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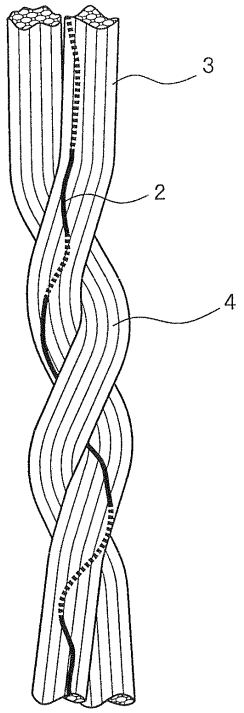
# (54) ELASTIC COMPOSITE TWIST YARN AND PROCESS FOR PRODUCING SAME, AND PILE TEXTILE PRODUCT OBTAINED USING SAID ELASTIC COMPOSITE TWIST YARN

(57) An elastic composite twisted yarn includes a covered elastic yarn (2), having a core yarn (21) formed of an elastic yarn and a sheath yarn 22 formed of a thermoplastic multi filament, and first and second low stretch yarns (3, 4) formed of a thermoplastic multi-filament yarn or a spun yarn. The covered elastic yarn (2) is drawn at a predetermined draw ratio to be inserted into the first low stretch yarn 3 in a combined yarn state. The yarn in the combined yarn state and the second low stretch yarn (4) are combined and twisted to obtain an elastic composite twisted yarn. A plurality of heteromorphic microloops formed of a constituent single fiber of the sheath yarn (22), which appears during the relaxation by a contractile force of the covered elastic yarn (2), protruding from the core yarn (21) to a diameter direction, is usually incorporated into a constituent single fiber of the first low stretch yarn (3) and thermally set. It is possible to obtain an elastic composite twisted yarn and floor coverings, which drastically reduce the decline of the crimp, have a feel of expansion for the yarn itself and an appropriate soft texture in addition to the beauty of the appearance, have excellent recoverability to immediately return to the original shape even when the volume is temporarily decreased, and furthermore have excellent elasticity and design characteristics.

FIG. 3

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## Description

### TECHNICAL FIELD

**[0001]** The invention relates to: an elastic composite twisted yarn in which a shrinkable yarn obtained by inserting a covered elastic yarn having contractibility into one of two or more low shrinkable yarns and the other low shrinkable yarn are twisted together to be combined; a method for preparing the elastic composite twisted yarn; and a pile fiber product, such as various floor coverings formed of pile fabric and the like represented by a carpet or dust control mat, or an interior automotive trim, or the like, in which the elastic composite twisted yarn is used.

### BACKGROUND ART

**[0002]** Examples of representative products using pile fabric including a cut pile include various floor coverings such as a carpet, dust control mat, or the like (tuft, Wilton, Axminster, and sewing machine tuft), and an interior automotive trim. Various pile yarns have been used for these products, but recently, two or three multi-filament yarns formed of a thermoplastic synthetic fiber material, such as polyester, polypropylene, nylon, and the like, have been frequently used. It has been commonly implemented to combine and twist these plurality of multi-filament yarns or to subject multi-filament fibers to interlacing processing. In this case, two or three strands of yarn having different colors or the same color are usually used, but the same material basically having common workability or appropriate for a texture of a desired floor covering is generally used.

**[0003]** In this case, in order to obtain excellent functions, physical properties and the like found in a spun yarn, it has been considered to mix a fiber formed of another kind of synthetic resin having benefits of the spun yarn. For example, according to Japanese Patent Application Laid-Open No. 61-13265 (Patent Document 1), for the purpose of providing a method for preparing a large interlaced composite yarn having both durability and bulk retention properties due to abundant bulk properties and a uniform form of yarn, an interlaced composite yarn is prepared. The interlaced composite yarn is prepared by subjecting at least one fiber yarn which has a single fiber fineness of 5 d or more and a total denier of 500 d or more and at least one crimp-processed yarn in the combined yarn state to fluid interlacing treatment, drawing the corresponding yarn at a draw ratio of 1.05 times or more, and subsequently performing relaxation treatment. Here, examples of the crimp-processed yarn include an extrusion processed yarn, an asymmetric heating friction processed yarn, an forming-processed yarn (knit de knit), a false twist-processed yarn (including yarn which is twisted, thermally set, and untwisted), a crimped yarn by abrasion, a composite crimped yarn (potentially crimped yarn), an DTY yarn (yarn obtained by subjecting an undrawn yarn spun at high speed to draw false twist processing), and the like.

**[0004]** Further, for example, according to Japanese Patent Application Laid-Open No. 06-10225 (Patent Document 2), disclosed is a composite yarn in which one or more strands of spun yarn, having parallel bundles in most of the single fiber bundles substantially forming a core and being partially fasciated by winding the single fiber to the fiber bundles of the core, are aligned with at least one filament yarn to be combined and then twisted to obtain a twisted yarn. In the composite yarn, it is preferred that the filament yarn has a thermal shrinkage ratio or a ratio of expansion and contraction higher than that of the spun yarn.

**[0005]** The composite yarns thus obtained are collected with filament yarns to be a combined yarn while a fasciated spun yarn is formed. Thus, the composite yarns may restrain the filament yarns without impairing thermal shrinkage characteristics or shrinkage characteristics of the filament yarns and prevent yarns from being cut due to missing fibers during a yarn twisting operation and a spinning and weaving operation. Since the composite yarns have both rough and hard texture and bulky texture, not only a yarn for a general knitted fabric but also a yarn with a unique texture to be used for a pile fabric, a carpet, a nap-raised fabric and the like can be obtained.

### PRIOR ART DOCUMENT

### PATENT DOCUMENTS

**[0006]**

Patent Document 1: Japanese Patent Application Laid-Open No. 61-13265
Patent Document 2: Japanese Patent Application Laid-Open No. 06-10225

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

**[0007]** However, for the composite yarn proposed by Patent Document 1, most of the bulkiness of the yarn depends on crimp-processed yarns. Thus, in the process of preparing the composite yarn, tension and thermal shrinkage are repeated at all times in most cases. Even if some of the raw material yarns of the composite yarn have been subjected to crimp processing, the form produced by the crimp processing previously performed easily collapses due to repetitions of heating and cooling during the dyeing process, drying process, or the like, or tension and relaxation during the yarn twisting process, winding process, and further the drawing process, and the like. Accordingly, it is difficult to recover the fiber form imparted by the crimp processing at a 100% level. This is one of the reasons why the sales expansion of polypropylene fibers and polyester fibers which are expected to be one of main raw materials for floor coverings is hindered.

**[0008]** Meanwhile, in the composite yarn proposed by Patent Document 2, the composite yarn itself has bulkiness but an extremely strong rough and hard texture in some cases as described in Patent Document 2. Particularly, when used as a pile yarn of a pile product such as various floor coverings, an interior automotive trim, and the like, the composite yarn is not appropriate in terms of texture. Moreover, when fiber yarns used depend only on a bulky texture caused by a general yarn prepared from a general thermoplastic synthetic fiber or a crimp-processed fiber, contractibility or stretch properties by the yarns is insufficient for the reason as described above, and a feel of expansion or texture and an elastic recovery index when a pile product is prepared may not be expected very much.

**[0009]** For these reasons, the composite yarns disclosed in Patent Document 1 and Patent Document 2 do not meet the volume requirements needed particularly for floor coverings, and the beauty of the appearance also tends to deteriorate.

**[0010]** In particular, with respect to polypropylene or polyester, which is one of the main raw materials of a yarn for floor covering, the trend is apparent and the same phenomenon occurs in other synthetic fibers even though there is a difference in degree.

**[0011]** Further, from the viewpoint of design characteristics, the form of yarn subjected to a so-called freeze processing of curve-fixing all of the processed yarn in the form of waves during the thermal setting forms a market which is differentiated from a generally processed yarn. However, even in the freeze-processed yarn, a two-dimensional wave shape is mechanically imparted to a linear multi-filament yarn and the shape is memorized during the thermal setting. Due to repetitive tension added while being subjected to subsequent various processes, a shape to be recovered easily declines as in the generally crimped yarn described above, a two-dimensional wave shape fixed during the thermal setting is also easily collapsed. Accordingly, not only design characteristics but also bulkiness are gradually affected, and as a result, a soft feel does not last long.

**[0012]** The invention has been made in an effort to solve the problems in the related art. An object of the invention is to develop: an elastic composite twisted yarn, especially a pile yarn to be used in floor coverings, which drastically reduces decline in the crimp, adds beauty of the appearance, has a swelling property and soft texture, has excellent recoverability to immediately return to the original shape even when the bulkiness is temporarily decreased by intensely applying pressure repeatedly over a long period, always maintains voluminousness, and has excellent elasticity and design characteristics; a method for preparing the elastic composite twisted yarn; and a high-quality pile fiber product using the elastic composite twisted yarn.

MEANS FOR SOLVING THE PROBLEMS

**[0013]** The object is achieved by an elastic composite twisted yarn which is characterized to include, as a basic configuration of the invention, a covered elastic yarn obtained by covering a core yarn, which is formed of an elastic yarn having self-stretchability, with a thermoplastic multi-filament serving as a sheath yarn, and two or more low stretch yarns including first and second low stretch yarns formed of a thermoplastic multi-filament yarn or a spun yarn. The elastic composite twisted yarn is formed by inserting the covered elastic yarn into the first low stretch yarn under drawing at a predetermined draw ratio and twisting the second low stretch yarn and the first low stretch yarn with the covered elastic yarn inserted. In the elastic composite twisted yarn, a plurality of heteromorphic micro-loops formed of a constituent single fiber of the sheath yarn, which appears during the relaxation by the contractile force of the covered elastic yarn, protruding from the core yarn to a diameter direction is incorporated into constituent single fibers of the first and second low stretch yarns and thermally set.

**[0014]** According to a preferred embodiment, the core yarn of the covered elastic yarn is a polyurethane yarn or a crimp-processed yarn. Further, as the core yarn, other than the polyurethane yarn, for example, a natural or synthetic rubber yarn, a thermoplastic elastomer yarn, and the like may be used. In addition, it is preferred that the sheath yarn of the covered elastic yarn and the first and second low stretch yarns are a multi-filament formed of the same or different

material(s), and it is more preferred that two or more strands of the covered elastic yarns are inserted into the first low stretch yarn. Furthermore, it is preferred that the thermoplastic multi-filament is formed of any one of polypropylene, polyester and polyamide, or a combination of them, but may be composed of another thermoplastic synthetic fiber.

**[0015]** Further, it is preferred that the fineness of a single fiber constituting the sheath yarn is equivalent to or less than that of a single fiber constituting the first and second low stretch yarns. In addition, the number of twists of the elastic composite twisted yarn as a final product after the thermal setting is preferably between 48 and 430 times/m while shrinking.

**[0016]** In addition, the elastic composite twisted yarn is efficiently prepared by the following method for preparing the elastic composite twisted yarn according the invention.

**[0017]** That is, the basic sequence of the method for preparing the elastic composite twisted yarn according to the invention is characterized to include: aligning two or more strands of covered elastic yarns, which are obtained by covering a core yarn formed of an elastic yarn having a self-stretchability with a thermoplastic multi-filament as a sheath yarn under tension, with a first low stretch yarn formed of a thermoplastic multi-filament yarn or a spun yarn and winding a rotation member which intermittently rotates in one direction with the strands at a predetermined length to pass the strands through a rotatable yarn guiding member such as, for example, a spindle which is disposed adjacent to the rotation member and to draw the strands toward a cording point disposed on the upper side; accommodating a second low stretch yarn formed of a thermoplastic multi-filament yarn or a spun yarn in a fixed pot disposed at an upper portion of the rotation member; taking the corresponding second low stretch yarn out to be drawn toward the upper cording point from the center of the pot; twisting and combining a combined yarn of the covered elastic yarn drawn upwardly and a first non-stretch yarn with a second low stretch yarn drawn upwardly from the shaft center of the pot while forming a balloon between the rotatable yarn guiding member and the cording point; and winding the composite twisted yarn which has passed through the cording point.

**[0018]** Here, the elastic composite twisted yarn according to the invention may be prepared by continuously performing a twisted yarn processing using a single yarn twister, but may also be prepared by individually performing each of the above-described sequences and appropriately combining the sequences after each sequence is performed as long as the sequence may be performed without considering the rationality.

**[0019]** The method for preparing the elastic composite twisted yarn preferably includes adjusting, by the rotation member, tension of the covered elastic yarn and the first low stretch yarn, which are wound around the rotation member to be in a combined yarn state, and adjusting tension of the second low stretch yarn drawn from the inside of the pot between the pot and the cording point, and may further include relaxing the wound composite twisted yarn, followed by thermal setting. The elastic composite twisted yarn thus obtained is optimally used as a pile yarn of a pile fiber product. The representative products of the pile fiber product include various floor coverings or an interior automotive trim as descried above, but may be of course applied to other products.

## EFFECT OF THE INVENTION

**[0020]** The elastic composite twisted yarn according to the invention is wound around a cheese after twisting a combined yarn and second low stretch yarn, which is one of the first and second stretch yarns, while maintaining the tension state of the combined yarn. The combined yarn is obtained by causing at least two covered elastic yarns, which include a core yarn in a state that an elastic yarn having a self-stretchability is drawn at a required draw ratio and include a sheath yarn in which a thermoplastic synthetic multi-filament yarn is wound around the core yarn, to be aligned with and inserted into a first low stretch yarn, which is one strand of first and second low stretch yarns. Subsequently, thermal setting is performed while the elastic composite twisted yarn wound around the cheese is released and simultaneously relaxed.

**[0021]** During the previous yarn twisting process of subjecting the elastic composite twisted yarn to thermal setting in this way, the sheath yarn formed of a plurality of low-stretch multi-filaments in the covered elastic yarn is repeatedly tensioned and relaxed by adjustment of tension caused by an intermittent rotation of the rotation member and twisting caused by ballooning, and thus an elastic yarn as a core yarn shrinks during the relaxation. While shrinking, a constituent single yarn of the sheath yarn formed of the multi-filament wound around the core yarn forms a plurality of micro loops in a variety of sizes according to the longitudinal direction of the core yarn and randomly extends in a diameter direction from the core yarn as a center. In this case, the core yarn of the covered elastic yarn formed of the core yarn and the sheath yarn is not completely buried in the core of the sheath yarn, and a portion exposed to the outside of the sheath yarn is locally present. Meanwhile, during the relaxation in the yarn twisting process, the first low stretch yarn which is a constituent yarn of the combined yarn is also slackened in a relaxed state. During the relaxation, the micro loops of the covered elastic yarn and the slackened portion of a constituent single yarn of the first low stretch yarn are entangled. Further, if twisting the combined yarn and the second low stretch yarn is initiated at a cording point (joint point), the micro loops of the covered elastic yarn cold also be entangled with the constituent single yarn of the second low stretch yarn and combined with each other.

**[0022]** During the repetition of relaxation and tension in the yarn twisting process, the covered elastic yarn, which is

one of constituent yarns of the combined yarn, is repeatedly stretched and single fibers of multi-filament, which are constituent yarns of the covered elastic yarn and the first and second low stretch yarns, are locally entangled with each other to be combined. The shape of the yarn is fixed by the subsequent relaxation and thermal setting, and thus the elastic composite twisted yarn of the invention, which is a complete yarn after the thermal setting, is stretched and shrinks in response to the stretch and shrinkage of the covered elastic yarn. In this case, only the covered elastic yarn without the first and second low stretch yarns does not shrink alone, three yarns behave as one body, and the first and second low stretch yarns greatly stretch following the stretching of the covered elastic yarn. As a result, when cut piles are formed by cutting, for example, pile tips of a pile fiber product which uses the elastic composite twisted yarn of the invention as a pile yarn, the entire cut tips shrink together in response to the shrinkage of the elastic yarn.

**[0023]** Here, if a difference in thermal shrinkage ratios between the first low stretch yarn and the second low stretch yarn occurs, for example, the first low stretch yarn greatly shrinks during the thermal setting, such that the first low stretch yarn and the second low stretch yarn tend to become a core and a sheath, respectively, and thus the entire elastic composite twisted yarn presents a shape close to a three-dimensional coil. For that reason, the cut pile yarn in a relaxed state entirely shrinks in a longitudinal direction without leaving only the first and second low stretch yarns at the cut end and becomes fluffy to have a bent and/or twisty shape. Accordingly, the elastic recovery ratio is significantly improved compared to a pile caused by a pile yarn in the related art.

**[0024]** That is, a floor covering or interior automotive trim according to the invention using the elastic composite twisted yarn has a level of elastic recovery force, which may not be expected from the same kind of product in the related art, and the level of elastic recovery force is maintained over a long period. Thus, floor coverings, which are difficult to collapse even when repeated pressure from the above is applied and where the depression is not conspicuous, may be obtained. Furthermore, in addition to bulkiness resulting from the form of a yarn having a three-dimensional coil shape which the elastic composite twisted yarn according to the invention itself has, a beautiful and peculiar product expression may be obtained and high design properties may also be obtained.

**[0025]** As a result, in various floor coverings of a tuft carpet or pile carpet or an interior automotive trim, which may be obtained by using the elastic composite twisted yarn of the invention being used as a pile yarn or a cut pile yarn, bulkiness or voluminousness, which may not be obtained from floor coverings using a pile yarn or a cut pile yarn in the related art, may be obtained. Accordingly, a same level of volume can be obtained even though a weight per unit is reduced compared to that in the related art, and thus the resource savings and the ecology which are required under the modern economy are achieved.

**[0026]** Here, two or more strands of the covered elastic yarn which follow the first low stretch yarn are advantageous in that the contact area with the first and second low stretch yarns may be increased, and as a result, the multi-filament which is a covered yarn of the covered elastic yarn and the multi-filament of the first and second low stretch yarns may be frequently entangled and combined many times.

**[0027]** Further, the specific configuration and operational effects of the elastic composite twisted yarn according to the invention, the method for preparing the elastic composite twisted yarn, and a pile fiber product using the elastic composite twisted yarn will be described in more detail with reference to embodiments of the invention being described below.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0028]**

FIG. 1 is a partial three-dimensional view schematically illustrating a structural example of a covered elastic yarn which is one of original yarns of the elastic composite twisted yarn according to the invention at the time of initiating relaxation.

FIG. 2 is a partial three-dimensional view schematically illustrating a construction example of the covered elastic yarn while shrinking.

FIG. 3 is a partial three-dimensional view schematically illustrating a structural example of the elastic composite twisted yarn according to the invention at the time of initiating relaxation.

FIG. 4 is a partial three-dimensional view schematically illustrating a structural example of the elastic composite twisted yarn according to the invention while shrinking.

FIG. 5 is a front view illustrating an example of an apparatus for preparing the elastic composite twisted yarn according to the invention and an example of the preparation sequence.

## MODE FOR CARRYING OUT THE INVENTION

**[0029]** In the invention, main characteristics of the elastic composite twisted yarn are in the following five points.

1. In twisting a filament yarn which is generally used in carpets and an interior automotive trim, a highly elastic yarn having self-stretchability, such as a polyurethane yarn, a textured yarn having high bulkiness, and the like, is added to the filament yarns.
The textured yarn mentioned herein is a processed yarn having high self-stretchability, which has bulkiness higher than stretchability of the first and second low stretch yarns in the invention.
2. The highly elastic yarn is not, for example, a polyurethane yarn alone, but a covered elastic yarn having a polyurethane yarn as a core yarn which are covered with polypropylene, polyester, nylon, and the like serving as a sheath yarn.
3. The sheath yarn covering the highly elastic yarn being a core yarn is preferably white having high transparency or has the same color system as the main raw material in terms of dyeability, and the like.
4. The first and second low stretch yarns are preferably formed of the same material as the sheath yarn of the covered elastic yarn, and the material is preferably any one of polypropylene, polyester, and nylon. The covered elastic yarn is combined with the first low stretch yarn to produce a combined yarn. The second low stretch yarn is solely used to be twisted with the combined yarn.
5. The combined yarn of the covered elastic yarn and the first low stretch yarn is preferably in a state that shrinkage is caused by heat receiving, and the like after a covered elastic yarn is inserted.

**[0030]** Hereinafter, the invention will be described in detail with reference to the accompanying drawings based on representative embodiments.

**[0031]** FIGS. 1 and 2 schematically illustrate a structural example of a covered elastic yarn which is one of original yarns of the elastic composite twisted yarn according to the invention at the time of initiating relaxation and while shrinking. FIG. 3 schematically illustrates a structural example of the elastic composite twisted yarn according to the invention at the time of initiating relaxation. FIG. 4 schematically illustrates a structural example of the elastic composite twisted yarn while shrinking.

**[0032]** An elastic composite twisted yarn 1 according to the invention has a covered elastic yarn 2 having self-stretchability and at least first and second low stretch yarns 3 and 4, as illustrated in FIGS. 3 and 5.

**[0033]** For the covered elastic yarn 2, a highly elastic yarn is used as a core yarn 21, as illustrated in FIGS. 1 and 2, and the core yarn 21 is covered with a sheath yarn 22 formed of a multi-filament yarn including a thermoplastic resin. Further, in the following description, the covered elastic yarn 2 which is one of the constituent yarns of the elastic composite twisted yarn 1 is exemplified as a yarn having a polyurethane yarn as the core yarn 21 and a multi-filament yarn which is a low stretch yarn formed of a thermoplastic resin as the sheath yarn 22, but the covered elastic yarn 2 is not limited to this example. It is also possible to use a highly crimped yarn formed of, for example, polyamide 6 or polyamide 66 in the core yarn 21 in the case of a product which does not require stretchability very much. However, in that case, the same material as the core yarn 21 needs to be used in the sheath yarn 22, and the self-stretchability of the core yarn 21 needs to significantly exceed that of the constituent filament of the sheath yarn 22.

**[0034]** In the sheath yarn 22, a multi-filament formed of polypropylene, polyester, and polyamide is usually used, but a multi-filament formed of another thermoplastic synthetic resin may also be used depending on the purpose of use. These multi-filaments have preferably been subjected to a typical bulkiness processing or crimp processing. One strand of the covered elastic yarn 2 formed of the core yarn 21 and the sheath yarn 22 may be used, but in order to increase the contact area with the first and second low stretch yarns 3 and 4, it is preferred that two or more strands are used while the total fineness is controlled to be equal to that of one strand of the covered elastic yarn 2. In the embodiment, the total fineness of two strands of the covered elastic yarn 2 is 75 x 2 d (denier), the fineness of a polyurethane yarn which is the core yarn 21 to be inserted into each covered elastic yarn 2 is from 20 to 30 d, and the single yarn fineness of the sheath yarn 22 is from 1 to 2 d.

**[0035]** In the first and second low stretch yarns 3 and 4, an untwisted multi-filament yarn having the same material as the sheath yarn 22 is usually used. However, a spun yarn, which may be obtained by, for example, a false twisting processing, may be used depending on the purpose of use. It is preferred that the above-described multi-filament yarn has also been subjected to a typical crimp processing or bulkiness processing. The total finenesses of the first and second low stretch yarns 3 and 4 are from 600 to 2,500 d, respectively. The single yarn fineness of each filament constituting the first and second low stretch yarns 3 and 4 is from 3 to 20 d, and the value is usually significantly larger compared to a single yarn fineness of the sheath yarn 22, which is from 1 to 2 d. In addition, even when the first and second low stretch yarns 3 and 4 are subjected to the crimp processing or bulkiness processing, the ratio of expansion and contraction is set at a level significantly lower than that of an elastic yarn which is the core yarn 21.

**[0036]** Next, an overview of the method for preparing the elastic composite twisted yarn 1 according to the invention having the structure described above will be provided.

**[0037]** From two pieces of cheese 6 and 6 for a covered elastic yarn formed of an elastic yarn having self-stretchability, which is placed on a creel, and one or more pieces of cheese 7 for a first low stretch yarn formed of a thermoplastic multi-filament having low stretchability, each covered elastic yarn 2 is longitudinally taken out under drawing at a pre-

determined draw ratio and drawn downward. The covered elastic yarn 2 aligned with the first low stretch yarn 3 is wound around an intermittently rotatable rotation member (yarn reserve disc) 10 of a yarn twister at 180° or more and less than 360°, then passes through a freely-rotatable yarn guiding member (not illustrated), which is disposed adjacent to the rotation member, and is drawn upwardly. In this case, from a cheese 8 for a second low stretch yarn, which is accommodated in a pot 11 being fixedly mounted adjacent to the upper portion of the rotation member 10, a second low stretch yarn 4 is simultaneously grasped outside, and the second low stretch yarn 4 is drawn upwardly through a tension controller which is positioned above the center of the pot.

**[0038]** The covered elastic yarns 2 and 2, which are combined and drawn upwardly through the rotatable yarn guiding member (not illustrated), and a first low stretch yarn 3 are pulled upwardly outside the pot 11 between a cording point 9 and the rotatable yarn guiding member (not illustrated) while forming a balloon. Here, the combined yarn of the covered elastic yarns 2 and 2 and the first low stretch yarn 3, and the second low stretch yarn 4 drawn upwardly from the shaft center of the pot are twisted and combined at the cording point 9 which is above the shaft center of the pot. The twisted yarns are then wound by a winding unit 13 to be prepared as a composite twisted yarn.

**[0039]** The tension of the combined yarn formed of the covered elastic yarn 2 wound around the rotation member 10 and the first low stretch yarn 3 is intermittently adjusted by intermittently rotating the rotation member 10 to change the drawn length of the combined yarn wound around the rotation member 10. At this point, the tension of the second low stretch yarn 4 drawn from the pot 11 is controlled at all times by passing the yarn through a tension adjusting apparatus between the cording point 9 and the pot 11. The composite twisted yarn formed of the covered elastic yarns 2 and 2 and the first and second low stretch yarns 3 and 4 is wound around a cheese 14, and then released and thermal setting in a relaxed state at a high temperature to completely prepare the elastic composite twisted yarn according to the invention.

**[0040]** It should be noted that a single fiber constituting the sheath yarn 22 is more easily twisted with mainly the constituent single fiber of the first low stretch yarn 3 by adjusting the thickness (fineness) of the single fiber of the multi-filament constituting the sheath yarn 22 which covers the surface of the elastic yarn constituting the core yarn 21 to be equal to or less than the thickness of the first and second low stretch yarns 3 and 4. Meanwhile, the contact area of both of the yarns is increased to increase friction, and a plurality of micro loops having various shapes and sizes, which is generated when the covered elastic yarn 2 shrinks, appropriately twists the filament single yarn formed of a constituent fiber of the first low stretch yarn 3 in the vicinity to cause the crimp of the first low stretch yarn to the maximum extent during the shrinkage of the elastic composite twisted yarn. In this case, some of the loops could be entangled with some of the second low stretch yarn 4.

**[0041]** In addition, in the invention, it is most important to insert the covered elastic yarn 2 into the first low stretch yarn 3. The second low stretch yarn 4 or other low stretch yarns are not inserted because a difference in shrinkage among the covered elastic yarn 2, the first low stretch yarn 3 and the second low stretch yarn 4 is caused when the crimp is exhibited during the thermal setting and thus the first low stretch yarn 3 tends to entirely constitute a core and on the other hand, the second low stretch yarn 4 tends to entirely constitute a sheath, and as a result, the entire twisting structure of the elastic composite twisted yarn becomes similar to a three-dimensional coil and a final product is allowed to have a unique design properties of the invention and elasticity recovery performance which has not been observed until now.

Examples

**[0042]** Hereinafter, the invention will be described in more detail with reference to the accompanying drawings based on representative embodiments.

(Example 1)

**[0043]** FIG. 5 illustrates an example of a preparation apparatus of the elastic composite twisted yarn according to the invention and the preparation sequence thereof.

**[0044]** As the preparation apparatus, a cable twister (CarpetCabler 8.02, manufactured by Oerlikon Textile, Ltd.) 5 was used to prepare an elastic composite twisted yarn for a carpet.

**[0045]** The covered elastic yarn 2 was produced by using a polyurethane fiber with 30 d as a core yarn 21 and winding a multi-filament with 75d/36f, which was formed of a polyester fiber and subjected to crimp processing, over the core yarn 21 to be used as a sheath yarn 22, and two strands of the covered elastic yarn 2 were adopted. The covered elastic yarn 2 is a commercially available covered elastic yarn usually used in a product requiring stretchability and elasticity, such as socks, tights, pantyhose, and the like.

**[0046]** In the first and second low stretch yarns 3 and 4, each of the untwisted multi-filament yarns with a total fineness of 1,200 d, which were formed of a polyester fiber and subjected to crimp processing, was used.

**[0047]** From two pieces of the cheese 6 and 6 for the covered elastic yarn and two pieces of the cheese 7 and 7 for the first low stretch yarn also including a cheese for exchange, which are disposed at the upper creel of the cable twister 5, two strands of the covered elastic yarns 2 and 2 and the first low stretch yarn 3 are introduced in a combined yarn

state into a yarn guiding tube 12 downwardly disposed. In this case, two strands of the covered elastic yarns 2 and 2 are drawn at a predetermined ratio and simultaneously, one strand of the first low stretch yarn 3 is controlled to a predetermined tension by a tension controller which is disposed at a machine body and is not illustrated. The yarn guiding tube 12 is placed in a yarn reserve disc 10 from the central portion of the bottom surface of the yarn reserve disc 10 serving as the rotation member which is mounted on the bottom end of the apparatus, and is derived, from a yarn derive opening 10a of a yarn guide groove formed on the periphery of the disc 10 into a groove bottom. Then, the yarn guiding tube 12 is wound at from 3/4 revolution and less than 1 revolution along the yarn guide groove to pass through the rotatable yarn guiding member which is being rotated (not illustrated), is rotated along the circumference of the disc 10, and reaches the upper cording point 9 while forming a balloon.

**[0048]** Meanwhile, a cheese 8 for a second low stretch yarn of the second low stretch yarn 4 is accommodated in the pot 11, and the second low stretch yarn 4 is drawn into the cording point 9 from the outer circumference thereof through a yarn guide 15 disposed on an axis line at the upper portion of the pot. In this case, the combined yarn including the covered elastic yarns 2 and 2 using the polyurethane yarn as the core yarn 21 and the first low stretch yarn 3 are twisted as the a balloon between the rotatable yarn guiding member (not illustrated) and the cording point 9 is formed. The combined yarn is then twisted and combined with the second low stretch yarn 4 to form a cheese 14 while being wound by the upper winding unit 13. During the formation of the cheese 14, the disc 10 finely controls the tension of the combined yarn of the covered elastic yarn 2 and the first low stretch yarn 3 while changing the amount of drawing of the combined yarn caused by the intermittent rotation. Further, the second low stretch yarn 4 is adjusted, along with the combined yarn which is combined and twisted, by a tension adjusting apparatus 16 disposed between the cording point 9 and the winding unit 13.

**[0049]** As described above, the two strands of the covered elastic yarns 2 and 2 and the first and second low stretch yarns 3 and 4 are twisted, and are then subjected to a thermal setting process by a thermal setting machine not illustrated in the drawings. During the thermal setting, the twisted yarn of the covered elastic yarns 2 and 2, the first low stretch yarn 3, and the second low stretch yarn 4 is released from the cheese 14 in the machine body of the thermal setting machine, is mounted on a stainless steel belt which is not shown and moves at a speed of 9 m/min, and is continuously moved while expanding the width in a coil shape to maintain the relaxed state. During the movement, a pre-streamer and a main steamer, which are not illustrated in the drawing, are allowed to sequentially pass through. During that time, the twisted and combined first and second low stretch yarns 3 and 4 are applied with a large contractile force of the covered elastic yarn 2 using a polyurethane fiber as the core yarn 21, the crimp of each filament, which is a constituent fiber of the first and second low stretch yarns 3 and 4 including the sheath yarn 22, is exhibited to the maxim extent, and the shrinkage of the filament yarn having the largest shrinkage is more apparently exhibited when there is a difference in shrinkage between the filaments of each yarn. As a result, the elastic composite twisted yarn 1 thus obtained has a structure close to a three-dimensional coil, unique design characteristics which are not observed in other carpet yarns may be obtained in addition to the unique bulkiness of the invention, and the structure is memorized in the thermal setting process also including the subsequent drying process. A pile carpet was prepared by using the twisted yarn as a pile yarn.

**[0050]** Test on the compressibility (%), compressive elasticity modulus (%), thickness reduction ratio by the compression, as well as thickness (mm), reduction value (mm), and reduction ratio (%) of the thickness reduction by the dynamic load accompanying friction of the carpet obtained was performed. The results are shown in Table 1. A weight-per-unit condition for the tests was set at 660 g/m$^2$.

(Example 2)

**[0051]** A carpet was prepared by performing a twisting processing under the same conditions as in Example 1, except that, as the covered elastic yarn, a core yarn 21 made of a polyurethane fiber with 30 d and a sheath yarn 22 made of a polypropylene multi-filament yarn with 75d/36f, which was subjected to a crimp processing were used, and each of the untwisted multi-filament yarns formed of polypropylene and with a total fineness of 1, 200 d, which had been subjected to crimp processing, was used in the first and second low stretch yarns 3 and 4. The weight-per-unit condition was set at 660 g/m$^2$, in the same manner as in Example 1.

**[0052]** The obtained carpet was also subjected to the same tests as in Example 1. The results are shown in Table 1.

(Example 3)

**[0053]** As the covered elastic yarn, a core yarn 21 made of a polyurethane fiber with 30 d and a sheath yarn 22 wound around the core yarn 21 and made of a multi-filament formed of a polyamide 66 with 75d/36f, which had been subjected to a crimp processing, into the core yarn 21. A carpet was prepared by performing a twisting processing under the same conditions as in Example 1, except that each of the untwisted multi-filament yarns formed of polyamide 66 and with a total fineness of 1, 200 d, which had been subjected to crimp processing, was also used in the first and second low stretch yarns 3 and 4. The weight-per-unit condition was set at 660 g/m$^2$, in the same manner as in Examples 1 and 2.

**[0054]** The obtained carpet was subjected to the same tests as in Example 1. The results are shown in Table 1.

(Comparative Examples 1 to 3)

**[0055]** Carpets were prepared under the same conditions as in Examples 1 to 3, except that the covered elastic yarn was excluded. The weight-per-unit condition for the carpets obtained was set at 660 g/m$^2$, in the same manner as in Examples 1 to 3.

**[0056]** In addition, these carpets were subjected to the same tests as in Examples 1 to 3. The results are shown in Table 1.

| Test Item | Unit | Comparative Example 1 | Example 1 | Comparative Example | Example 2 | Comparative Example3 | Example3 | Remark |
|---|---|---|---|---|---|---|---|---|
| | | PET | PET | PP | PP | PA | PA | |
| Compressibility | (%) | 75.5 | 65.4 | 69.9 | 64.3 | 69.6 | 61.9 | Minimum ⇒ Good |
| Compressive elasticity modulus | (%) | 78.9 | 79.1 | 71.0 | 75.1 | 75.8 | 78.8 | Maximum ⇒ Good |
| Thickness reduction ratio by the compression | (%) | 15.9 | 13.7 | 20.2 | 16.0 | 16.9 | 14.0 | Minimum ⇒ Good |
| Thickness reduction by dynamic load accompanying friction | Thickness (mm) | 11.3 | 10.2 | 10.4 | 9.2 | 10.0 | 8.9 | - |
| | Reduction value (mm) | 5.2 | 4.2 | 4.3 | 3.4 | 4.0 | 3.2 | - |
| | Reduction ratio (%) | 46.0 | 41.2 | 41.3 | 37.0 | 40.0 | 35.6 | Minimum ⇒ Good |

**[0057]** All of the test materials were 5/23G tuft. Further, the test method relating to the compressibility, the compressive elasticity modulus, and the thickness reduction ratio by the compression was performed in accordance with JIS L 1021-6. The test method relating to the thickness reduction by the dynamic load accompanying friction was performed in accordance with JIS L 1021-7.

**[0058]** As apparent from the Table 1, it can be known that a change in material of a yarn induces the same tendency in any of the compressibility, the compressive elasticity modulus, the thickness reduction ratio by the compression, and the thickness reduction by the dynamic load accompanying friction, and characteristics of a carpet prepared from the elastic composite twisted yarn of the invention have been significantly improved compared to the composite twisted yarn which does not include a covered elastic yarn.

**[0059]** As described above, high bulkiness, which may not be expected from the pile yarn in the related art, can be obtained by using the elastic composite twisted yarn according to the invention to prepare a floor covering or an interior automotive trim, such as tuft, and carpets with a more stable form and higher density may be obtained if placed under the same weight-per-unit condition. Since carpets with a typical texture can be obtained even though they have a lower weight-per unit than that of a typical carpet, reducing the weight per unit, which is also leading to the resource savings and the ecology required under the modern economy, may be achieved. A floor covering produced by using the elastic composite twisted yarn is a high-quality floor covering with a soft feel, which is strong against the downward pressure and in which depression is not conspicuous, due to a highly elastic recovery force which is a characteristic of a product of the invention. In addition, excellent design properties, which may not be obtained in the related art, can be obtained with bulkiness and beautiful and unique product expression which are led by the shape of the yarn having a three-dimensional coil shape, which is peculiar to the invention.

DESCRIPTION OF REFERENCE NUMERALS

**[0060]**

| | |
|---|---|
| 1 | Elastic composite twisted yarn |
| 2 | Covered elastic yarn |
| 21 | Core yarn |
| 22 | Sheath yarn |
| 3 | First low stretch yarn |
| 4 | Second low stretch yarn |
| 5 | Cable twister |
| 6 | Cheese for covered elastic yarn |
| 7 | Cheese for first low stretch yarn |
| 8 | Cheese for second low stretch yarn |
| 9 | Cording point (joint point) |
| 10 | Rotation member (yarn reserve disc) |
| 10a | Yarn derive opening |
| 11 | Pot |
| 12 | Yarn guiding tube |
| 13 | Winding unit |
| 14 | (Winding) Cheese |
| 15 | Yarn guide |
| 16 | Tension adjusting apparatus |

## Claims

**1.** An elastic composite twisted yarn including a covered elastic yarn obtained by covering a core yarn formed of an elastic yarn having a self-stretchability with a thermoplastic multi-filament as a sheath yarn, and two or more low stretch yarns including first and second low stretch yarns formed of a thermoplastic multi-filament yarn or a spun yarn, being **characterized in that**:

the elastic composite twisted yarn is formed by inserting the covered elastic yarn into the first low stretch yarn under drawing at a predetermined draw ratio in a combined yarn state; and
twisting the second low stretch yarn and the first low stretch yarn with the covered elastic yarn inserted, and,
in the elastic composite twisted yarn, a plurality of heteromorphic micro-loops formed of a constituent single fiber of the sheath yarn, which appears during relaxation by a contractile force of the covered elastic yarn,

protruding from the core yarn to a diameter direction is incorporated into constituent single fibers of the first low stretch yarn and thermally set.

2. The elastic composite twisted yarn according to claim 1, being **characterized in that** the core yarn of the covered elastic yarn is a polyurethane yarn, a natural or synthetic rubber, or a crimp-processed yarn.

3. The elastic composite twisted yarn according to claim 1 or 2, being **characterized in that** the sheath yarn of the covered elastic yarn and the first and second low stretch yarns are a multi-filament formed of the same or different material(s).

4. The elastic composite twisted yarn according to claim 3, being **characterized in that** two or more strands of the covered elastic yarns are inserted into the first low stretch yarn.

5. The elastic composite twisted yarn according to claim 3, being **characterized in that** the thermoplastic multi-filament is formed of any of propylene, polyester or polyamide, or a combination of them.

6. The elastic composite twisted yarn according to any one of claims 3 to 5, being **characterized in that** a fineness of a single fiber constituting the sheath yarn is equivalent to or less than that of a single fiber constituting the low stretch yarns.

7. The elastic composite twisted yarn according to claim 1, being **characterized in that** the number of twists of the elastic composite twisted yarn after the thermal setting is from 48 to 430 times/m.

8. A method for preparing the elastic composite twisted yarn according to any of claims 1 to 7, the method including:

aligning two or more strands of covered elastic yarns, which are obtained by covering a core yarn formed of an elastic yarn having self-stretchability with a thermoplastic multi-filament serving as a sheath yarn under tension, with a first low stretch yarn formed of a thermoplastic multi-filament yarn or a spun yarn, introducing the aligned yarns into a rotation member corresponding to a lower flyer rotating in one direction, and then drawing the strands toward a cording point disposed on the upper side;
accommodating a second low stretch yarn formed of a thermoplastic multi-filament yarn or a spun yarn in a fixed pot disposed adjacent to an upper portion of the rotation member;
taking said corresponding second low stretch yarn out to be drawn toward the cording point disposed on the upper side from the center of the pot;
forming a balloon between the rotation member and the cording point and twist-combining a combined yarn including the covered elastic yarn drawn upwardly and the first low stretch yarn with a second low stretch yarn drawn upwardly from the shaft center of the pot at the coding point; and
winding the composite twisted yarn which has passed through the cording point.

9. The method for preparing the elastic composite twisted yarn according to claim 8, being **characterized in that** the method includes:

adjusting, by intermittently rotating the rotation member, a tension of the covered elastic yarn and the first low stretch yarn, which are wound around the rotation member; and
adjusting the tension of the second low stretch yarn drawn from the inside of the pot between the pot and the cording point.

10. The method for preparing the elastic composite twisted yarn according to claim 9, being **characterized in that** the method includes relaxing the wound composite twisted yarn, followed by thermal setting.

11. A pile fiber product, being **characterized in that** the elastic composite twisted yarn according to any one of claims 1 to 7 is used as a pile yarn.

12. The pile fiber product according to claim 11, being **characterized in that** the pile fiber product includes various floor coverings or an interior automotive trim.

FIG. 1

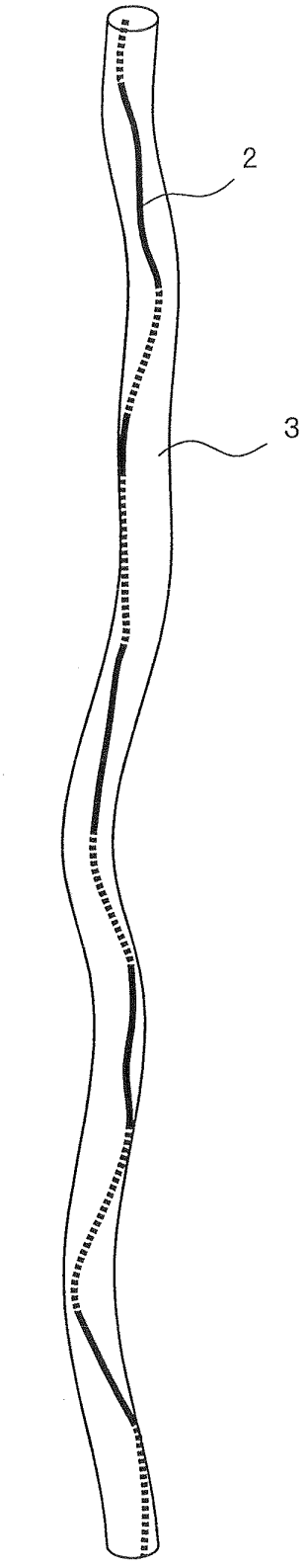


FIG. 2

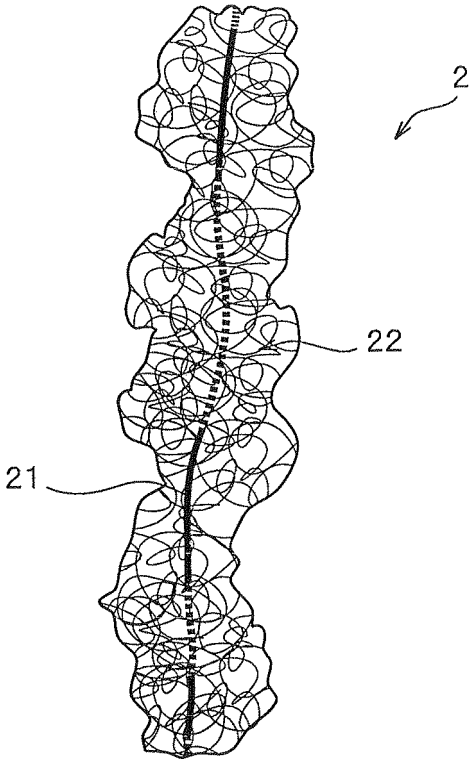


FIG. 3

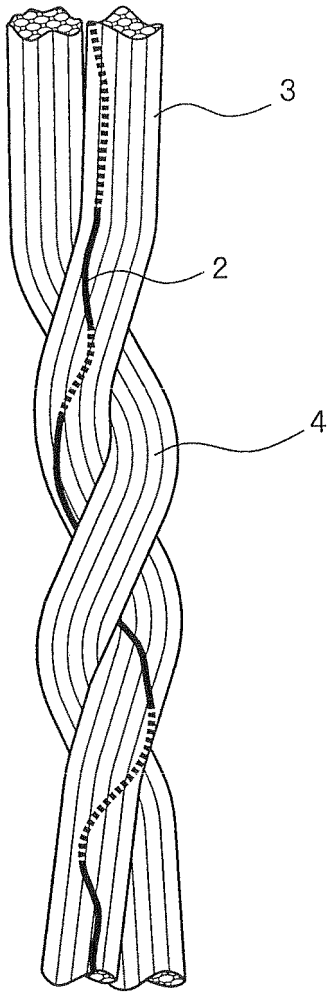


FIG. 4

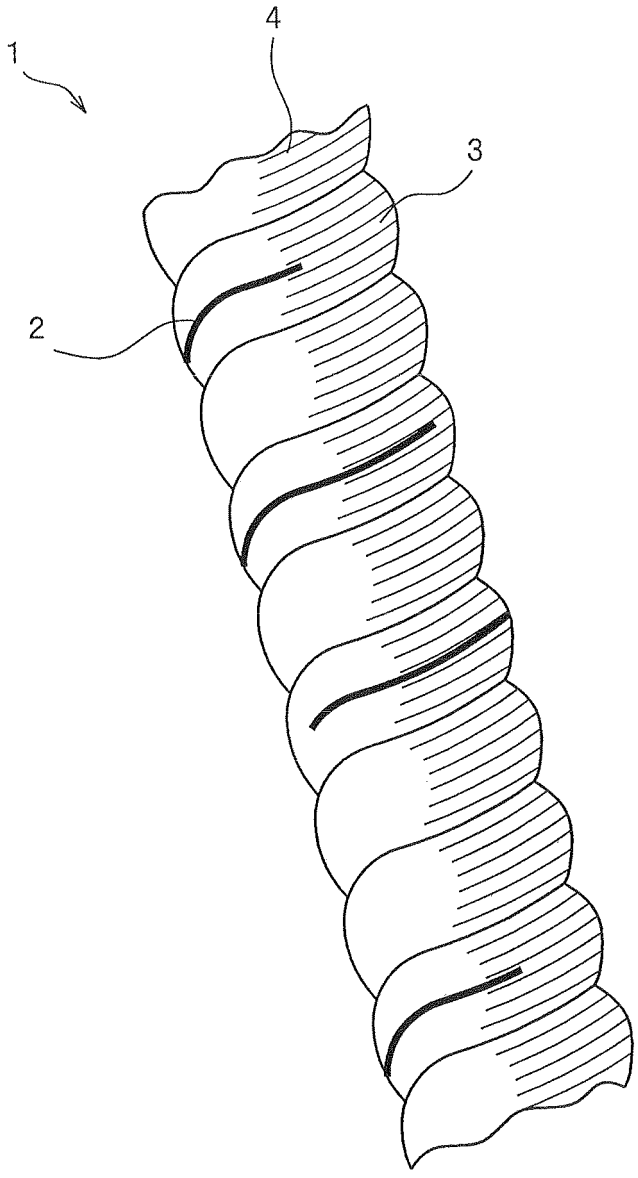
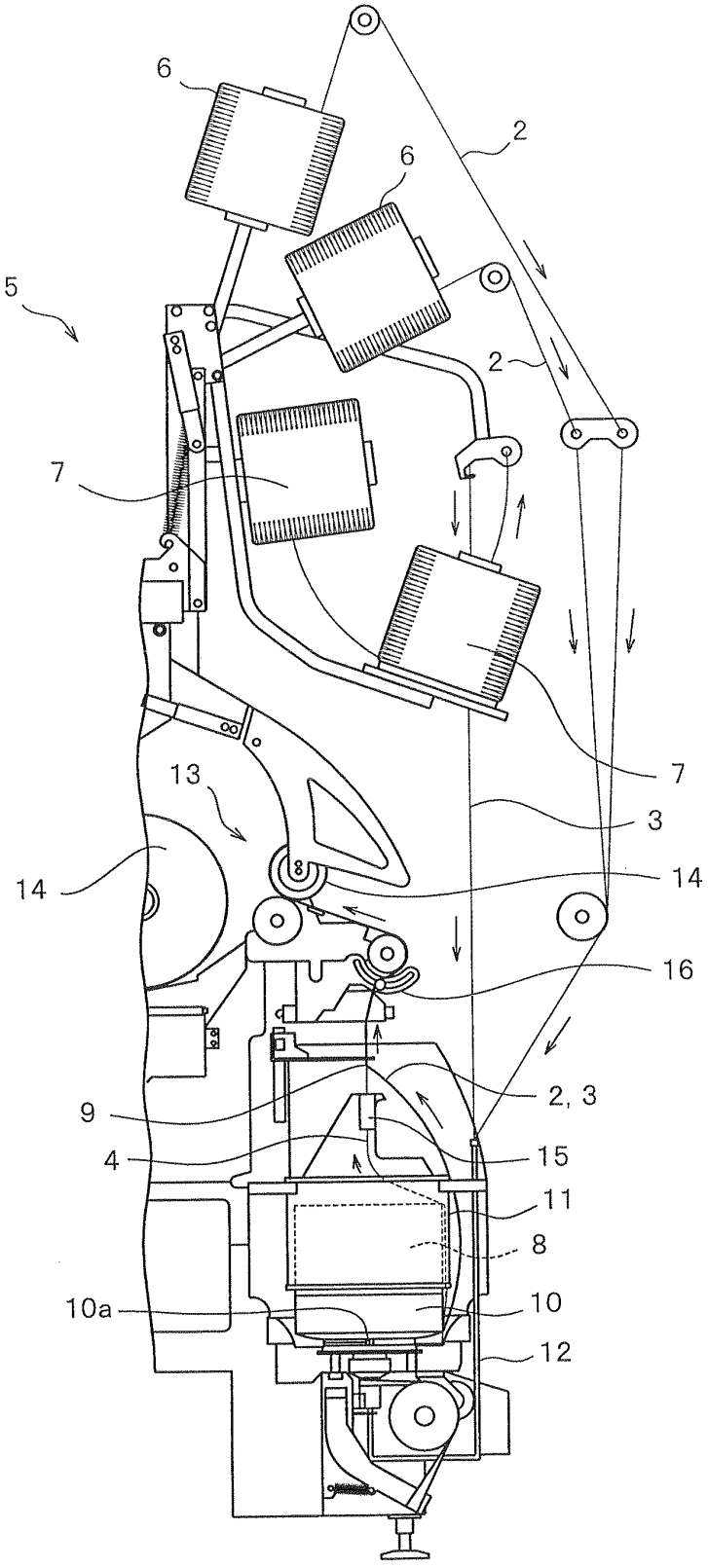


FIG. 5



**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2012/061038

A. CLASSIFICATION OF SUBJECT MATTER
*D02G3/04*(2006.01)i, *D02G3/32*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D02G1/00-3/48, D02J1/00-13/00

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 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | JP 6-10225 A (Toray Industries, Inc.), 18 January 1994 (18.01.1994), entire text (Family: none) | 1-12 |
| A | JP 49-9426 B1 (Toray Industries, Inc.), 04 March 1974 (04.03.1974), entire text (Family: none) | 1-12 |
| A | JP 4-11035 A (Du Pont-Toray Co., Ltd.), 16 January 1992 (16.01.1992), entire text (Family: none) | 1-12 |

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

* Special categories of cited documents:
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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 11 June, 2012 (11.06.12) | 03 July, 2012 (03.07.12) |
| Name and mailing address of the ISA/ Japanese Patent Office<br>Facsimile No. | Authorized officer<br>Telephone No. |

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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2012/061038

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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| A | JP 2001-303375 A (Asahi Kasei Corp.), 31 October 2001 (31.10.2001), entire text (Family: none) | 1-12 |
| A | Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 002071/1977(Laid-open No. 101845/1977) (Kan'ichi KAWASHIMA), 12 January 1977 (12.01.1977), entire text (Family: none) | 1-12 |
| A | JP 63-92769 A (Negoro Sangyo Co.), 23 April 1988 (23.04.1988), entire text (Family: none) | 1-12 |

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## REFERENCES CITED IN THE DESCRIPTION

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- JP 6010225 A **[0004] [0006]**