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CA 2668002 C 2014/07/29

(11)(21) 2 668 002

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2007/10/26
(87) Date publication PCT/PCT Publication Date: 2008/05/08
(45) Date de délivrance/Issue Date: 2014/07/29
(85) Entrée phase nationale/National Entry: 2009/04/29
(86) N° demande PCT/PCT Application No.: JP 2007/071351
(87) N° publication PCT/PCT Publication No.: 2008/053977
(30) Priorités/Priorities: 2006/10/30 (JP2006-294097); 2007/03/22 (JP2007-074764)

(51) Cl.Int./Int.Cl. *D02G 1/02* (2006.01), *D01D 5/34* (2006.01), *D01F 8/14* (2006.01), *D02G 3/02* (2006.01)

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(54) Titre : FIL TEXTURE A FAUSSE TORSION ULTRAFIN ET POLYESTER DE TYPE AME-ENVELOPPEANTISTATIQUE, SES UTILISATIONS ET SON PROCEDE DE PRODUCTION

(54) Title: ANTISTATIC CORE-SHEATH TYPE POLYESTER ULTRAFINE FALSE-TWIST TEXTURED YARN, USES OF AND METHOD FOR PRODUCING THE SAME

(57) Abrégé/Abstract:
The polyester false-twist textured yarn of the present invention has a sheath part encapsulating an antistatic component, and is not susceptive to deformation of the false-twist, therefore a little fluff in false-twist texturing occurs. Thus, a polyester textile that is excellent also in antistatic performance, while maintaining such performances as soft feeling, warmth-retaining property, water-absorbing property, hygroscopic property that belong to an ultrafine polyester false-twist textured yarn. Further, since it is excellent in heat-resisting properties as compared with conventional polyetheramide-based antistatic agent, the yarn is excellent in wash durability when it is high-pressure dyed and can be suitably used for a textile for use in such applications as school uniform, uniform and dustproof wear for which static charge should be prevented.

Abstract

The polyester false-twist textured yarn of the present invention has a sheath part encapsulating an antistatic component, and is not susceptive to deformation of the false-twist, therefore a little fluff in false-twist texturing occurs. Thus, a polyester textile that is excellent also in antistatic performance, while maintaining such performances as soft feeling, warmth-retaining property, water-absorbing property, hygroscopic property that belong to an ultrafine polyester false-twist textured yarn. Further, since it is excellent in heat-resisting properties as compared with conventional polyetheramide-based antistatic agent, the yarn is excellent in wash durability when it is high-pressure dyed and can be suitably used for a textile for use in such applications as school uniform, uniform and dustproof wear for which static charge should be prevented.

DESCRIPTION

ANTISTATIC CORE-SHEATH TYPE POLYESTER ULTRAFINE FALSE-TWIST TEXTURED YARN, USES OF AND METHOD FOR PRODUCING THE SAME

Technical Field

The present invention relates to a core-sheath type polyester ultrafine false-twist textured yarn having antistatic property and method for producing the same, and an antistatic woven fabric containing the antistatic core-sheath type polyester ultrafine false-twist textured yarn. More specifically, the invention relates to a production method that can give stably a polyester ultrafine false-twist textured yarn of a core-sheath structure having antistatic property with excellent durability.

Background Art

Polyester fiber is widely used for clothing application and the like due to excellent grade and stable physical properties thereof. However, since polyester is originally hydrophobic, in such a field that requires antistatic property, many attempts have been proposed to give hydrophilic property

to polyester to allow it to express antistatic property.

As examples thereof, there are known, for example, a method of blending a polyoxyalkylene-based polyether compound to polyester (Japanese Patent Publication No JP-B-39-5214), a method of blending a substantially incompatible polyoxyalkylene-based polyether compound and organic/inorganic compound to polyester (Japanese Patent Publication No JP-B-44-31828, Japanese Patent Publication No JP-B-60-11944, Japanese Patent Publication No JP-A-53-80497, Japanese Patent Publication No JP-A-53-149247, Japanese Patent Publication No JP-A-60-39413, Japanese Patent Publication No JP-A-3-139556 and the like), and the like.

However, there is such a problem in the above method that, although good antistatic property is expressed in the case of usual drawn yarns (FOY), good antistatic property can not be obtained in the case of a false-twist textured yarn, because fluff occurs due to the deformation of false-twist.

Further, recently in particular, demand for feeling, skin contact feeling, appearance and the like of a woven or knit fabric is heightening more and more, and a textile having soft feeling is produced by using a polyester false-twist textured yarn of ultrafine fineness having a single filament fineness of 1.6 dtex or less. But, in the case of a polyester false-twist textured yarn, along with the proceeding of the ultrafine fineness, it becomes extremely difficult to inhibit sufficiently the generation of static charge. Thus, in such applications as sportswear, uniform, dustproof wear, or even in such applications as blouses and shirts that often contact directly to skin, it is not much to say that there is almost

no textile that has sufficient antistatic property under the present circumstances.

Disclosure of the Invention

Purposes of the present invention are to provide a core-sheath type polyester ultrafine false-twist textured yarn that can give a polyester textile that is excellent also in antistatic performance, while maintaining such performances as soft feeling, warmth-retaining property, water-absorbing property, hygroscopic property that belong to an ultrafine polyester false-twist textured yarn; and to provide a method for producing a core-sheath type polyester ultrafine false-twist textured yarn capable of producing stably the same.

As the result of hard studies for achieving the aforementioned purposes, the present inventors found that the purpose of the invention could be achieved by melt spinning a core-sheath type polyester ultrafine composite filament, which was formed by covering a core component composed of polyester incorporated with a polyoxyalkylene-based polyether compound and organic ionic compound that are substantially incompatible with polyester with a sheath component, under a specified condition, and then drawing and false-twist texturing the resulting product.

Namely, according to the invention, there are provided

following 1) to 3).

1) An antistatic core-sheath type polyester ultrafine false-twist textured yarn characterized by being a false-twist textured core-sheath type composite filament, wherein:

the core part of the core-sheath type composite filament is formed from an antistatic polyester composition A containing the following (a) and (b), as an antistatic agent, relative to 100 parts by weight of aromatic polyester,

(a) from 0.2 to 30 parts by weight of polyoxyalkylene-based polyether, and

(b) from 0.05 to 10 parts by weight of an organic ionic compound that is substantially nonreactive with the polyester; and

the sheath part is formed from an aromatic polyester composition B, and

the core-sheath type composite filament satisfies simultaneously the following (1) to (3) conditions:

(1) a single filament fineness of the false-twist textured yarn is 1.6 dtex or less,

(2) a crimp percentage of the false-twist textured yarn is form 3 to 30%, and

(3) a ratio SA:SB of a core part area SA and a sheath part area SB is in the range of from 5:95 to 80:20.

2) A method for producing an antistatic core-sheath type polyester ultrafine false-twist textured yarn characterized

in that, when melt-spinning a core-sheath type composite filament having a core part that is formed from an antistatic polyester composition A containing the following (a) and (b), as an antistatic agent, relative to 100 parts by weight of aromatic polyester,

(a) from 0.2 to 30 parts by weight of polyoxyalkylene-based polyether, and

(b) from 0.05 to 10 parts by weight of an organic ionic compound that is substantially nonreactive with the polyester; and a sheath part that is formed from an aromatic polyester composition B,

a filament is drawn at a ratio of discharge velocity and drawing velocity at spinning (drawing velocity/discharge velocity, hereinafter it is sometimes abbreviated as draft magnification) in the range of from 150 to less than 800, and is then subjected to false-twist texturing.

3) An antistatic woven fabric characterized in that the antistatic woven fabric is a woven fabric containing a core-sheath type polyester false-twist textured yarn, wherein the core-sheath type polyester false-twist textured yarn is the antistatic core-sheath type polyester ultrafine false-twist textured yarn as described in the above 1).

Brief Description of the Drawings

Fig. 1 is an outline view of a simultaneous drawing and

false-twist texturing machine for producing a false-twist textured yarn, which is used in the present invention, wherein 1 is an undrawn core-sheath type polyester yarn, 2 is a yarn guide, 3, 3′ are feed rollers, 4, are interlace nozzles, 5 is a first stage heater, 6 is a cooling plate, 7 is a false-twisting tool (three-axis friction disc unit), 8 is first delivery rollers, 9 is a second stage heater, 10 is second delivery rollers, 11 is winding rollers, and 12 is a polyester false-twist textured yarn cheese.

Fig. 2 is a front view showing an embodiment of a false-twisting disc unit for use in the invention, wherein 13 is a false-twisting disc, 14 is a guide disc, 15 is a rotation axis, 16 is a timing belt, and 17 is a driving belt.

Best Mode for Carrying Out the Invention

Hereinafter, embodiments of the present invention are described in detail.

A polyester in the invention is intended to be an aromatic polyester having an aromatic ring in a chain unit in the polymer, which is a polymer obtained by the reaction of a bifunctional aromatic carboxylic acid or an ester-formable derivative thereof with a diol or an ester-formable derivative thereof.

Examples of the bifunctional aromatic carboxylic acid as mentioned here include terephthalic acid, isophthalic acid, orthophthalic acid, 1,5-naphthalenedicarboxylic acid,

2,5-naphthalenedicarboxylic acid, 2,6-naphthalenedicarboxylic acid, 4,4'-biphenyldicarboxylic acid, 3,3'-biphenyldicarboxylic acid, 4,4'-biphenyletherdicarboxylic acid, 4,4'-biphenylmethanedicarboxylic acid, 4,4'-biphenylsulfonedicarboxylic acid, 4,4'-biphenylisopropylidenedicarboxylic acid, 1,2-bis(phenoxy)ethane-4,4'-dicarboxylic acid, 2,5-anthracenedicarboxylic acid, 2,6-anthracenedicarboxylic acid, 4,4'-p-phenylenedicarboxylic acid, 2,5-pyridinedicarboxylic acid, β-hydroxyethoxybenzoic acid, p-oxybenzoic acid, and the like. In particular, terephthalic acid is preferable.

These bifunctional aromatic carboxylic acids may be used in combination of two or more kinds. Further, if only a small amount, one kind or two or more kinds in combination of a bifunctional aliphatic carboxylic acid such as adipic acid, azelaic acid, sebacic acid and dodecanedionic acid, a bifunctional alicyclic carboxylic acid such as cyclohexanedicarboxylic acid and 5-sodiumsulfoisophthalic acid may be used with these bifunctional aromatic carboxylic acids.

Preferable examples of the diol compound include aliphatic diols such as ethylene glycol, propylene glycol, butylene glycol, hexylene glycol, neopentyl glycol,

2-methyl-1,3-propane diol, diethylene glycol, trimethylene glycol, alicyclic diols such as 1,4-cyclohexane dimethanol, and mixtures thereof, and the like. Further, if only a small amount, a polyoxyalkylene glycol, of which both ends or one end has not been blocked, may be copolymerized with these diol compounds.

Furthermore, in such a range that polyester is substantially linear, polycarboxylic acids such as trimellitic acid and pyromellitic acid, and polyols such as glycerin, trimethylolpropane and pentaerythritol may be used.

Specific examples of the preferable aromatic polyester include polyethylene terephthalate, polybutylene terephthalate, polyhexylene terephthalate, polyethylene naphthalate, polybutylene naphthalate, polyethylene-1,2-bis(phenoxy)ethane-4,4'-dicarboxylate and the like, and in addition, copolymerized polyesters such as polyethylene isophthalate/terephthalate, polybutylene terephthalate/isophthalate and polybutylene terephthalate/decanedicarboxylate. Among these, polyethylene terephthalate and polybutylene terephthalate that have balanced mechanical properties, molding properties and the like are particularly preferable.

Such aromatic polyesters may be synthesized by an arbitrary method. For example, polyethylene terephthalate can be easily produced through a first step reaction in which

terephthalic acid and ethylene glycol are directly subjected to an esterification reaction, or a lower alkyl ester of terephthalic acid such as dimethyl terephthalate and ethylene glycol are subjected to an ester exchange reaction, or terephthalic acid and ethylene oxide are reacted to generate glycol ester of terephthalic acid and/or oligomer thereof, and a subsequent second step reaction in which the resulting product is heated under a reduced pressure to subject the same to polycondensation reaction until an intended polymerization degree is achieved.

Polyoxyalkylene-based polyether (a) to be blended to the composition for use in the invention may be a polyoxyalkylene glycol consisting of a single oxyalkylene unit, or a copolymerized polyoxyalkylene glycol consisting of two kinds or more of oxyalkylene units, in so far as it is substantially insoluble in polyester, or may be a polyoxyethylene-based polyether represented by the following formula (I):

$$Z\left[\left(CH_2CH_2O\right)_n\left(R^1O\right)_m-R^2\right]_k \quad \cdots (I)$$

(wherein, Z represents an organic compound residue having from 1 to 6 active hydrogen atoms; R^1 represents an alkylene group or substituted alkylene group having 6 or more carbon atoms; R^2 represents a hydrogen atom, monovalent hydrocarbon group having 1 - 40 carbon atoms, monovalent hydroxyhydrocarbon group having 2 - 40 carbon atoms or monovalent acyl group having 2

- 40 carbon atoms; k represents an integer of from 1 to 6; n represents an integer that satisfies $n \geq 70/k$; and m represents an integer of 1 or greater).

Specific examples of such polyoxyalkylene-based polyether include polyoxyethylene glycol having a molecular weight of 4000 or more, polyoxypropylene glycol having a molecular weight of 1000 or more, polyoxytetramethylene glycol, ethylene oxide having a molecular weight of 2000 or more, propylene oxide copolymer, trimethylolpropane ethylene oxide adduct having a molecular weight of 4000 or more, nonylphenol ethylene oxide adduct having a molecular weight of 3000 or more, and compounds in which a substituted ethylene oxide having 6 or more carbon atoms is added to an end OH group thereof. Among these, polyoxyethylene glycol having a molecular weight of from 10000 to 100000, and compounds in which an alkyl group-substituted ethylene oxide having 8 - 40 carbon atoms is added to both ends of polyoxyethylene glycol, which has a molecular weight of from 5000 to 16000.

The blending amount of such a polyoxyalkylene-based polyether compound is in the range of from 0.2 to 30 parts by weight relative to 100 parts by weight of the aromatic polyester. When it is less than 0.2 part by weight, hydrophilicity is insufficient and satisfactory antistatic property can not be exerted. On the other hand, when the blending amount is more than 30 parts by weight, an additional effect of improving

antistatic property can not be recognized anymore, but, in contrast, mechanical properties of an obtained composition tends to be degraded, and, in addition, since the polyether tends to bleed out to lower the biting property of the chip to a ruder upon melting and molding, and also to degrade molding stability.

In the polyester composition of the invention, in order to improve antistatic property in particular, an organic ionic compound is blended. As the organic ionic compound, for example, sulfonic acid metal salts and sulfonic acid quaternary phosphonium salts represented by the following formulae (II) and (III), respectively, can be mentioned as preferable ones.

$$RSO_3M \quad \cdots\cdots (II)$$

(wherein R represents an alkyl group having 3 - 30 carbon atoms, or an aryl group having 7 - 40 carbon atoms, and M represents an alkali metal or an alkali earth metal).

$$RSO_3PR^1R^2R^3R^4 \quad \cdots\cdots (III)$$

(wherein R represents an alkyl group having 3 - 30 carbon atoms, or an aryl group having 7 - 40 carbon atoms, R^1, R^2, R^3 and R^4 each represents an alkyl group or aryl group, and among these a lower alkyl group, phenyl group or benzyl group is preferable).

When R is an alkyl group in the formula (II), the alkyl

group may be linear or have a branched side chain. M is an alkali metal such as Na, K and Li, or an alkali earth metal such as Mg and Ca. Among these, Li, Na and K are preferable. Such sulfonic acid metal salts may be used in only one kind singly or in two or more kinds in combination.

Preferable specific examples can include sodium stearylsulfonate, sodium octylsulfonate, sodium dodecylsulfonate, a mixture of sodium alkylsulfonates having average carbon atoms of 14, a mixture of sodium dodecylbenzenesulfonates, sodium dodecylbenzenesulfonate (hard type, soft type), lithium dodecylbenzenesulfonate (hard type, soft type), magnesium dodecylbenzenesulfonate (hard type, soft type), and the like.

The sulfonic acid quaternary phosphonium salt in the formula (III) may be used in one kind singly or in two or more kinds in combination. Preferable specific example can include tetrabutylphosphonium alkylsulfonate having average carbon atoms of 14, tetraphenylphosphonium alkylsulfonate having average carbon atoms of 14, butyltriphenylphosphonium alkylsulfonate having average carbon atoms of 14, tetrabutylphosphonium dodecylbenzenesulfonate (hard type, soft type), tetraphenylphosphonium dodecylbenzenesulfonate (hard type, soft type), benzyltriphenylphosphonium dodecylbenzenesulfonate (hard type, soft type) and the like.

Such organic ionic compounds may be used in one kind or

in two or more kinds in combination. The blending amount thereof needs to be in the range of from 0.05 to 10 parts by weight relative to 100 parts by weight of the aromatic polyester. When a blending amount of the organic ionic compound is less than 0.05 part by weight, the effect of improving antistatic property is small, and when it is more than 10 parts by weight, mechanical properties of the composition tends to be degraded, and, in addition, since the ionic compound also tends to bleed out to lower the biting property of the chip to a ruder upon melting and molding, and also to degrade molding stability.

In the polyester B, a publicly known delustering agent, for example, titanium dioxide or the like may be blended in such a range that does not prevent the purpose of the invention. But, 10% by weight or more of a delustering agent results in degradation of spinning property of an undrawn yarn, which is to be a parent yarn of the invention, therefore the range is preferably from 0.01 to 10% by weight.

The ultrafine false-twist textured yarn of the invention needs to have a single filament fineness of 1.6 dtex or less, and a crimp percentage of from 3 to 30%. By determining them in these ranges, a woven or knit fabric excellent in soft feeling is obtained. The crimp percentage of less than 3% does not give sufficiently swollen feeling when the ultrafine yarn is made into a woven or knit fabric, and, on the other hand, the percentage of more than 30% tends to lower antistatic

performance, unpreferably.

Further, the ratio SA:SB of the core part area SA and the sheath part area SB needs to be in the range of from 5:95 to 80:20. The area ratio of less than 5:95 results in an insufficient expression of antistatic performance by the polyester A, and the ratio of more than 80:20 leads to elution of an antistatic polyester of the core part when an alkali weight reduction of 10% or more is conducted, to lower antistatic performance or lower the strength of a false-twist textured yarn to 3.0 cN/dtex or less, to result in an insufficient strength when it is formed into textile, and make it unsuitable for such applications as sportswear that require strength, thereby limiting applications, unpreferably.

The polyester ultrafine false-twist textured yarn of the invention described above can give stable antistatic performance by subjecting an undrawn yarn, which has been drawn at a ratio of discharge velocity and drawing velocity at spinning (drawing velocity/discharge velocity, hereinafter it is referred to as draft) in the range of from 150 to less than 800 upon melt spinning an undrawn yarn to be a parent yarn thereof, to a false-twist texturing. The draft of less than 150 results in an insufficient expression of antistatic performance by the polyester A, and the draft of more than 800 lowers spinnability, unpreferably, although the antistatic performance is expressed.

In order to set the draft within the above range, the diameter of spinneret discharge opening and spinning velocity are approximately set. And, it can preferably be obtained easily and efficiently by performing melt spinning at a spinning velocity of from 2000 to 4500 m/min, particularly in the range of from 2500 to 3500 m/min, while setting the discharge opening diameter Φ to from 0.1 to 0.3 mm.

The double refractive index of an undrawn multifilament on this occasion is preferably in the range of from 0.02 to 0.05. In the case where the double refractive index is less than 0.02, tension at false-twist texturing is low and tends to generate surging, which results in filament sway to cause a heat set spot and dyeing unevenness defect, and increase in texturing magnification and weak yarn, unpreferably. On the other hand, in the case where the double refractive index is greater than 0.05, fluff of raw thread tends to occur to cause process disorder, unpreferably.

There is no necessity to limit a method for false-twist texturing the undrawn yarn, but, for example, such a method as described below is employed.

Firstly, an air interlacing treatment may be performed in a process other than a drawing and false-twist texturing, but it is preferably performed just before the drawing and false-twist texturing by providing an interlace nozzle to a false-twist texturing apparatus, as shown in Fig. 1. This

prevents fluff generation to result in a preferable effect on handling properties, and, in addition, by giving an air interlacing to a yarn after a heat-set false-twisting, perfectly uniformizes blending and interlacing and results in antistatic property and the expression of high-grade feeling based on the effect of uniformity in the length direction of the yarn.

Next, the undrawn yarn that has been given an interlacing treatment is loaded on a drawing and false-twist texturing machine provided with two-stage heaters, for example, as shown in Fig. 1, to form into a polyester false-twist textured yarn having crimps.

In Fig. 1, there is illustrated a process in which the above-described polyester undrawn yarn (1) is subjected to an air interlacing treatment with interlace nozzles (4, 4′) that are set up between two pairs of feed rollers (3, 3′). The undrawn yarn having been subjected to interlacing treatment here is twisted through friction with the rotating false-twisting disc (7) while being drawn between the feed rollers (3′) and the first delivery rollers (8). During this time, the yarn is heat-treated with the first stage heater (5), cooled with the cooling plate (6), and passes though the false-twisting disc (7) to be detwisted. Further, running yarn is heat-treated again, according to need, with the second stage heater (9) that is set up between the first delivery

rollers (8) and the second delivery rollers (10), and, furthermore, after giving an air interlacing (4') to the yarn after a heat-set false-twisting, it is wound with the winding roller (11) as a cheese-shaped package (12), to produce a polyester false-twist textured yarn.

While taking a high speed drawing and false-twist texturing into consideration, the first stage heater (5) and the second stage heater (9) are preferably of a non-contacting system. Particularly the second stage heater is not often used, but it may be used for the purpose of providing feeling and the like, according to need.

In the invention, it is preferable that the false-twisting tool (7) is of a three-axis friction disc type as shown in Fig. 2, wherein a disc at the lowest stage has the material of ceramic and the contact length of the running yarn and the disc is determined to be from 2.5 to 0.5 mm, and that, further, the disc has a diameter of from 90 to 98% of the diameter of a disc just upstream thereof.

That is, the false-twisting tool (7) as exemplified in Fig. 2 is of a three-axis friction disc type having three rotation axes (15) to each of which two false-twisting discs (13) are fixed, wherein each of rotation axes (15) is rotated at a predetermined velocity with the timing belt (16) that is driven with the driving belt (17), to enable respective false-twisting discs (13) to rotate. In the method of the

invention, as at least the bottom disc located in the detwisting section among false-twisting discs (13) (in the example shown in Fig. 2, the bottom disc fixed to the left side rotation axis), a disc that is made of ceramic and has a diameter of from 90 to 98% of the diameter of a disc on just upstream side thereof (in the example shown in Fig. 2, the bottom disc fixed to the central rotation axis) is used. And, the contact length of the ceramic disc and a running yarn is determined to be from 2.5 to 0.5 mm.

On this occasion, the material of the bottom disc is preferably ceramic from the viewpoint of abrasion resistance. According to studies of the present inventors, it was revealed that, in the composite false-twist texturing according to the invention, by determining the contact length of the running yarn and the disc to be from 2.5 to 0.5 mm, it became possible to make a contact area as small as possible when the yarn having a crimped state after the termination of twisting entered the last detwisting section to reduce resistance and, as the result, fluff significantly to improve strength as the result, and that determining the diameter of the disc to be in the range of from 90 to 98% of the diameter of a disc just above thereof reduced resistance value when the yarn moved to a subsequent step (specifically, heat set) and was effective for smooth movement, and the like. It was confirmed that, among these, determining the contact length of the running yarn and the above-described

disc to be from 2.5 to 0.5 mm reduced significantly texturing fluff and, as the result, was particularly effective for improving strength.

Temperature in false-twist texturing in the invention is preferably set to be from the glass transition temperature (hereinafter, referred to as TG) TG + 100°C to TG + 200°C, specifically from 170 to 300°. A temperature less than 170°C results in low crimpability and solid feeling, and a temperature more than 300°C results in progress of an extreme flatness of a textured yarn to tends to generate texturing fluff, unpreferably. When an apparatus provided with a heater of non-contact system is used as a false-twist texturing machine, heat treatment is preferably performed while setting the temperature of the first stage non-contacting heater at from 170 to 300°C. Meanwhile, an appropriate heater temperature is based on a commercially available false-twist texturing machine (216 spindles, Model HTS-15V, manufactured by Teijin Seiki), wherein such a specification as a non-contacting length of from 1.0 to 1.5 m and a yarn velocity of 800 m/min or more is assumed. Therefore, it is a matter of course that a preset temperature should be adjusted suitably in such cases where a special heater is used or a texturing is performed at a hypervelocity.

Here, the first heater in a twisting area is one for improving drawing property and false-twist texturing property

(twistability) of an undrawn yarn. When the temperature thereof is a temperature less than 170°C in the case of a non-contacting heater, twistability lowers and the intended crimp of the invention can not be given, to result in paper-like feeling when the yarn is formed into a woven or knit fabric. Further, yarn breakage and fluff at drawing and false-twist texturing occur frequently, and a crimp spot and dyeing spot at dyeing tends to occur, unpreferably. On the other hand, when the temperature of the first heater exceeds 300°C, single filament breakage tends to occur at drawing and false-twist texturing, in particular, single filament breakage tends to occur for an undrawn yarn (B') on a high elongation percentage side, to give a polyester composite false-twist textured yarn having a lot of fluff, unpreferably. Depending on the type of drawing and false-twist texturing machines, a first stage heater may be divided into a first half section and a latter half section. In the method of the invention, the first half and latter half sections of the first stage heater may be set at the same temperature.

The heat treatment time of a yarn in the first stage heater may be approximately set depending on the type of a heater, length and temperature thereof, and the like. However, a too short heat treatment time tends to results in an insufficient crimp percentage, and to generate a drawn false-twist yarn breakage, fluff of a false-twist textured yarn, and a dyeing

spot for woven or knit fabric due to tension variation. On the other hand, a too long heat treatment time tends to result in a too large crimp percentage. Consequently, in the case where the heat treatment is performed with a non-contact type heater, usually, the range of from 0.04 to 0.12 second, in particular the range of from 0.06 to 0.10 second is appropriate.

Regarding the draw ratio at texturing, the area of from 1.4 to 2.4 is the optimal zone. In a ratio outside this area, on a lower ratio side, surging and heat set spot due to yarn sway occur, and, on a higher ratio side, flatness of a textured yarn proceeds to generate texturing fluff, unpreferably.

Regarding a false-twist count, when the fineness of a composite false-twist textured yarn is denoted by Y (dtex), the count is set in the range of $[(15000 \text{ to } 35000)/Y^{1/2}]$ time/m, more preferably $[(20000 \text{ to } 30000)/Y^{1/2}]$ time/m. When a false-twist count is less than $15000/Y^{1/2}$ time/m, it becomes difficult to provide fine and solid crimp, and an obtained textile becomes paper-like to result in a hard feeling. When a false-twist count exceeds $35000/Y^{1/2}$ time/m, yarn breakage and fluff occur often.

The ultrafine polyester false-twist textured yarn of the present invention thus obtained can also keep performances such as soft feeling, warmth-retaining property, water-absorbing property, hygroscopic property, which belong to conventional ultrafine polyester false-twist textured yarns, and can give

polyester textiles also excellent in antistatic performance.

Example

Hereinafter, the present invention is described more specifically on the basis of Examples and Comparative Examples. Respective measured values shown in Examples are values that were measured by the following methods. Simply denoted "part" in Examples and Comparative Examples means "part by weight," if not otherwise specified.

(1) Intrinsic viscosity

A sample was dissolved in o-chlorophenol, and measurement was performed with an Uberode viscosity tube at 35°C.

(2) Transit angle

A yarn running on a false-twisting disc was photographed, then a transit angle θ of the yarn on respective false-twisting discs was actually measured on the photograph, and the average value of these measured values was defined as the transit angle.

(3) Crimp percentage

A sample of a polyester false-twist textured yarn was wound on a cassette frame with an applied tension of 0.044 cN/dtex to form a cassette of about 3300 dtex. To one end of the cassette, two weights of 0.0177 cN/dtex and 0.177 cN/dtex were loaded, and length S0 (cm) after the lapse of 1 minute was measured. Subsequently, in a state where the weight of

0.177 cN/dtex had been removed, the sample was treated in boiling water at 100°C for 20 minutes. After the boiling water treatment, the weight of 0.0177 cN/dtex was removed. The sample was air dried for 24 hours in a free state, to which weights of 0.0177 cN/dtex and 0.177 cN/dtex were loaded again, and length S1 (cm) after the lapse of 1 minute was measured. Subsequently, the weight of 0.177 cN/dtex was removed, and length S2 after the lapse of 1 minute was measured. A crimp percentage was calculated according to the following calculating formula, and the average value of 10 measured values was used.

Crimp percentage (%)=[(S1-S2)/S0] × 100

(4) Feeling

The false-twist textured yarn of the invention was used for forming a textile, which was classified into following levels 1 to 3 according to organoleptic tests by authorities. (Soft feeling)

Level 1: exerting soft and flexible feeling

Level 2: exerting a slightly poor soft feeling, but repulsion power can be felt

Level 3: giving desiccated feeling or hard feeling

(5) Count of fluff

Generated fluffs was counted for a polyester false-twist textured yarn sample by performing continuous measurement with a fluff counter type DT-104 manufactured by Toray at a velocity

of 500 m/min for 20 minutes, and was denoted by fluff counts per sample length of 10000 meters.

(6) Test method of charging property

(Measurement method of friction-charged electrostatic potential)

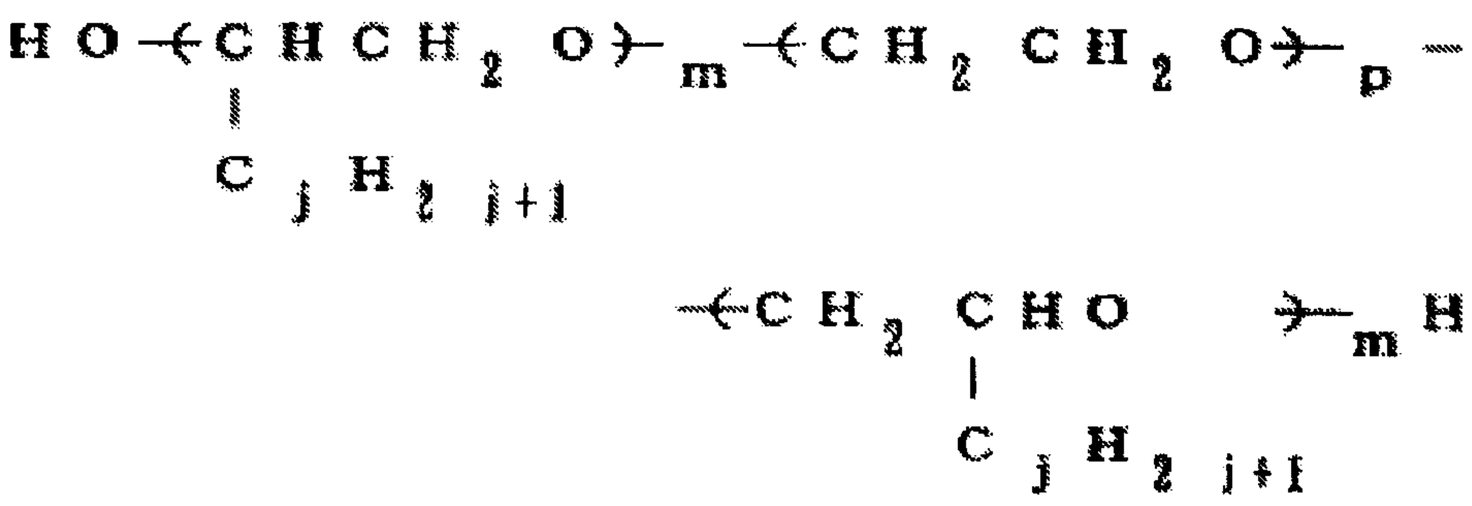
A test piece was scrubbed with a friction cloth while rotating the piece, and generated friction-charged electrostatic potential was measured. It follows the L1094 charging property test method B method (friction-charged electrostatic potential measurement method). An antistatic effect was exerted when a friction-charged electrostatic potential was about 2000 V or less (preferably 1500 V or less).

Example 1

Into an ester exchange reaction can, 100 parts of dimethyl terephthalate, 60 parts of ethylene glycol, 0.06 part (0.066% by mol relative to dimethyl terephthalate) of calcium acetate monohydrate, and 0.013 part (0.01% by mol relative to dimethyl terephthalate) of cobalt acetate tetrahydrate as an orthochromatic agent were put. The temperature of these reaction materials was raised from 140°C to 220°C over 4 hours under a nitrogen atmosphere to subject the materials to an ester exchange reaction, while distilling methanol that generated in the reaction can out of the reaction system.

After the termination of the ester exchange reaction, to the reaction mixture, 0.058 part (0.080% by mol relative

to dimethyl terephthalate) of trimethyl phosphate as a stabilizer and 0.024 part of dimethylpolysiloxane as a defoaming agent were added. Next, after 10 minutes, to the reaction mixture, 0.041 part (0.027% by mol relative to dimethyl terephthalate) of antimony trioxide was added, the temperature of which was raised, at the same time, to 240°C while distilling excess ethylene glycol, and subsequently the reaction mixture was moved to a polymerization reaction can. Next, the pressure was reduced from 760 mmHg to 1 mmHg and, simultaneously, the temperature was raised from 240°C to 280°C over 1 hour and 40 minutes, to subject the mixture to a polycondensation reaction, followed by adding 4 parts of water-insoluble polyoxyethylene-based polyether represented by the following formula and 2 parts of sodium dodecylbenzenesulfonate under vacuum, which was subjected to an additional polycondensation reaction for 240 minutes, followed by adding 0.4 part of IRGANOX™ 1010 manufactured by Ciba-Geigy as an oxidation inhibitor under vacuum, which was subjected to a further additional polycondensation reaction for 30 minutes. In the polymerization reaction process, an antistatic agent was added, and an obtained polymer was formed into a chip with an ordinary method.



(wherein j is an integer of from 18 to 28 and is 21 as an average value; P is 100 as an average value; and m is 5 as an average value. Here, the average value means an average value of the number of oxyethylene units in copolymerized polyoxyethylene-based polyether composed of two kinds or more of oxyethylene units).

The intrinsic viscosity of the obtained polymer was 0.657, and the softening point was 258°C.

The obtained chip, and a usual polyethylene terephthalate chip that contained 0.4% by weight of titanium oxide fine particles and had an intrinsic viscosity of 0.65 were dried according to an ordinary method. Then each of chips was molten with a spinning apparatus by an ordinary method, which was passed through a spinning block and guided into a spin pack for a composite filament. Filaments from a spinneret having 72 pierced core-sheath type composite circular discharge openings that was mounted on the spin pack were cooled and solidified with cooling wind from a spinning cylinder of an ordinary cross flow type, and converged into one yarn while being given a spinning oil agent. The yarn was pulled out at

a velocity of 3000 m/min (draft magnification: 200), to give a polyester core-sheath type composite undrawn yarn of 140 dtex/72filament, which had a core/sheath area ratio of 70:30.

The polyester undrawn yarn was set on a 216-spindle HTS-15V manufactured by TEIJIN SEIKI, which was given air interlacing with a flow volume of 60 nL/min so as to give a interlace degree of 50 points/m while allowing the yarn to pass through an interlace nozzle having a pressured air-blowing opening with a diameter of 1.8 mm in the first stage and latter stage, as shown in Fig. 1 (4, 4'). Then, while setting conditions so that a draw ratio was 1.60 and first heater (non-contact type) temperature was 250°C, and using an urethane disc having a diameter of 60 mm and thickness of 9 mm as a false-twisting disc, drawing and false-twist were performed at a transit angle of 43 degrees so that false-twist count × (false-twist yarn fineness (dtex))$^{1/2}$ was near 26000, which was wound in a cheese-like figure at a velocity of 800 m/min, to give a polyester false-twist textured yarn of 84 dtex/72filament (average single filament fineness of 1.17 dtex) having a core/sheath ratio of 70:30.

These polyester false-twist textured yarns were used for producing a tubular knitted fabric, and antistatic property was measured. The friction-charged electrostatic potential of the obtained polyester false-twist textured yarn was 1200 V. In addition, these polyester false-twist textured yarns

were formed into a woven fabric according to an ordinary method, for which the grade was organolepticly evaluated, to show that the fabric had a very deep and high-grade feeling, and exerted soft feeling. The results are shown in Table 1.

Comparative Example 1

Polyethylene glycol was reacted with acrylonitrile in the presence of an alkali catalyst, which was further subjected to a hydrogen addition reaction, to synthesize polyethylene glycol diamine (number average molecular weight of 4000) that included an amino group at 97% or more of both terminals. The diamine was subjected to salt reaction with adipic acid according to an ordinary method to give a 45% aqueous solution of polyethylene glycol diammonium adipate.

Into a concentration can having a volume of 2 m^3, 200 kg of the 45% aqueous solution of polyethylene glycol diammonium adipate, 120 kg of a 85% caprolactam aqueous solution, and 16 kg of 40% hexamethylenediammonium isophthalate aqueous solution were put. They were heated for about 2 hours until the interior temperature was 110°C at normal pressure to be concentrated to a concentration of 80%. Subsequently, the concentrated liquid was moved to a polymerization can having a volume of 800 litters. Then, heating was started while flowing nitrogen into the polymerization can at 2.5 l/min.

At the time when the interior temperature became 120°C,

5.2 kg (2.5% by weight) of sodium dodecylbenzenesulfonate and 5.2 kg (2.5% by weight) of 1,5,5-trimethyl-2,4,6-tri(3,5-di-tert-butyl-4-hydroxybenzene)benzene (TTB) were added, followed by starting the stirring and heating of the system for 18 hours until the interior temperature became 245°C to complete polymerization. After the end of the polymerization, it was pelletized according to an ordinary method to give a pellet consisting of a block polyetheramide composition.

The pellet consisting of a block polyetheramide composition was blended to usual polyethylene terephthalate chip having an intrinsic viscosity of 0.65 that did not contain titanium oxide so as to give 1.4% by weight. Then, a polyester false-twist textured yarn of 84 dtex/72filament (average single filament fineness of 1.17 dtex) having a core/sheath ratio of 70:30 was obtained in the same way as in Example 1, except that the above-described blended material was used for a core component. A textile consisting of the fiber showed soft and excellent feeling similar to that in Example 1, however, it had such a very poor friction-charged electrostatic potential as 3400 V. Results are shown collectively in Table 1.

Examples 2 and 3

Each of core-sheath type composite polyester false-twist textured yarns of 56 dtex/72filament (average single filament

fineness of 0.78 dtex) and 111 dtex/72filament (average single filament fineness of 1.54 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Example 1 except for changing the polymer discharging amount. Textiles made of these yarns had both excellent friction-charged electrostatic potential and feeling. Results are shown collectively in Table 1.

Comparative Examples 2 and 3

Each of core-sheath type composite polyester false-twist textured yarns of 56 dtex/72filament (average single filament fineness of 0.78 dtex) and 111 dtex/72filament (average single filament fineness of 1.54 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Comparative Example 1 except for changing the polymer discharging amount. Textiles made of these yarns had such excellent feeling as that in Example 1, however, they had a high friction-charged electrostatic potential and were unsuitable for practical use. Results are shown collectively in Table 1.

Comparative Example 4

A core-sheath type composite polyester false-twist textured yarn of 133 dtex/72filament (average single filament fineness of 1.85 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Example 1 except for increasing the polymer discharging amount. A textile made of the yarn had such excellent friction-charged electrostatic potential

as that in Example 1, however, it had a hard feeling and was unsuitable for practical use. Results are shown collectively in Table 1.

Comparative Example 5

A core-sheath type composite polyester false-twist textured yarn of 84 dtex/36filament (average single filament fineness of 2.33 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Example 1 except for replacing the spinneret with one having 36 holes. A textile made of the yarn had such excellent friction-charged electrostatic potential as that in Example 1, however, it had a hard feeling and was unsuitable for practical use. Results are shown collectively in Table 1.

Comparative Example 6

A core-sheath type composite polyester false-twist textured yarn of 133 dtex/72filament (average single filament fineness of 1.85 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Comparative Example 1 except for increasing the polymer discharging amount. A textile made of the yarn had a friction-charged electrostatic potential which was improved as compared with that in Comparative Example 1 but still insufficient, and, in addition, it had a hard feeling and was unsuitable for practical use. Results are shown collectively in Table 1.

Comparative Example 7

A core-sheath type composite polyester false-twist textured yarn of 84 dtex/36filament (average single filament fineness 2.33 dtex) having a core-sheath ratio of 70:30 was obtained in the same way as in Comparative Example 1 except for replacing the spinneret with one having 36 holes. A textile made of the yarn had a friction-charged electrostatic potential which was improved as compared with that in Comparative Example 1 but still insufficient, and, in addition, it had a hard feeling and was unsuitable for practical use. Results are shown collectively in Table 1.

Table 1

	Draft magnification (times)	Single filament fineness (dtex)	Crimp percentage (%)	Fluff (numbers/ 10000m)	Friction-charged electrostatic potential (V)	Feeling (level)
Exam 1	200	1.17	15	20	1200	1
Exam 2	300	0.78	18	30	1200	1
Exam 3	180	1.54	20	15	1100	1
Comp Ex 1	200	1.17	20	15	3400	1
Comp Ex 2	300	0.78	15	30	4000	1
Comp Ex 3	180	1.54	15	20	2700	1
Comp Ex 4	120	1.85	20	13	1000	3
Comp Ex 5	185	2.33	25	10	1000	3
Comp Ex 6	120	1.85	18	10	2000	3
Comp Ex 7	185	2.33	25	10	2000	3

* PEG (molecular weight of 20000)
** Sodium dodecylbenzenesulfonate

Claims

1. An antistatic core-sheath type polyester ultrafine false-twist textured yarn characterized by being a false-twist textured core-sheath type composite filament, wherein:

the core part of the core-sheath type composite filament is formed from an antistatic polyester composition A containing the following (a) and (b), as an antistatic agent, relative to 100 parts by weight of aromatic polyester,

(a) from 0.2 to 30 parts by weight of polyoxyalkylene-based polyether, and

(b) from 0.05 to 10 parts by weight of an organic ionic compound that is substantially nonreactive with the polyester; and

the sheath part is formed from an aromatic polyester composition B, and

the core-sheath type composite filament satisfies simultaneously the following (1) to (3) conditions:

(1) a single filament fineness of the false-twist textured yarn is 1.6 dtex or less,

(2) a crimp percentage of the false-twist textured yarn is from 3 to 30%, and

(3) a ratio SA:SB of a core part area SA and a sheath part area SB is in the range of from 5:95 to 80:20.

2. The antistatic core-sheath type polyester ultrafine false-twist textured yarn according to claim 1, wherein the aromatic polyester composition B is a polyester composition that comprises a delustering agent in from 0.01 to 10 by weight relative to 100 parts by weight of the aromatic polyester.

3. The antistatic core-sheath type polyester ultrafine false-twist textured yarn according to claim 1, wherein the delustering agent is titanium dioxide.

4. A method for producing an antistatic core-sheath type polyester ultrafine false-twist textured yarn wherein, when melt-spinning a core-sheath type composite filament having a core part that is formed from an antistatic polyester composition A containing the following (a) and (b), as an antistatic agent, relative to 100 parts by weight of aromatic polyester,

(a) from 0.2 to 30 parts by weight of polyoxyalkylene-based polyether, and

(b) from 0.05 to 10 parts by weight of an organic ionic compound that is substantially nonreactive with the polyester; and a sheath part that is formed from an aromatic polyester composition B,

a filament is drawn at a ratio of drawing velocity to discharge velocity at spinning in the range of from 150 to

less than 800, and is then subjected to false-twist texturing.

5. The method for producing an antistatic core-sheath type polyester ultrafine false-twist textured yarn according to claim 4, wherein the aromatic polyester composition B is a polyester composition that comprises a delustering agent in from 0.01 to 10 by weight relative to 100 parts by weight of the aromatic polyester.

6. The method for producing an antistatic core-sheath type polyester ultrafine false-twist textured yarn according to claim 4, wherein the delustering agent is titanium dioxide.

7. An antistatic water-repellent woven fabric wherein the water-repellant woven fabric is formed by subjecting a woven fabric comprising a core-sheath type polyester false-twist textured yarn to water-repellent processing, wherein the core-sheath type polyester false-twist textured yarn is the antistatic core-sheath type polyester ultrafine false-twist textured yarn according to any one of claims 1 - 3.

Fig. 1

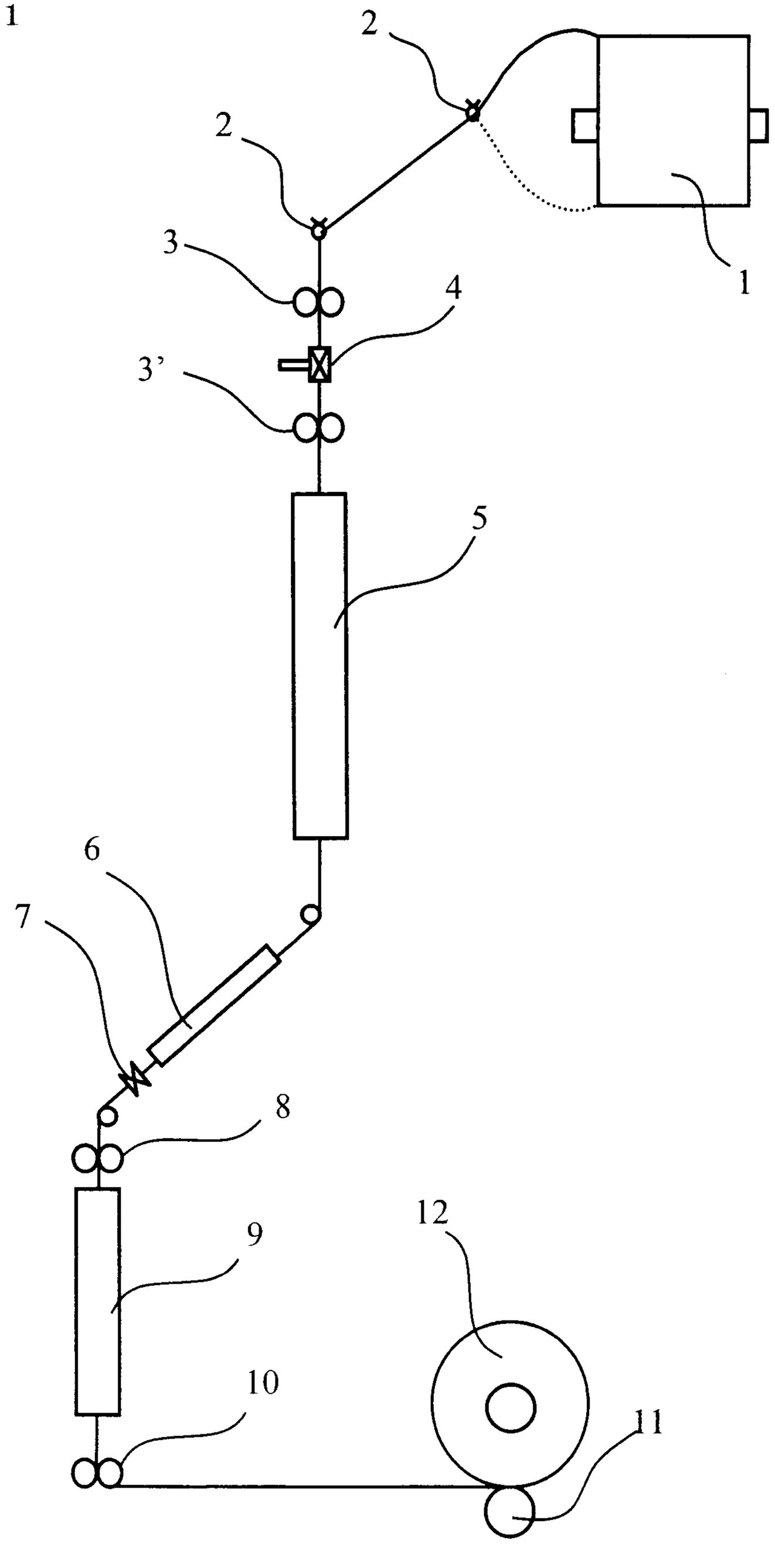
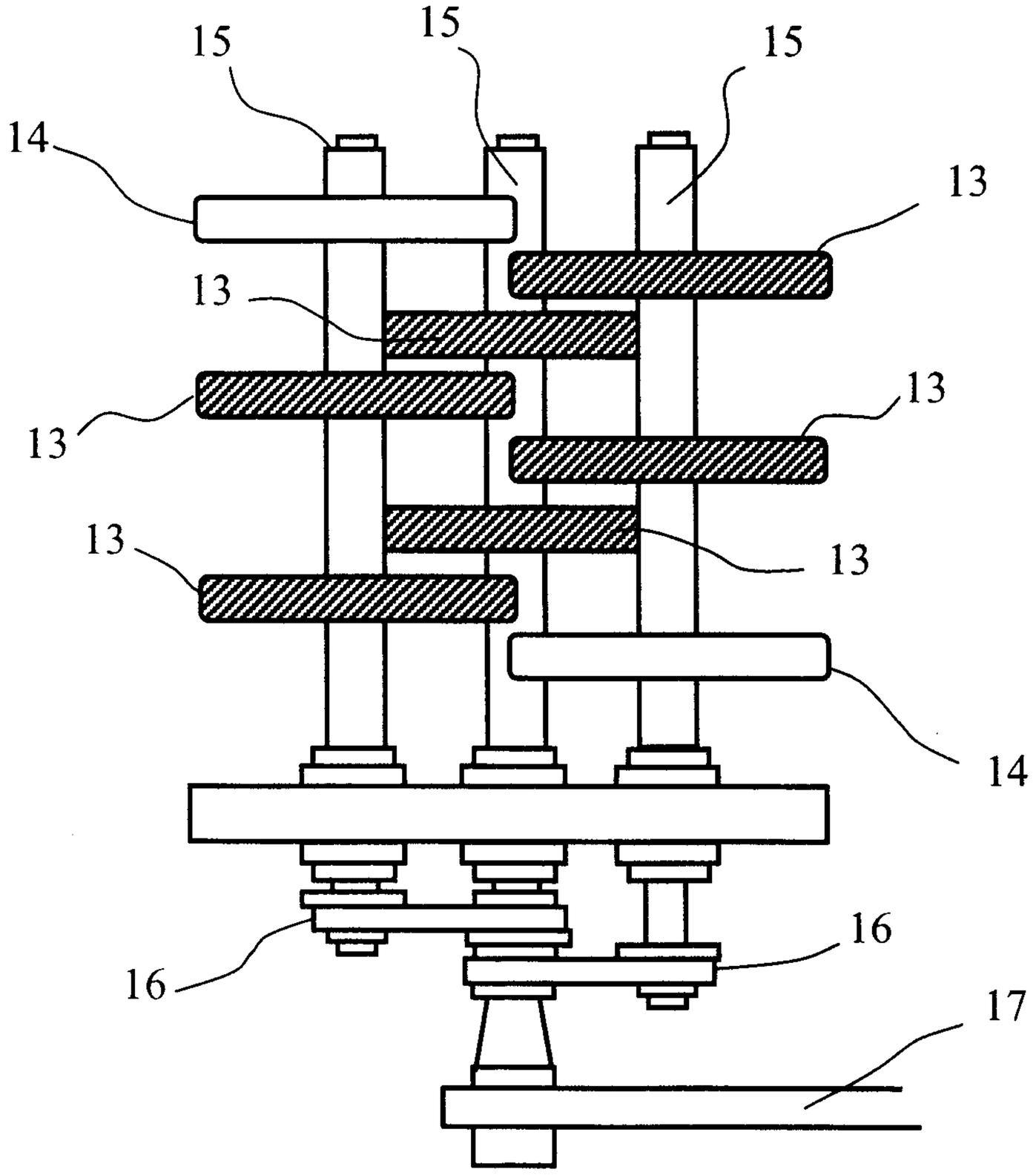
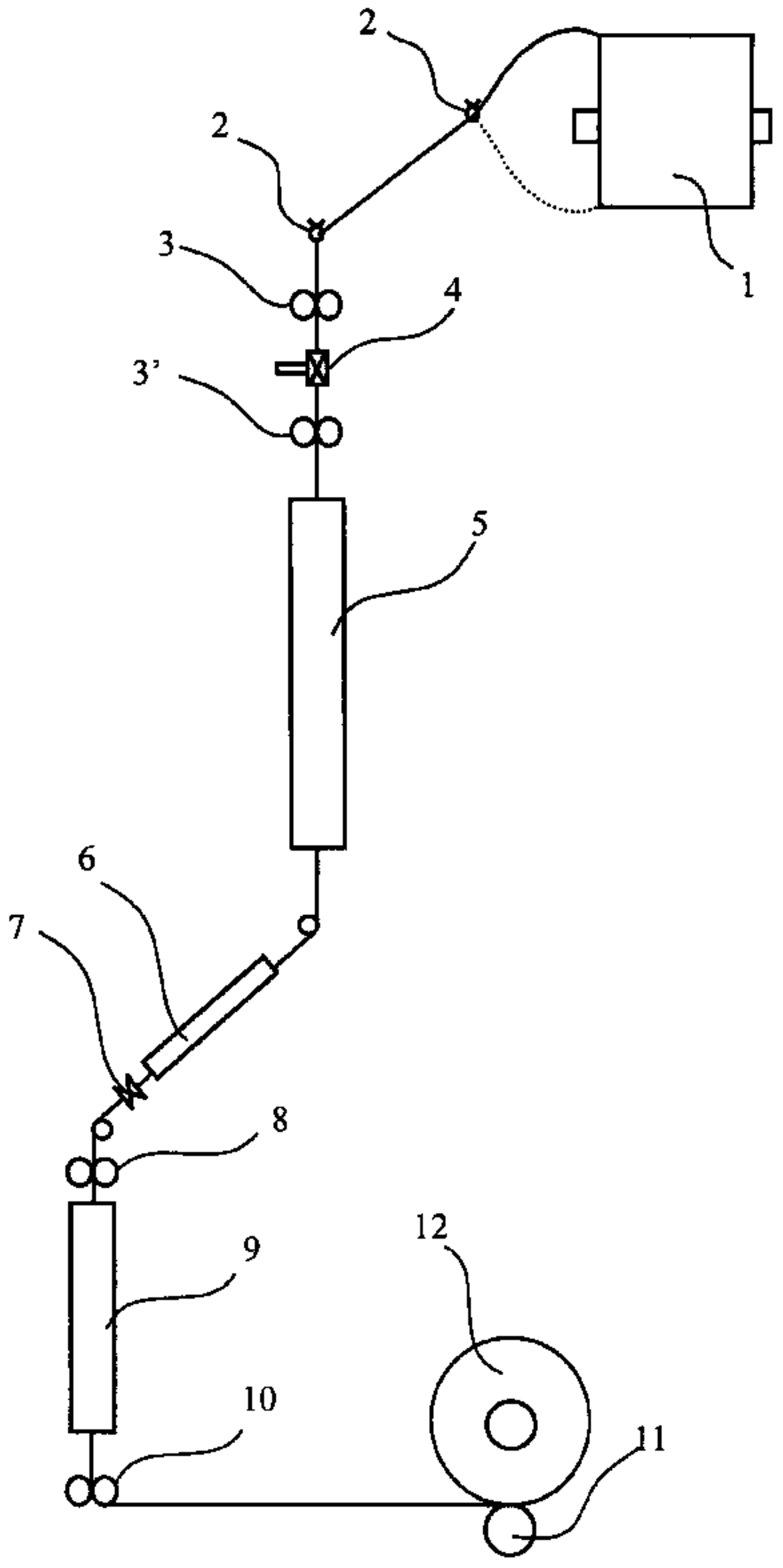


Fig. 2

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