively performed.

[0049] It is preferable that a single fiber fineness of the conductive fiber is 1 dtex - 15 dtex.

[0050] In a case that a single fiber fineness of the conductive fiber is 1 dtex or more, a spun yarn count can be increased.

In a case that a single fiber fineness of the conductive fiber is 15 dtex or less, it is preferable since the strength of the spun yarn manufactured can be improved. From the above standpoint, a single fiber fineness of the conductive fiber is more preferably 3 dtex - 11 dtex.

[0051] It is preferable that a fiber length of a single fiber of the conductive fiber is 30 mm - 200 mm.

[0052] In a case that a fiber length of a single fiber of the conductive fiber is 30 mm or longer, mixing with cotton or other chemical synthetic fibers can be easy. In a case that a fiber length of a single fiber of the conductive fiber is 200 mm or shorter, mixing with wool becomes possible, and a spun yarn can be manufactured by using various spinning methods such as cotton spinning or worsted spinning. In light of ease of spinning processing, it is more preferable that a single fiber fineness is 3 dtex - 11 dtex and a fiber length of a single fiber is 35 mm - 120 mm.

[0053] In the spun yarn, it is preferable that a yarn count of a single spun yarn is a metric count (NM) of 20 - 110. A single spun yarn for a sewing thread is manufactured within a range of a metric count of 20 - 110. In a case of a sweater, it is preferable that a processed yarn obtained by the two-folded yarn processing after manufacturing a single spun yarn of a metric count of 20 - 40 is used. In a case of a fleece, it is preferable that a processed yarn obtained by the three-folded yarn (three-twisted yarn) processing after manufacturing a single spun yarn of a metric count of 90 - 105 is used.

As a mixing counterpart in a case of a fleece, it is preferable that a polyester short fiber is used in light of the thread strength of the spun yarn.

[0054] Further, in a single spun yarn, it is preferable that the number of fuzz having a length of 1 mm or longer is 130/m or more, since corona discharge from a fiber cross section, which is a characteristic of the conductive fiber, can be sufficiently performed.

[0055] It is preferable that an upper limit of the number is 300/m or less in light of passability in processing steps.

[0056] In the garment of the present invention, it is preferable that the number of fuzz with a length of 3 mm or longer in a single spun yarn is 10/m or more and the number of fuzz with a length of 5 mm or longer is 1/m or more.

[0057] Within the above range, corona discharge from the fiber cross section, which is a characteristic of the conductive fiber, can be sufficiently performed, and it is preferable.

[0058] In light of the passability in processing steps, it is preferable that the upper limit of the number of fuzz with a length of 3 mm or longer is 100/m or less and an upper limit of the number of fuzz with a length of 5 mm or longer is 10/m or less.

[0059] The number of fuzz can be increased by decreasing the number of twisting of a single spun yarn. It should be noted that, since the strength of the thread decreases as the number of twisting decreases, the number of twisting may be set appropriately to balance the both.

[0060] In the garment of the present invention, it is preferable that the conductive fiber is a fiber containing 5 mass% - 9 mass% of carbon black, or 10 mass% - 14 mass% of conductive titanium oxide.

[0061] The carbon black is preferable since conductive capability of the fiber can be easily increased. A fiber of conductive titanium oxide has lower conductive capability than the one of carbon black, while it is inconspicuous when it is included in a garment due to its gray color.

[0062] It is preferable that the conductive fiber is a sheath-core type acrylic fiber which contains a conductive material in the core part in light of conductive capability, color, prevention of dropping of the conductive material in processing, and possibility of maintaining and enhancing conductivity even though washing is repeated.

(spun yarn)

[0063] The spun yarn used in the present invention can be obtained by a general cotton spinning method or a worsted spinning method. Regarding the fiber forming a spun yarn, 30 - 100 mass% of the conductive fiber, or the sheath-core type acrylic fiber is preferably contained with respect to the spun yarn and in addition, other fibers are mixed and spun. In this case, as a counterpart for mixing, an acrylic fiber or a polyester fiber is preferable to maintain the strength of the thread of the spun yarn. In a case of manufacturing a thread having a metric count of 90 or larger, a polyester fiber is more preferable as a counterpart for mixing.

(sheath-core type acrylic fiber)

[0064] Preferred Examples in a manufacturing method of the conductive acrylic fiber of the present invention are explained in detail as follows.

[0065] In the manufacturing method of the conductive acrylic fiber according to the present Embodiment, firstly, an undiluted spinning solution for a sheath component and an undiluted spinning solution for a core component are prepared. As an undiluted spinning solution of the sheath component, an organic solvent solution obtained by solving acrylic polymer in an organic solvent is prepared. As an undiluted spinning solution of the core component, an organic solvent solution obtained by mixing conductive particles (A) and acrylic polymer (B) so as mass ratio (A)/(B) to be from 4 to 20 and solving the mixture in an organic solvent is prepared.

[0066] In the present Example, the acrylic polymers used for the undiluted spinning solutions for the sheath component and the core component are not limited in particular, and general acrylic polymers used in manufacturing conventional acrylic fibers can be used. In particular, for example, it is preferable to use the acrylic polymer which can exhibit heat shrinkability easily in the heat shrink processing step after spinning as explained later. Regarding heat shrinkability by composition and relaxation of the acrylic polymer, though depending on the monomer component to be copolymerized, generally, the less acrylonitrile content the polymer has, the higher heat shrinkability tends to be. Accordingly, it is desirable that a content of acrylonitrile in the undiluted spinning solution is appropriately adjusted so that a predetermined heat shrinkability can be obtained in the heat shrinking processing step thereafter.

[0067] Particularly, regarding the undiluted spinning solution for the sheath component, it is appropriate that a content of acrylonitrile in acrylic polymer is from 50 mass% to 98 mass %, particularly from 50 mass% to 95 mass%. In a case that a content of acrylonitrile is less than 50 mass%, original characteristics of acrylic fiber such as dyeing clearness and chromogenic nature can not be effectively exhibited, and other physical properties including thermal characteristics tend to be deteriorated. Further, to improve solubility and dyeability of acrylonitrile, it is preferable that acrylonitrile is copolymerized with unsaturated monomers such as acrylic acid ester.

[0068] Accordingly, it is preferable that a content of acrylonitrile in the sheath part is from 50 mass% to 98 mass% as described above by copolymerizing with unsaturated monomer. Thereby, the acrylic fiber can have excellent dyeing clearness, chromogenic nature and thermal properties without losing the characteristics which the acrylic fiber originally has. It should be noted that, in the present Example, unsaturated monomers with which acrylonitrile is copolymerized is not limited in particular. However, for example, acrylic acid and acrylic acid esters, methacrylic acid and methacrylic acid esters, vinyl acetate, vinyl chloride, vinylidene chloride and the like can be used.

[0069] In this case, for manufacturing the acrylic fiber having a sheath-core structure stably without thread breakage in spinning while suppressing an exposure of the core part to the sheath part it is extremely important to adjust viscosity of the undiluted spinning solution of the sheath component. It is important that solid concentration and temperature in the undiluted spinning solution of the sheath component is controlled so as viscosity of the undiluted spinning solution of the sheath component to be 300 poise or less, preferably 150 poise or less.

[0070] On the other hand, regarding the undiluted spinning solution of the core component, the conductive particles (A) and the acrylic polymer (B) are mixed so as mass ratio (A)/(B) to be from 4 to 20 and solved in an organic solvent as described above. By setting the value of the above mass ratio to be 4 or more, continuous phase of the conductive particles is stably formed in the acrylic fiber when manufacturing the conductive acrylic fiber, and the acrylic fiber can have sufficient conductive capability. In a case that the above mass ratio (A)/(B) exceeds 20, dispersibility of the conductive particles or spinnability of the undiluted spinning solution are deteriorated in spinning, and breakage of the core part is likely to occur when picking up or drawing the coagulated yarn. Therefore, spinnability as well as conductivity of the acrylic fiber deteriorate.

[0071] At this time, it is preferable that the conductive particle contained in the undiluted spinning solution of the core component is metallic oxide whose conductivity in a powder form is 10^{-3} S/cm or more and has high whiteness. As such conductive particles, titanium oxide or zinc oxide can be preferably used, and in addition, for example, tin oxide, indium oxide, or titanium oxide in which a surface is covered with tin oxide or zinc oxide can also be used. Further, in order to enhance conductivity, antimony oxide can be used together with tin oxide and indium oxide, and tin oxide, indium oxide, aluminium oxide, potassium oxide, germanium oxide and the like can be used together with zinc oxide. In this case, a form of the conductive particles contained in the undiluted spinning solution is not limited in particular. However, it is preferable that, in a case that the particle is granular, mean particle size is $3\mu\text{m}$ or smaller in light of stability in a filtration step of the undiluted solution and a spinning step in manufacturing the acrylic fiber.

[0072] As for the organic solvent to adjust each undiluted spinning solution of the above sheath component and the core component, organic solvent such as dimethylacetamide, dimethylformamide, dimethyl sulfoxide and the like is preferably used. However, it is not limited in particular, and other organic solvents used generally in spinning the acrylic fiber may be selected.

[0073] In the present Embodiment, solid concentration and temperature of each undiluted spinning solution of the above sheath component and the core component are not limited in particular, too. However, when solid concentration is too low, void is likely to occur in fiber after spinning, and as a result, it may lead to deterioration of fiber physical properties or deterioration of conductive capability. Accordingly, it is preferable that solid concentration in the undiluted spinning solution of the sheath component is 5 mass% or higher, and solid concentration in the undiluted spinning solution of the core component is 30 mass% or higher.

[0074] Next, spinning is conducted according to a wet spinning method with a sheath-core type spinning nozzle using the undiluted spinning solutions of the sheath component and of the core component prepared as above, setting a proportion between the sheath part and the core part so as a content of the conductive particles contained in the acrylic fiber to be from 5 mass% to 15 mass%. In spinning, in a case that a content of the conductive particles contained in the fiber is less than 5 mass%, targeted excellent conductive capability can not be added to the acrylic fiber since the conductive particles are a few. On the other hand, in a case that a content of the conductive particles is beyond 15 mass%, there occurs a problem that the usage of a product is limited since the fiber whiteness is inferior when manufacturing the conductive acrylic fiber.

[0075] It should be noted that, the wet spinning method can be conducted in the same manner as the method used generally in manufacturing the conventional acrylic fiber. For example, spinning can be conducted by extruding the undiluted spinning solution of the sheath component and the core component from the sheath-core type spinning nozzle into the coagulated liquid composed of the organic solvent and water, and solidifying.

[0076] At this time, as the sheath-core type spinning nozzle, it is preferable that a spinning nozzle having 3000 holes or more, particularly 5000 holes or more is used. The spinning is conducted by using such a sheath-core type spinning nozzle having 3000 holes or more, thereby the conductive acrylic fiber can be manufactured with extremely high productivity.

[0077] Thereafter, for the coagulated yarn obtained by the above wet spinning, each processing such as drawing, applying desolventizing agent and oil agent, drying and densification and the like is applied, then heat shrink processing is conducted in which the coagulated yarn is shrunk at shrink rate from 30% to 50%. The processing method and the processing condition in each processing of drawing, applying the desolventizing agent and oil agent, drying and densi-

fication and the like is not limited in particular and can be changed appropriately if necessary. For example, drawing processing can be conducted in hot water at 80°C or higher using desolventizing agent. Further, in light of spinning stability and physical properties of the obtained fiber and the like, a draw ratio is preferably set to be 3 - 10 times and more preferably 4 - 7 times.

Example

[0078] Hereinafter, the present invention is specifically explained referring to Examples. It should be noted that, evaluation items in Examples are measured by the following methods.

(measuring method for the electric resistance value of a single fiber)

[0079] The conductive acrylic fibers were bonded to metal monads while distancing at precisely 1 cm intervals with silver paste ("DOTITE" manufactured by Fujikura Kasei Co., Ltd.). DC voltage of 1000 V is applied between the metal monads under the atmosphere of temperature of 20°C and relative moisture of 40 RH%. Then the resistance value between the metal monads was measured ("SM-8210" manufactured by former Toa Dempa Co., Ltd.).

(measuring method for frictional charge amount)

[0080] A product used in measurement was washed five times repeatedly by JIS L217 106 method, rinsed with injected water for 20 minutes, then tumble dried.

[0081] A frictional charge amount of the washed product was measured based on JIS T8118 method.

(measuring method for the number of fuzz)

[0082] The fuzz in the spun yarn was measured based on JIS L1095 9.22.2 B method.

(Example 1)

[0083] A spun yarn was manufactured by putting 100 mass% of conductive sheath-core type acrylic fiber (ET10 manufactured by Mitsubishi Rayon Co. Ltd., fineness: 3.3 dtex, fiber length: 38 mm) into a machine for a cotton spinning step. The conductive sheath-core type acrylic fiber contains conductive titanium oxide in the core part, and a content of conductive titanium oxide with respect to a total fiber is 12 mass%. At this time, since a single fiber strength is weak, the single fiber breakage occurs according to a draw ratio and the spinning rate in each step, which leads to the possibility of fray occurrence. Therefore, the spinning rate of a carding machine is set to be 40 m/minute or lower and a draw ratio of a draw frame is set to be 8 times. Spinning of the single spun yarn was conducted with a metric count of 32 and the number of twisting of 630 times/m in a spinning frame. As a sensor for measuring yarn evenness used in rolling the single spun yarn, not a normal capacitance method but an optical method was adopted. After the single spun yarn was manufactured, a doubling step was conducted, and S-twisting was conducted for 400 times/m as the final twist with a twisting machine to make it two-folded yarn. Thus the sewing thread A was manufactured.

[0084] Separately, a knitted fabric of rib knitting structure with 12G was manufactured by using two-folded yarn with a yarn count of 2/32 by metric count made of 100% of wool.

[0085] Then, a round neck sweater was manufactured by using the sewing thread A and the knitted fabric. The sewn parts at which the sewing thread A was used were a sleeve part, a side part, a shoulder part, an armhole part and a collar part.

[0086] The sweater was dyed after sewn with black color and a black sweater was obtained. Then, a frictional charge amount of the black sweater was measured. The composition of the garment is shown in Table 1 and the evaluation result is shown in Table 2.

(Example 2)

[0087] A pink V neck sweater was obtained in the same manner as Example 1 except that a V-neck sweater was manufactured, and the dyeing after sewn was performed with a pale color, i.e. pink.

[0088] A frictional charge amount of the pink sweater was measured. The composition of the garment is shown in Table 1 and the evaluation result is shown in Table 2.

(Example 3)

[0089] A sweater was obtained in the same manner as Example 1 except that the sewing thread A was used for sewing a sleeve part, a side part, a shoulder part and an armhole part, and as for sewing a collar part, a sewing thread not containing the conductive fiber was used instead of the sewing thread A, as shown in Table 1. The evaluation result is shown in Table 2.

(Example 4)

[0090] As shown in Table 1, a sweater was obtained in the same manner as Example 1 except that the sewing thread A was used for sewing a sleeve part, a side part, a shoulder part, an armhole part and a cuff part. The evaluation result is shown in Table 2.

(Example 5)

[0091] As shown in Table 1, a sweater was obtained in the same manner as Example 1 except that the sewing thread A was used for sewing a sleeve part, a side part, a shoulder part, an armhole part and a cuff part, a name tag with a size of 1 cm by 5cm was sewn to an upper part of the back body with the sewing thread A, and dyeing after sewn was conducted with navy blue color. The evaluation result was shown in Table 2.

(Example 6)

[0092] A spun yarn B was manufactured in the same manner as Example 1 except that a content of conductive titanium oxide with respect to the total fiber was 20 mass%.

[0093] Then, a round neck sweater was manufactured in the same manner as Example 1 except that the spun yarn B was used in a sleeve part, a side part, a shoulder part and an armhole part. The composition of the garment is shown in Table 1 and the evaluation result is shown in Table 2.

(Comparative Example 1)

[0094] A black sweater was obtained in the same manner as Example 1 except that instead of the conductive fiber in Example 1, non-conductive acrylic fiber (V 17, manufactured by Mitsubishi Rayon Co., Ltd., single fiber fineness: 3.3 dtex, fiber length: 38mm) was used.

[0095] Then, a frictional charge amount of the black sweater was measured. The composition of the garment is shown in Table 1 and the evaluation result is shown in Table 2.

[Table 1]

	Conductive fiber			Sewing thread			Sweater	
	Electric resistance value	Single fiber fineness	Fiber length	Fiber used	Mixture rate	Count	Parts at which sewing thread A or B is used	Content of conductive fiber
	Ω	dtex	mm		mass%	NM		mass%
Example 1	5×10^5	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion, Collar portion	3.6

EP 3 366 151 A1

(continued)

	Conductive fiber			Sewing thread			Sweater	
	Electric resistance value	Single fiber fineness	Fiber length	Fiber used	Mixture rate	Count	Parts at which sewing thread A or B is used	Content of conductive fiber
	Ω	dtex	mm		mass%	NM		mass%
Example 2	5×10^5	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion, Collar portion	4.0
Example 3	5×10^5	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion	4.0
Example 4	5×10^5	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion, Cuff portion	4.5
Example 5	5×10^5	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion, Cuff portion, Name tag	4.5

(continued)

	Conductive fiber			Sewing thread			Sweater	
	Electric resistance value	Single fiber fineness	Fiber length	Fiber used	Mixture rate	Count	Parts at which sewing thread A or B is used	Content of conductive fiber
	Ω	dtex	mm		mass%	NM		mass%
Example 6	18×10^4	3.3	38	Conductive fiber	100	2/32	Sleeve portion, Side portion, Shoulder portion, Armhole portion	3.4
Comparative Example 1	Acrylic fiber not containing conductive fiber			Acrylic fiber	100	2/32	-	0

[Table 2]

	Frictional charge amount		Number of fuzz		
	Friction cloth (acryl)	Friction cloth (nylon)	1mm or longer	3mm or longer	5mm or longer
	$\mu\text{C/garment}$	$\mu\text{C/garment}$	number/m	number/m	number/m
Example 1	0.39	0.39	183	15	2
Example 2	0.56	0.53	167	13	2
Example 3	0.5	0.73	170	15	2
Example 4	0.42	0.74	180	14	2
Example 5	0.53	0.39	165	15	2
Example 6	0.21	0.27	175	15	3
Comparative Example 1	1.40	0.89	120	10	1

Claims

1. A garment in which each woven or knitted fabric part is sewn with a sewing thread containing a conductive fiber, wherein
a content of the conductive fiber in the sewing thread is 30 mass% - 100 mass%,
a content of the conductive fiber in each woven or knitted fabric part is 1 mass % or less, and
a frictional charge amount is $0.8\mu\text{C/garment}$ or less.
2. The garment according to claim 1, wherein an electric resistance value is $1 \times 10^4 \Omega$ - $5 \times 10^8 \Omega$ per 1cm length of the conductive fiber in a fiber axis direction.
3. The garment according to claim 1 or 2, wherein a content of the sewing thread with respect to a total mass of the garment is 2 mass% - 8 mass%.
4. The garment according to claim 1 or 2, wherein a content of the conductive fiber with respect to a total mass of the garment is 2 mass% - 8 mass%.

EP 3 366 151 A1

5. The garment according to any one of claims 1 to 4, wherein the sewing thread is used in at least one part among a shoulder part, a sleeve part, a collar part, a side part, an armhole part, a hem part and a cuff part.
6. The garment according to any one of claims 1 to 5, wherein the sewing thread is a spun yarn.
7. The garment according to any one of claims 1 to 6, wherein a single fiber fineness of the conductive fiber is 1 dtex - 15 dtex.
8. The garment according to claim 6 or 7, wherein a fiber length of a single fiber of the conductive fiber contained in the spun yarn is 30 mm - 200 mm.
9. The garment according to any one of claims 6 to 8, wherein a yarn count of a single spun yarn has a metric count of 20 - 110, the number of fuzz which is 1 mm or longer in a single spun yarn is 130/m or more.
10. The garment according to claim 9, wherein the number of fuzz which is 3 mm or longer is 10/m or more, and the number of fuzz which is 5 mm or longer is 1/m or more in the single spun yarn.
11. The garment according to any one of claims 6 to 10, wherein the spun yarn is two-folded yarn or three-folded yarn.
12. The garment according to any one of claims 1 to 11, wherein the conductive fiber contains 5 mass% - 9 mass% of carbon black or 10 mass% - 25 mass% of conductive titanium oxide.
13. The garment according to any one of claims 1 to 12, wherein the conductive fiber is a sheath-core type acrylic fiber containing a conductive material in a core part.
14. The garment according to any one of claims 1 to 13, wherein the garment is a sweater or a fleece.
15. A sewing thread containing 30 mass% - 100 mass% of the conductive fiber.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/080771

A. CLASSIFICATION OF SUBJECT MATTER

A41D13/008(2006.01)i, A41D31/00(2006.01)i, D01F8/08(2006.01)i, D02G3/04(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)

A41D13/008, A41D31/00, D01F8/08, D02G3/04

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016

Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
X	JP 49-2648 A (Kuraray Co., Ltd.),	15
Y	10 January 1974 (10.01.1974),	1-12, 14
A	page 1, lower right column; page 2, upper left column (Family: none)	13
Y	JP 48-16149 B1 (Kanebo, Ltd.),	1-12, 14
A	19 May 1973 (19.05.1973), column 1 & GB 1329858 A page 2, left column, lines 14 to 16 & DE 2049543 A1 & CA 933738 A	13, 15

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

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Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/080771

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 47-13542 Y1 (Teijin Ltd.), 17 May 1972 (17.05.1972), claims; columns 1 to 2; fig. 3 & US 3590570 A claim 1; fig. 3 & GB 1257709 A & DE 1902647 A & FR 2003846 A	1-12, 14 13, 15
A	JP 10-310944 A (Kanebo, Ltd.), 24 November 1998 (24.11.1998), (Family: none)	1-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 105110/1977 (Laid-open No. 32323/1979) (Toray Industries, Inc.), 02 March 1979 (02.03.1979), (Family: none)	1-15
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 38539/1992 (Laid-open No. 94284/1993) (Kanebo, Ltd.), 24 December 1993 (24.12.1993), (Family: none)	1-15
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 111313/1982 (Laid-open No. 17714/1984) (Fujimori Kogyo Co., Ltd.), 03 February 1984 (03.02.1984), (Family: none)	1-15

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2010255157 A [0006]
- JP 2015030934 A [0006]