



(11)

**EP 3 006 614 A1**

(12)

**EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:

**13.04.2016 Bulletin 2016/15**

(51) Int Cl.:

**D04B 1/14** <sup>(2006.01)</sup> **A41B 17/00** <sup>(2006.01)</sup>  
**A41D 31/00** <sup>(2006.01)</sup> **A41D 1/04** <sup>(2006.01)</sup>

(21) Application number: **14804135.3**

(86) International application number:

**PCT/JP2014/063658**

(22) Date of filing: **23.05.2014**

(87) International publication number:

**WO 2014/192648 (04.12.2014 Gazette 2014/49)**

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB  
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO  
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

**BA ME**

• **TABATA, Jiro**

**Osaka-shi**

**Osaka 530-8222 (JP)**

• **ADACHI, Kazuyuki**

**Osaka-shi**

**Osaka 530-8222 (JP)**

(30) Priority: **29.05.2013 JP 2013112573**

(74) Representative: **Webster, Jeremy Mark**

**Mewburn Ellis LLP**

**City Tower**

**40 Basinghall Street**

**London EC2V 5DE (GB)**

(71) Applicant: **Toray Industries, Inc.**

**Tokyo 103-8666 (JP)**

(72) Inventors:

• **MATSUMOTO, Kouichi**

**Osaka-shi**

**Osaka 530-8222 (JP)**

(54) **FIBROUS STRUCTURE**

(57) The present invention provides a fabric that is less likely to generate crackling static electricity when worn, less likely to get wrinkled after being washed, and has highly durable warmth retention and wear comfortability, and a garment manufactured using the same.

The fabric of the present invention is a fabric comprising a viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, a cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, a polyacrylic

synthetic fiber in an amount of more than 25% by weight and less than 30% by weight, and a polyurethane elastic fiber in an amount of more than 5% by weight and less than 10% by weight, wherein the fabric has a friction-charged electrostatic potential of 1500 V or less and wash-and-wear properties, as determined according to Method 124 in AATCC after being laundered five times in accordance with Method 103 in JIS L0217, of grade 3 or higher.

**EP 3 006 614 A1**

**Description**

## Technical Field

**[0001]** The present invention relates to a fabric having an exothermic property caused by moisture absorption, warmth retention, and wear comfortability, and a garment manufactured using the same. The present invention particularly relates to a fabric that is preferably used for innerwear, T-shirts, and the like, which come into direct contact with human skin, and is less likely to generate crackling static electricity when worn and to get wrinkled after being washed, and a garment.

## Background Art

**[0002]** Conventionally, fiber products having a moisture-retaining property are obtained, for example, by adding moisturizing components such as squalane to a fabric such as a woven fabric or a knitted fabric in a post-process. Such post-processed fiber products, however, have a problem in that their properties including moisture-retaining property are poor in washing resistance, and to solve this problem, it has been common to use large amounts of binders (see, Patent Document 1).

**[0003]** On the other hand, examples of the method of improving the washing resistance without using a binder include the following methods. Specifically, a method is proposed in which a functional protein material is fixedly secured to a fabric made of synthetic fibers, and then the fabric is post treated with an aqueous alkaline solution and/or an aqueous solution of an anionic surface active agent (see, Patent Document 2). Furthermore, a cellulose fiber-containing fiber product is proposed which is obtained by adding a metal compound and a natural functionalizing agent to a fabric including cellulose fibers, and subjecting the fabric to crosslinking improvement (see, Patent Document 3).

**[0004]** Unfortunately, these proposals, which improve washing resistance but impair safety and softness which are most important for use in garments that come into direct contact with the skin, are not satisfactory in both washing resistance and wear comfortability, and are problematic from the viewpoint of reduction in the environmental load in recent years.

**[0005]** As means for improving warmth retention, a fabric is proposed which is composed of a three-layer structure of a lining, a warmth retention material such as padding, and an outer material (see, Patent Document 4). Unfortunately, this proposal has a problem in that the fabric feels stuffy when worn because the outer material is used for the purpose of enhancing wind-proofness and warmth retention, and the fabric is thick because of the three-layer structure and unsuitable for applications such as innerwear.

**[0006]** As a fabric preferably used particularly for innerwear, T-shirts, and the like, which come into direct contact with human skin, for example, a fabric is proposed which comprises a polyacrylic synthetic fiber in an amount of 30% by weight to 47% by weight, a viscose rayon fiber in an amount of 20% by weight to 30% by weight, a cation-dyeable polyester fiber in an amount of 30% by weight to 45% by weight, and a polyurethane elastic fiber in an amount of 3% by weight to 10% by weight (see, Patent Document 5). Unfortunately, this proposal has a problem in that the fabric is likely to generate static electricity when worn because of the high content of the polyacrylic synthetic fiber and the polyester fiber which are hydrophobic polymers, and also has a problem in that pilling is likely to occur on the fabric because of the high mixing ratio of the polyacrylic synthetic fiber.

## Prior Art Documents

## Patent Documents

**[0007]**

Patent Document 1: JP 02-300301 A  
 Patent Document 2: JP 10-131047 A  
 Patent Document 3: JP 2002-88649 A  
 Patent Document 4: JP 07-59762 B  
 Patent Document 5: JP 2010-216053 A

## Summary of the Invention

## Problems to be Solved by the Invention

**[0008]** The present inventors intensively studied to solve the problems described above, and discovered that a fabric

that is less likely to generate crackling static electricity when worn, less likely to get wrinkled after being washed, and has warmth retention excellent in washing resistance and excellent wear comfortability can be obtained by using a yarn obtained by mixed fiber spinning of a viscose rayon fiber, i.e., a viscose rayon fiber, a cation-dyeable polyester fiber, a polyacrylic synthetic fiber, and a polyurethane elastic fiber at an optimal composition ratio.

**[0009]** Thus, an object of the present invention is to solve the problems described above and provide a fabric that is less likely to generate crackling static electricity when worn, less likely to get wrinkled after being washed, and has highly durable warmth retention and wear comfortability, and a garment manufactured using the same.

#### Means for Solving the Problems

**[0010]** To solve the problems described above, the present invention has the following structure.

**[0011]** The fabric of the present invention is a fabric comprising a viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, a cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, a polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight, and a polyurethane elastic fiber in an amount of more than 5% by weight and less than 10% by weight, wherein the fabric has a friction-charged electrostatic potential of 1500 V or less and wash-and-wear properties, as determined according to Method 124 in AATCC after being laundered five times in accordance with Method 103 in JIS L0217 (2011), of grade 3 or higher.

**[0012]** In a preferred aspect of the fabric of the present invention, the fabric has an exothermic property caused by moisture absorption of at least 2.6°C.

**[0013]** In a preferred aspect of the fabric of the present invention, the fabric takes not longer than 40 minutes to decrease its diffusible remaining water content to 30% or lower.

**[0014]** In a preferred aspect of the fabric of the present invention, the fabric has a warmth retention rate of 14% or more.

**[0015]** In a preferred aspect of the fabric of the present invention, the fabric has a pilling grade of 2.5 or higher.

**[0016]** In a preferred aspect of the fabric of the present invention, the cation-dyeable polyester long fiber includes a fiber having a modified cross-section.

**[0017]** In a preferred aspect of the fabric of the present invention, the fabric is a knitted fabric of monolayer structure.

**[0018]** By using the fabric of the present invention, a garment contemplated by the present invention can be obtained.

#### Effects of the Invention

**[0019]** The present invention provides a fabric that is less likely to generate crackling static electricity when worn, less likely to get wrinkled after being washed, has a durable moisture-retaining property, and has warmth retention and moisture content despite its thin textile, and therefore is suitably used for innerwear, T-shirts, and the like requiring wear comfortability, and a garment manufactured using the same. Mode for Carrying Out the Invention

**[0020]** Embodiments of the fabric of the present invention will now be described in detail.

**[0021]** The fabric of the present invention is a fabric comprising a viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, a cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, a polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight, and a polyurethane elastic fiber in an amount of more than 5% by weight and less than 10% by weight.

**[0022]** As described above, it is important that the fabric of the present invention contain the viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight. The amount of the viscose rayon fiber is preferably 32 to 38% by weight, more preferably 33 to 36% by weight. The viscose rayon fiber contained in an amount of more than 30% by weight can provide a highly durable fabric having a moisture-retaining property. By virtue of the moisture-retaining property, the fabric is unlikely to generate crackling static electricity when worn and can be provided with an exothermic property caused by moisture absorption.

**[0023]** In the fabric, the amount of static electricity generation is determined by the friction-charged electrostatic potential measured in accordance with JIS-L1094-2008 "Testing methods for electrostatic propensity of woven and knitted fabrics". The lower the friction-charged electrostatic potential, the less the static electricity is likely to occur, and the higher the friction-charged electrostatic potential, the more the static electricity is likely to occur. Also in this regard, it is important that the fabric of the present invention have a friction-charged electrostatic potential of 1500 V or less. The friction-charged electrostatic potential of 1500 V or less reduces the likelihood that the fabric generates crackling static electricity when worn. The friction-charged electrostatic potential is preferably 1000 V or less, more preferably 500 V or less.

**[0024]** The fabric of the present invention, if containing the viscose rayon fiber in an amount of 40% by weight or more, will be likely to get wrinkled after being washed and have reduced warmth retention by the nature of the viscose rayon fiber.

**[0025]** The viscose rayon fiber for use in the present invention is preferably used in the form of a spun yarn from the viewpoint of improving the warmth retention. The count of the spun yarn is preferably 30S to 100S in the cotton count because the yarn is used for innerwear, T-shirts, and the like, which come into direct contact with human skin. The

fineness of single fiber constituting the spun yarn is preferably 0.5 decitex to 2.5 decitex for its intended use.

**[0026]** It is important that the fabric of the present invention contain the cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight. The cation-dyeable polyester fiber allows dyeing at a lower temperature than in the case of conventional polyester fibers, which in turn allows dyeing with the same dye as used for the polyacrylic synthetic fiber used together. The cation-dyeable polyester fiber can prevent thermal degradation of the polyurethane elastic fiber used together because it can be provided with an excellent chromogenic property and fastness property at a dyeing temperature of 105°C to 115°C.

**[0027]** The cation-dyeable polyester fiber contained in an amount of more than 30% by weight reduces the occurrence of wrinkles in the fabric after being washed. For the wrinkles after being washed, a specimen is laundered five times by a laundering method in accordance with Method 103 in JIS L0217 (2011), and the wrinkling occurred on the surface of the specimen is graded according to the replicas described in AATCC 124. When the wash-and-wear properties according to Method 124 in AATCC after the five-time laundering are grade 3 or higher, the fabric can be judged as having little wrinkling.

**[0028]** If the amount of the cation-dyeable polyester fiber is 40% by weight or more, the moisture-retaining property of the fabric will be reduced by the nature of the cation-dyeable polyester fiber, resulting in an increased friction-charged electrostatic potential and a reduced exothermic property caused by moisture absorption. The amount of the cation-dyeable polyester fiber is preferably 32 to 36% by weight, more preferably 33 to 35% by weight.

**[0029]** The cation-dyeable polyester fiber preferably includes a fiber having a modified cross-section. By virtue of the fiber having a modified cross-section, sweat absorbed by a knitted fabric (the fabric) quickly dries to effectively prevent the body from cooling down. In the present invention, to include the fiber having a modified cross-section means to use two or more fibers having different cross-sectional shapes. Examples of such cases include the case where a fiber having a circular cross-section is used together with a fiber having any cross-section other than the circular cross-section, and the case where two or more fibers having different modified cross-sections other than the circular cross-section alone are used. This forms numbers of tiny spaces to increase the diffusion velocity of water sucked up by surface tension.

**[0030]** The cation-dyeable polyester fiber preferably has a single fiber fineness of 0.8 to 1.8 decitex from the viewpoint of excellent perspiration absorbency. In particular, a single fiber fineness of 1.0 decitex or less, even when the fiber having a modified cross-section is not included and a fiber having a uniform cross-section alone is used, provides a fabric having excellent perspiration absorbency.

**[0031]** The cation-dyeable polyester fiber for use in the present invention may be either a spun yarn or a long fiber, for example. From the viewpoint of improving the wash-and-wear properties, it is preferably used in the form of long fiber. In this case, the total fineness is preferably 50 decitex to 200 decitex because the fiber is used for innerwear, T-shirts, and the like, which come into direct contact with human skin.

**[0032]** Making a conventional polyester cation-dyeable can be achieved, for example, by copolymerizing the conventional polyester with 1.0 to 3.0 mol% of a 5-sodium sulfoisophthalic acid component as generally known.

**[0033]** It is important that the fabric of the present invention contain the polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight. The polyacrylic synthetic fiber contained in an amount of more than 25% by weight can provide the fabric with warmth retention. If the amount of the polyacrylic synthetic fiber is 30% by weight or more, the moisture-retaining property of the fabric will be reduced by the nature of the polyacrylic synthetic fiber, resulting in an increased friction-charged electrostatic potential and a reduced exothermic property caused by moisture absorption. The amount of the polyacrylic synthetic fiber is preferably 26 to 28% by weight.

**[0034]** The fineness of the single fibers constituting the polyacrylic synthetic fiber is preferably 0.6 to 2.2 decitex. For a softer texture and improved warmth retention, the polyacrylic synthetic fiber preferably has a smaller fineness, but a single fiber fineness of less than 0.6 decitex can make it difficult to carry out spinning and reduce the strength of a spun yarn, whereas a single fiber fineness of more than 2.2 decitex tends to result in a texture that is hard particularly for clothes worn directly against the skin, such as innerwear. In view of these facts, the single fiber fineness of the polyacrylic synthetic fiber is more preferably 0.6 decitex to 1.5 decitex. The polyacrylic synthetic fiber for use in the present invention is preferably used in the form of a spun yarn from the viewpoint of improving the warmth retention. The count of the spun yarn is preferably 30S to 100S in the cotton count because the yarn is used for innerwear, T-shirts, and the like, which come into direct contact with human skin.

**[0035]** In addition, in the present invention, a spun yarn obtained by mixed fiber spinning of the viscose rayon fiber and the polyacrylic synthetic fiber described above is also preferably used.

**[0036]** Furthermore, in the fabric of the present invention, it is important that the polyurethane elastic fiber be used in an amount of more than 5% by weight and less than 10% by weight. This provides an appropriate elongation and increases the gaps between knitted fabric loops, enabling smooth conforming to body movements to effectively improve the wear comfortability.

**[0037]** As the polyurethane synthetic fiber for use in the present invention, one having a total fineness of 15T to 45T and 1 to 3 filaments is preferably used because the fiber is used for innerwear, T-shirts, and the like, which come into direct contact with human skin.

**[0038]** Preferred examples of the form of the fabric of the present invention include woven fabric, knitted fabric, and nonwoven fabric. In the case of woven fabric and knitted fabric, the viscose rayon fiber, the cation-dyeable polyester fiber, and the polyacrylic synthetic fiber may be either a long fiber or a spun yarn, but for use for innerwear, T-shirts, and the like, which come into direct contact with the skin, and to achieve various properties, the preferred form of the fabric is a knitted fabric comprising a spun yarn obtained by mixed fiber spinning of the viscose rayon fiber and the polyacrylic synthetic fiber, the cation-dyeable polyester fiber in the form of a long fiber, and the polyurethane synthetic fiber.

**[0039]** In the fabric of the present invention, as described above, it is important that the friction-charged electrostatic potential be 1500 V or less and the wash-and-wear properties be grade 3 or higher.

**[0040]** Furthermore, in the present invention, the fabric of the present invention preferably has an exothermic property caused by moisture absorption of at least 2.6°C. The exothermic property caused by moisture absorption is preferably as high as possible, and when it is at least 2.6°C, wearers can feel warm when wearing the fabric. The exothermic property caused by moisture absorption is a temperature difference  $B - A$  (°C), where A is a surface temperature at which the temperature of a specimen is stabilized after the specimen is dried for at least 30 minutes by introducing dry air (humidity: 10% RH or less) passed through a silica gel container, and B is a maximum specimen surface temperature during the subsequent introduction of air with a humidity of about 90% RH for about 30 minutes, the air having been passed through ion exchange water. Therefore, with an increasing amount of the viscose rayon fiber which is highly hygroscopic, the exothermic property caused by moisture absorption improves, but with an increasing amount of the viscose rayon fiber, the fabric becomes likely to get wrinkled after being washed and has reduced warmth retention by the nature of the viscose rayon fiber.

**[0041]** In the present invention, the fabric of the present invention preferably takes not longer than 40 minutes to decrease its diffusible remaining water content to 30% or lower. The diffusible remaining water content, which indicates how fast the fabric wet with water will dry, is determined, specifically, by dropping about 0.3 g of water, reading the mass (g) immediately after dropping, and reading the mass (g) after dropping over time. With an increasing amount of the cation-dyeable polyester fiber and the polyacrylic synthetic fiber which are hydrophobic, the diffusible remaining water content improves, but the friction-charged electrostatic potential increases and the exothermic property caused by moisture absorption is reduced.

**[0042]** Furthermore, in the present invention, the fabric of the present invention preferably has a warmth retention rate of 14.0% or more. The warmth retention rate is preferably as high as possible, and when it is 14.0% or more, wearers can feel warm when wearing the fabric. The warmth retention indicates whether a textile diffuses heat with ease or difficulty. By the nature of the fibers, the warmth retention improves with an increasing amount of the cation-dyeable polyester fiber and the polyacrylic synthetic fiber which have low thermal conductivity, but the friction-charged electrostatic potential increases and the exothermic property caused by moisture absorption is reduced.

**[0043]** Furthermore, in the present invention, the fabric of the present invention preferably has a pilling grade (determined in accordance with Method A in JIS L1076 (2011)) of 2-3 or higher (2.5 or higher). The pilling test can determine how pills will be produced on the surface when the fabric is worn. When the pilling grade is 2 or lower, large numbers of pills are produced and conspicuous when the fabric is worn. To achieve the grade 2-3 or higher (2.5 or higher), it is important that the fabric comprise the viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, the cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, and the polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight. In particular, the polyacrylic synthetic fiber in an amount of more than 30% by weight will degrade the pilling.

**[0044]** The fabric of the present invention comprises the viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, the cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, and the polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight, whereby when the fabric is dyed in such a manner that the viscose rayon fiber is dyed with a reactive dye, and the cation-dyeable polyester fiber and the polyacrylic synthetic fiber are dyed with a cationic dye, gray not too pale can be expressed through black-dyeing with a reactive dye alone and gray not too dark can be expressed through black-dyeing with a cationic dye alone.

**[0045]** The form of the fabric in the present invention is preferably a knitted fabric of monolayer structure because the fabric is used for innerwear, T-shirts, and the like, which come into direct contact with human skin. When a garment manufactured from the fabric in the form of a knitted fabric of monolayer structure is worn, the viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight, the cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight, the polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight, and the polyurethane elastic fiber in an amount of more than 5% by weight and less than 10% by weight will touch the skin in a well-balanced manner. For example, when one of these materials, e.g., the viscose rayon fiber alone touches the skin, its textile will feel very cold by the nature of the fiber. In the case of the cation-dyeable polyester fiber or the polyacrylic synthetic fiber alone, its textile will feel very stuffy by the nature of the fiber. In the case of the polyurethane elastic fiber alone, its textile will feel very sticky.

**[0046]** Furthermore, in addition to the viscose rayon fiber, the cation-dyeable polyester fiber, the polyacrylic synthetic

fiber, and the polyurethane elastic fiber described above, the fabric of the present invention may comprise conventional cation-undyeable polyester fibers, polyester fibers obtained by copolymerizing polyester with a third component, polyamide fibers, acetate fibers, natural cellulose fibers such as cotton, hemp, and pulp, regenerated cellulosic fibers other than viscose rayon, protein fibers such as wool, and other fibers. The fibers constituting the fabric may be, for example, combined, mix-spun, co-woven, or interknitted.

**[0047]** The fabric of the present invention is suitable for garment applications including outerwear such as T-shirts, blousons, slacks, and skirts, underwear such as tights, spats, camisoles, and pants, and other garments put on bodies, and is preferably used for various garments.

## Examples

**[0048]** Methods of assessing the properties in Examples are as described below.

### (1) Friction-Charged Electrostatic Potential

**[0049]** The friction-charged electrostatic potential was measured by Testing methods for electrostatic propensity of woven and knitted fabrics in accordance with JIS-L1094 (2011).

### (2) Wash-and-Wear Properties

**[0050]** The wash-and-wear properties are determined by laundering a specimen five times by a laundering method in accordance with Method 103 in JIS L0217 (2011), and grading the wrinkling occurred on the surface of the specimen according to the replicas described in AATCC 124.

### (3) Exothermic Property Caused by Moisture Absorption

**[0051]** The exothermic property caused by moisture absorption is read on a recorder in such a manner that a specimen of about 10 cm × 10 cm in size is placed in a hermetically sealed container, and a surface temperature sensor is mounted so that the temperature of the specimen can be measured. After starting to measure the temperature of the specimen, dry air (humidity: 10% RH or less) passed through a silica gel container is introduced from a room atmosphere at a temperature of 20°C to dry the specimen. The specimen is dried for at least 30 minutes, and a surface temperature A at which the temperature of the specimen is stabilized is read. Subsequently, air with a humidity of about 90% RH passed through ion exchange water is introduced for about 30 minutes, and a maximum specimen surface temperature B during the introduction is read. The difference B - A was used as the exothermic property caused by moisture absorption (°C).

### (4) Time Taken for Diffusible Remaining Water Content to Decrease to 30% or Lower (Quick-Drying Property)

**[0052]** A specimen of about 10 cm × 10 cm in size is left to stand in an atmosphere at 20°C and 65% RH for 24 hours, and then the mass G (g) is read. In the same atmosphere, about 0.3 g of water is dropped onto the specimen, and the mass Go (g) immediately after dropping and the mass Gx (g) after dropping over time are read. The time (min) taken for the diffusible remaining water content (%), as determined by the following equation, to decrease to 30% of the mass immediately after dropping was determined.

$$\bullet \text{ Diffusible remaining water content (\%)} = \{(G_x - G)/(G_o - G)\} \times 100$$

### (5) Warmth Retention Rate

**[0053]** The warmth retention rate is determined in accordance with JIS L1096, 8.28 Warmth retaining property, 8.28.1 Method A (isothermal method) (2011).

### (6) Pilling

**[0054]** The pilling is assessed in accordance with Method A in JIS L1076 (2011).

**[0055]** The grade was determined according to the following criteria.

Grade 5 Production of pills is at the level shown in photographic rating standard No. 5.

Grade 4-5 (Grade 4.5) Production of pills is at the level about the halfway between photographic rating standards No. 4 and No. 5.

Grade 4 Production of pills is at the level shown in photographic rating standard No. 4.

Grade 3-4 (Grade 3.5) Production of pills is at the level about the halfway between photographic rating standards No. 3 and No. 4

Grade 3 Production of pills is at the level shown in photographic rating standard No. 3.

Grade 2-3 (Grade 2.5) Production of pills is at the level about the halfway between photographic rating standards No. 2 and No. 3

Grade 2 Production of pills is at the level shown in photographic rating standard No. 2

Grade 1-2 (Grade 1.5) Production of pills is at the level about the halfway between photographic rating standards No. 1 and No. 2

Grade 1 Production of pills is at the level shown in photographic rating standard No. 1 or higher.

#### (7) Assessment of Gray Tone

**[0056]** In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed by comparing with one dyed black with both the reactive dye and the cationic dye and one dyed white.

#### Example 1

**[0057]** Viscose rayon staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) in an amount of 55% by weight and polyacrylic fiber staple (single fiber fineness: 1.0 decitex, length: 45 mm, "TORELON" (registered trademark) available from Toray Industries, Inc.) in an amount of 45% by weight to which 0.4

owf% of tetraalkyl adipate was applied were mixed by carding to obtain a spun yarn of 1/64s (count).  
**[0058]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex, 48 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a mixed cross-section of circular cross-section fibers and star cross-section fibers, and a polyurethane fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a

cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.  
**[0059]** The gray fabric obtained was dyed through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 27% by weight of the polyacrylic fiber, 33% by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane elastic fiber at a textile weight ratio.

**[0060]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone, and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were each assessed. The results are shown in Table 1. The friction-charged electrostatic potential was not greater than 2000 V; the grade of the wash-and-wear properties were 3; the exothermic property caused by moisture absorption, the quick-drying property, and the warmth retention were all good; the pilling grade was 2-3 (2.5); and the gray tone was gray not too pale in the case of dyeing with a reactive dye alone and gray not too dark in the case of dyeing with a cationic dye alone. A knitted fabric having high functionality, which is required for garment applications, particularly, innerwear, was obtained.

#### Example 2

**[0061]** Viscose rayon staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) in an amount of 55% by weight and polyacrylic fiber staple (single fiber fineness: 1.0 decitex, length: 38 mm, "TORELON" (registered trademark) available from Toray Industries, Inc.) in an amount of 45% by weight to which 0.4

owf of tetraalkyl adipate was applied were mixed by carding to obtain a spun yarn of 1/64s (count).  
**[0062]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex, 96 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a circular cross-section, and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 42 wells/2.54 cm, and 58 courses/2.54 cm to obtain a gray fabric.

**[0063]** The gray fabric obtained was dyed through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile

with a basis weight of 145 g/m<sup>2</sup> comprising 27% by weight of the polyacrylic fiber, 33% by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a circular cross-section, and 6% by weight of the polyurethane elastic fiber at a textile weight ratio.

**[0064]** The textile obtained was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed. The results are shown in Table 1. A knitted fabric having high functionality was obtained similarly to Example 1. For the quick-drying property, it was confirmed that the property equivalent to that of the mixed cross-section finished yarn was obtained by using a high multi-finished yarn having a single fiber fineness of 1.0 decitex or less as the cation-dyeable polyester fiber having a circular cross-section. The pilling grade was 2-3 (2.5), and the gray tone was gray not too pale in the case of dyeing with a reactive dye alone and gray not too dark in the case of dyeing with a cationic dye alone.

#### Comparative Example 1

**[0065]** Viscose rayon fiber staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) in an amount of 35% by weight and polyacrylic fiber staple (single fiber fineness: 1.0 decitex, length: 45 mm, "TORELON" (registered trademark) available from Toray Industries, Inc.) in an amount of 65% by weight to which 0.4 owf% of tetraalkyl adipate was applied were mixed by carding to obtain a spun yarn of 1/64s (count).

**[0066]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex, 48 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a mixed cross-section of circular cross-section fibers and star cross-section fibers, and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.

**[0067]** The gray fabric obtained was dyed in the same manner as in Example 1 through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 39% by weight of the polyacrylic fiber, 21 % by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane fiber at a textile weight ratio.

**[0068]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed. The results are shown in Table 1. The wash-and-wear properties, the quick-drying property, and the warmth retention were high, but the friction-charged electrostatic potential was 2500 V, and the exothermic property caused by moisture absorption was 2.3°C, meaning that static electricity was likely to occur and the exothermic property caused by moisture absorption was low. The pilling grade was 2, and the gray tone was gray close to white in the case of black-dyeing with a reactive dye alone, and gray close to black in the case of black-dyeing with a cationic dye alone.

#### Comparative Example 2

**[0069]** Viscose rayon fiber staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) in an amount of 50% by weight and polyacrylic fiber staple (single fiber fineness: 1.0 decitex, length: 45 mm, "TORELON" (registered trademark) available from Toray Industries, Inc.) in an amount of 50% by weight to which 0.4 owf% of tetraalkyl adipate was applied were mixed by carding to obtain a spun yarn of 1/64s (count).

**[0070]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex -48 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a mixed cross-section of circular cross-section fibers and star cross-section fibers, and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.

**[0071]** The gray fabric obtained was dyed in the same manner as in Example 1 through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 30% by weight of the polyacrylic fiber, 30% by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane fiber at a textile weight ratio.

**[0072]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared,



and their gray tones were assessed. The results are shown in Table 1. The wash-and-wear properties, the quick-drying property, and the warmth retention were high, but the friction-charged electrostatic potential was 1700 V, and the exothermic property caused by moisture absorption was 2.5°C, meaning that static electricity was likely to occur and the exothermic property caused by moisture absorption was low. The pilling grade was 2. The gray tone was gray not too pale in the case of dyeing with a reactive dye alone and gray not too dark in the case of dyeing with a cationic dye alone.

#### Comparative Example 3

**[0073]** A spun yarn of 1/64s (count) comprising polyacrylic fiber staple (single fiber fineness: 1.0 decitex, length: 45 mm, "TORELON" (registered trademark) available from Toray Industries, Inc.) alone to which 0.4 owf% of tetraalkyl adipate was applied was obtained.

**[0074]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex, 48 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a mixed cross-section of circular cross-section fibers and star cross-section fibers, and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.

**[0075]** The gray fabric obtained was dyed in the same manner as in Example 1 through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 60% by weight of the polyacrylic fiber, 0% by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane fiber at a textile weight ratio.

**[0076]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed. The results are shown in Table 1. The wash-and-wear properties, the quick-drying property, and the warmth retention were very high, but the friction-charged electrostatic potential was 5000 V, and the exothermic property caused by moisture absorption was 0.4°C, meaning that static electricity was highly likely to occur and the exothermic property caused by moisture absorption was very low. The pilling grade was 1-2 (1.5), and the gray tone was white, i.e., not dyed in the case of black-dyeing with a reactive dye alone, and black in the case of black-dyeing with a cationic dye alone.

#### Comparative Example 4

**[0077]** A spun yarn of 1/64s (count) comprising viscose rayon fiber staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) alone was obtained.

**[0078]** The spun yarn thus obtained, a cation-dyeable polyester fiber filament (total fineness: 84 decitex, 48 filaments, "TETORON" (registered trademark) available from Toray Industries, Inc.) having a mixed cross-section of circular cross-section fibers and star cross-section fibers, and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.

**[0079]** The gray fabric obtained was dyed in the same manner as in Example 1 through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 0% by weight of the polyacrylic fiber, 60% by weight of the viscose rayon fiber, 34% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane fiber at a textile weight ratio.

**[0080]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed. The results are shown in Table 1. The friction-charged electrostatic potential and the exothermic property caused by moisture absorption were high, and the pilling grade was as high as 3; however, the wash-and-wear properties, the quick-drying property, and the warmth retention were very low. The gray tone was gray not too dark in the case of dyeing with a reactive dye alone and gray not too pale in the case of dyeing with a cationic dye alone.

#### Comparative Example 5

**[0081]** Viscose rayon fiber staple (single fiber fineness: 1.4 decitex, length: 38 mm, available from Daiwabo Rayon Co., Ltd.) in an amount of 55% by weight and acrylic staple (single fiber fineness: 1.0 decitex, length: 45 mm, "TORELON"

(registered trademark) available from Toray Industries, Inc.) in an amount of 45% by weight to which 0.4 owf% of tetraalkyl adipate was applied were mixed by carding to obtain a spun yarn of 1/64s (count).

**[0082]** The spun yarn thus obtained and a polyurethane elastic fiber (total fineness: 22 decitex, 2 filaments, "LYCRA" (registered trademark) available from Opelontex Co., Ltd.) were interknitted in plain stitch under the conditions of a cylinder diameter of 76.2 cm, 28 gauges/2.54 cm, 40 wells, and 62 courses to obtain a gray fabric.

**[0083]** The gray fabric obtained was dyed in the same manner as in Example 1 through the process of continuous relaxing/scouring - drying (at 175°C for 25 seconds) - setting - tucking - dyeing (jet dyeing temperature: 115°C) - drying (at 112°C) - setting to obtain a textile with a basis weight of 150 g/m<sup>2</sup> comprising 42% by weight of the polyacrylic fiber, 52% by weight of the viscose rayon fiber, 0% by weight of the cation-dyeable polyester fiber having a mixed cross-section, and 6% by weight of the polyurethane fiber at a textile weight ratio.

**[0084]** The textile obtained above was assessed for friction-charged electrostatic potential, wash-and-wear properties, exothermic property caused by moisture absorption, quick-drying property, warmth retention, and pilling. In dyeing, a specimen dyed black with a reactive dye alone and a specimen dyed black with a cationic dye alone were prepared, and their gray tones were assessed. The results are shown in Table 1. In Comparative Example 5, the friction-charged electrostatic potential, the exothermic property caused by moisture absorption, and the warmth retention were high, but the wash-and-wear properties and the quick-drying property were very low. The pilling grade was 2. The gray tone was gray both in the case of dyeing with a reactive dye alone and in the case of dyeing with a cationic dye alone.

**[0085]** Table 1

Table 1

|                    | Example 1                                                 | Example 2       | Comparative Example 1 | Comparative Example 2 | Comparative Example 3 | Comparative Example 4 | Comparative Example 5 |
|--------------------|-----------------------------------------------------------|-----------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Mixing ratio       | Polyacrylic (% by weight)                                 | 27              | 27                    | 39                    | 30                    | 60                    | 42                    |
|                    | Viscose rayon (% bv weight)                               | 33              | 34                    | 21                    | 30                    | 0                     | 52                    |
|                    | PET-finished yarn with mixed cross-section (% by weight)  | 34              | -                     | 34                    | 34                    | 34                    | 0                     |
|                    | PET-finished yarn with single cross-section (% bv weight) | -               | 33                    | -                     | -                     | -                     | -                     |
|                    | Polyurethane elastic yarn (% by weight)                   | 6               | 6                     | 6                     | 6                     | 6                     | 6                     |
|                    |                                                           |                 |                       |                       |                       |                       |                       |
| Textile properties | Friction-charged electrostatic potential (V)              | 1200            | 1000                  | 2500                  | 1700                  | 5000                  | 700                   |
|                    | Wash-and-wear properties (grade)                          | 3               | 3                     | 3                     | 3                     | 3.5                   | 2                     |
|                    | Exothermic property caused by moisture absorption (°C)    | 2.6             | 2.7                   | 2.3                   | 2.5                   | 0.3                   | 2.8                   |
|                    | property (min)                                            | 40              | 35                    | 40                    | 40                    | 20                    | 75                    |
|                    | Quick-drying Warmth retention (%)                         | 16              | 15                    | 20                    | 18                    | 25                    | 20                    |
|                    | Pilling (grade)                                           | 2-3 (grade 2.5) | 2-3 (grade 2.5)       | 2                     | 2                     | 1-2 (grade 1.5)       | 2                     |

5  
10  
15  
20  
25  
30  
35  
40  
45  
50  
55

(continued)

|           |                                |                                         |                                         |                                           |                                         |                                       |                                         |                            |
|-----------|--------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------|-----------------------------------------|---------------------------------------|-----------------------------------------|----------------------------|
|           |                                | Example 1                               | Example 2                               | Comparative Example 1                     | Comparative Example 2                   | Comparative Example 3                 | Comparative Example 4                   | Comparative Example 5      |
| Gray tone | Black-dyeing with reactive dye | Gray not too pale Degree of dyeing: 33% | Gray not too pale Degree of dyeing: 34% | Gray close to white Degree of dyeing: 21% | Gray not too pale Degree of dyeing: 30% | White (not dyed) Degree of dyeing: 0% | Gray not too dark Degree of dyeing: 60% | Gray Degree of dyeing: 52% |
|           | Black-dyeing with cationic dye | Gray not too dark Degree of dyeing: 61% | Gray not too dark Degree of dyeing: 60% | Gray close to black Degree of dyeing: 79% | Gray not too dark Degree of dyeing: 64% | Black Degree of dyeing: 100%          | Gray not too pale Degree of dyeing: 34% | Gray Degree of dyeing: 42% |

**Claims****1.** A fabric, comprising:

5 a viscose rayon fiber in an amount of more than 30% by weight and less than 40% by weight;  
a cation-dyeable polyester fiber in an amount of more than 30% by weight and less than 40% by weight;  
a polyacrylic synthetic fiber in an amount of more than 25% by weight and less than 30% by weight; and  
a polyurethane elastic fiber in an amount of more than 5% by weight and less than 10% by weight, wherein the  
10 fabric has a friction-charged electrostatic potential of 1500 V or less and wash-and-wear properties, as determined according to Method 124 in AATCC after being laundered five times in accordance with Method 103 in JIS L0217, of grade 3 or higher.

**2.** The fabric according to claim 1, wherein the fabric has an exothermic property caused by moisture absorption of at least 2.6°C.**3.** The fabric according to claim 1 or 2, wherein the fabric takes not longer than 40 minutes to decrease its diffusible remaining water content to 30% or lower.**4.** The fabric according to any one of claims 1 to 3, wherein the fabric has a warmth retention rate of 14% or more.**5.** The fabric according to any one of claims 1 to 4, wherein the fabric has a pilling grade of 2.5 or higher.**6.** The fabric according to any one of claims 1 to 5, wherein the cation-dyeable polyester fiber includes a fiber having a modified cross-section.**7.** The fabric according to any one of claims 1 to 6, wherein the fabric is a knitted fabric of monolayer structure.**8.** A garment manufactured by using the fabric according to any one of claims 1 to 7.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/063658

## A. CLASSIFICATION OF SUBJECT MATTER

D04B1/14(2006.01)i, A41B17/00(2006.01)i, A41D31/00(2006.01)i, A41D1/04(2006.01)n

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)

A41B9/00-9/16, A41B13/00-17/00, A41D1/02-1/04, A41D3/00-3/08, A41D29/00-31/02, D04B1/00-1/28, D04B21/00-21/20

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 1996-2014  
Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                              | Relevant to claim No. |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 2010-216053 A (Toray Industries, Inc.),<br>30 September 2010 (30.09.2010),<br>claim 1; paragraph [0001]; examples<br>(Family: none)                                          | 1-8                   |
| A         | JP 2012-097399 A (Daiwabo Holdings Co., Ltd.),<br>24 May 2012 (24.05.2012),<br>claims 1, 8; paragraph [0010]; examples<br>(Family: none)                                        | 1-8                   |
| P, X      | JP 2013-204204 A (Daiwabo Holdings Co., Ltd.),<br>07 October 2013 (07.10.2013),<br>claims 1, 11, 12; paragraphs [0001], [0036],<br>[0043] to [0045]; examples<br>(Family: none) | 1-8                   |



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

"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

"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)

"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

"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

"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

"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

"&"

document member of the same patent family

Date of the actual completion of the international search  
04 August, 2014 (04.08.14)

Date of mailing of the international search report  
12 August, 2014 (12.08.14)

Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

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

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- JP 2300301 A [0007]
- JP 10131047 A [0007]
- JP 2002088649 A [0007]
- JP 7059762 B [0007]
- JP 2010216053 A [0007]