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(54) **FILAMENTARY CORE, ELASTIC COMPOSITE YARN COMPRISING THE FILAMENTARY CORE, FABRIC COMPRISING THE FILAMENTARY CORE OR THE ELASTIC COMPOSITE YARN AND METHOD FOR MANUFACTURING THE FILAMENTARY CORE OR THE ELASTIC COMPOSITE YARN**

(57) The invention relates to a filamentary core (1) for a composite yarn (9) for a woven fabric, comprising at least one elastic filament (3) comprising rubber, preferably natural rubber, and at least one control filament (5, 7) comprising a synthetic polymer.

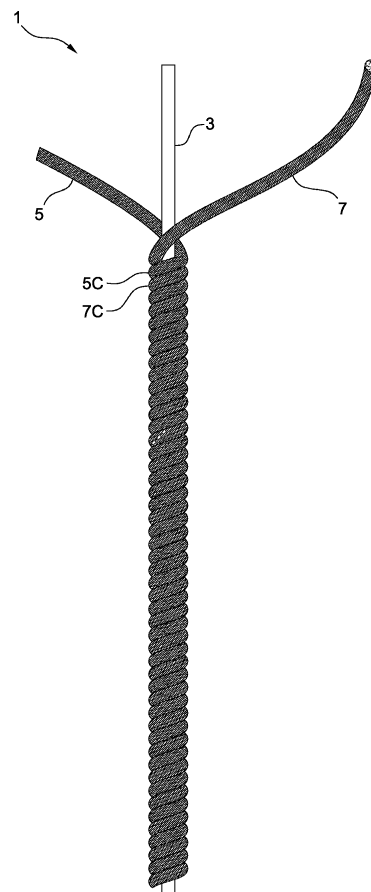


Fig. 1

Description

[0001] The present invention relates to a filamentary core, an elastic composite yarn comprising the filamentary core, a fabric comprising the filamentary core or the elastic composite yarn and a method for manufacturing the filamentary core or the elastic composite yarn.

[0002] Elastic composite yarns typically comprise a filamentary core with one or more elastic filaments and a sheath surrounding the filamentary core. Due to their excellent elongation properties, filaments made of elastane (also known as spandex or under the brand name lycra) became popular for the use in the filamentary core of elastic composite yarns. However, elastane filaments are poorly biodegradable. Therefore, attempts have been made to find alternatives for elastane with increased biodegradability.

[0003] For this purpose, WO 2020/0084361 suggests substituting elastane filaments with a thick core made of rubber. In order to be able to cover this thick core with a cotton sheath, it is suggested to use a hollow spindle spinning machine. Further, in order to prevent inelastic deformation of the yarn, it is suggested to place a complementary yarn made of natural fibers, such as cotton, between the core and the sheath.

[0004] However, as hollow spindle spinning machines are not always available in existing factories, there is a need to provide an at least partially biodegradable filamentary core which can be produced and processed by various spinning machines, in particular by ring spinning machines and by hollow spindle spinning machines. Further, the inventors identified a need to provide a filamentary core which can be produced and/or surrounded with a sheath with increased process stability, i.e. with a reduced risk of failure during manufacturing. Moreover, it was found desirable to provide an at least partially biodegradable core with increased elastic recovery.

[0005] It is an object of the invention to solve the drawbacks of the prior art, in particular to provide an at least partially biodegradable filamentary core, an elastic composite yarn comprising the filamentary core, a fabric comprising the filamentary core or the elastic composite yarn and a method for manufacturing the filamentary core or the elastic composite yarn, wherein the filamentary core can be produced with more spinning machines, increased process stability and/or has an increased elastic recovery.

[0006] This object is solved by the claims 1, 7, 19, 21 and 22.

[0007] According to one aspect of the invention, a filamentary core for an elastic composite yarn for a woven fabric is provided. The filamentary core comprises at least one elastic filament comprising rubber, preferably natural rubber, and at least one control filament comprising a synthetic polymer.

[0008] The at least one elastic filament and the at least one control filament can be connected to each other for forming the filamentary core. The connection can be realized with a plurality of connection points as described in WO 2012/062480 A2 which shall be incorporated into this document by reference for indicating, how said filaments can be connected to each other. For instance, the connection can be realized by intermingling or twisting of one of the filaments around the other or others. The connection between said filaments can also be realized continuously along the filamentary core in order to provide a continuous contact surface between adjacent filaments. The at least two filaments may be separately manufactured and separately delivered in order to form the filamentary core. In particular, the filamentary core can be made separately or simultaneously to the manufacturing process of its filaments. The filamentary core can be made simultaneously with respect to the manufacturing process of the composite yarn or in a pre-stage in order to produce an interstage product which in a second manufacturing phase is introduced into the manufacturing process for the elastic composite yarn. In particular, the filamentary core can be provided on a mandrel or spindle from which it can be processed into an elastic composite yarn.

[0009] The term fibers shall in the following encompass staple fibers and filaments. A filament shall in particular be understood as a fibrous structure of extreme or indefinite length. Contrary thereto, a staple fiber shall in particular be understood as a strand of definite or short length. In particular a short length shall be a length of maximally 500 mm, 200 mm, 150 mm, 100 mm, 80 mm, 60 mm or 45 mm.

[0010] In particular, a filament can be a monofilament or a multifilament. A monofilament is to be understood as one single strand of extreme or indefinite length. A multifilament is to be understood as comprising at least two strands of extreme or indefinite length being in particular coalesced into the one filament. In particular, a multifilament with two strands of indefinite length differ from two monofilaments in that they have been coalesced with each other into an interstage product before being processed into the filamentary core or yarn. The single strand of a monofilament or at least one of the at least two strands of a multifilament can in particular be a one-piece strand or a multi-piece strand. A one-piece strand is in particular to be understood as a strand consisting along its complete length of one single piece. A one-piece strand can for instance be produced by melt spinning. Contrary thereto, a multi-piece strand can comprise multiple short strands (staple fibers) arranged to form a strand of extreme or indefinite length. In the following a monofilament being realized as one-piece strand will be referred to as one-piece monofilament. A multifilament the strands of which are realized as one-piece filament will be referred to as one-piece multifilament.

[0011] A yarn shall in particular be understood as a collection of numerous filaments and/or staple fibers which may or may not be textured, spun, twisted or laid together. A composite yarn within the meaning of the present invention

shall in particular be a yarn comprising staple fibers and/or filaments of at least two different materials for instance a polyester filament being surrounded with a sheath of staple fibers made of cotton. An elastic composite yarn is in particular to be understood as a composite yarn comprising at least one elastic filament. Thus, an elastic composite yarn can for instance be an elastic rubber filament being covered with a cotton sheath. Particularly, the elastic composite yarn according to the invention shall be used for manufacturing fabrics, such as woven fabrics or knitted fabrics. The fabric according to the invention shall particularly be used for manufacturing of clothes, preferably denim fabrics.

[0012] The term "rubber" as used herein refers to polymer obtainable from polymerizing isoprene monomers. "Natural rubber" as referred to herein is rubber obtained from natural sources (the obtaining preferably not containing a polymerization step), e.g. from harvesting the natural rubber (mainly in the form of latex) from the rubber tree (*Hevea brasiliensis*) or others.

[0013] The elastic filament may comprise the rubber in an amount of at least 50 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 60 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 70 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 80 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 90 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 95 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 98 %-wt., with respect to the total weight of the elastic filament. The elastic filament may comprise the rubber in an amount of at least 99 %-wt., with respect to the total weight of the elastic filament. The elastic filament may consist of the rubber.

[0014] For an easier legibility, an elastic filament containing rubber will in the following also be called rubber filament. However, it shall be clear that this does not mean that the at least one elastic filament necessary purely consist of rubber.

[0015] Preferably, the at least one rubber filament is a monofilament, preferably a one-piece monofilament. For instance, such monofilament can be produced by extrusion, in particular by extruding a mass of natural rubber through a nozzle and solidifying the natural rubber. The solidification can be realized by commonly known vulcanization means. Contrary to the preferred use of the rubber filament as monofilament, elastane filaments, such as lycra, are commonly normally used as multifilament's. The inventors of the present invention found that using monofilaments instead of multifilaments surprisingly increases the process stability when processing rubber filaments instead of elastane filaments.

[0016] Further, it has been found advantageous to use rubber filament with a substantially round cross section, in particular an elliptical and/or circular cross section. This can in particular be achieved by producing the rubber filament by extrusion with a nozzle having a circular opening through which the filament is extruded. It has been found that by substituting the longitudinally cut flat rubber core used in WO2020/084361A1 by a rubber filament with substantially round cross section, the production of the filamentary core and of the composite yarn is less prone to failure, in other words can be produced with increased process stability. This might be explained in that cutting edges are avoided which might lead to unintended entanglement of the rubber filament with the control filament or the sheath thereby disturbing the spinning process. Further, it has been found that such filaments are less prone to filament breakage which can lead to the interruption of the manufacturing process but also to the final product becoming useless.

[0017] Preferably, the at least one control filament is a one-piece-monofilament or a one-piece multifilament. In particular, the use of one-piece filaments turned out to be advantageous in that they can be used to stabilize the rubber filament during spinning and thereby increase the stability of the process. Contrary thereto, threads consisting for instance of staple fibers are less stabile crosswise their length extension and are therefore less suitable for stabilizing the rubber filament. Preferably the at least one control filament is produced by melt spinning. An advantage of melt-spinning is that the control filament has a substantially flat surface, i.e. is not hairy as for instance a cotton thread. Preferably the at least one control filament has a substantially circular cross section, in particular a circular or elliptical cross section.

[0018] Within the meaning of the present invention, a control filament is in particular a filament with a different material composition and/or with different material characteristics, for instance due to a different linear mass density, than the elastic filament. In particular, the different material compositions enables the production of a filamentary core combining advantageous of two materials in one product. For instance, as described in EP 2 145 034 B1, the combination of an elastic filament with an inelastic filament in a filamentary core makes it possible to benefit from both, the properties of elastic filaments and of inelastic filaments, thereby leading to an elastic yarn with increased elastic recovery. Elastic recovery is an important property for an elastic yarn in that the yarn is capable of regaining its original length after deformation by first applying tensile stress and further releasing said stress. If the recovery properties of the elastic yarn are not sufficient or too low, an undesired growth effect may arise. The growth effect is undesired because the elastic yarn does not provide enough elastic recovery in order to bring back the elastic yarn to its original condition before the stress was applied. Considering in particular a fabric product, particularly trousers made of a fabric woven on the basis of elastic yarns, in highly stressed textile areas, as the area of knees and back of a the trousers, the growth effect causes an inappropriate saggy fit which could even make the product useless for the consumer. Thus, in order to avoid this growth effect, the at least one control filament can for instance be realized as a less elastic filament, compared to the

elastic filament, or even as inelastic filament as defined below. Thereby an at least partially biodegradable core can be provided which benefits from the increased elastic recovery provided from the combination of elastic filaments and less elastic or inelastic filaments, in particular as described in EP 2 145 034 B1.

[0019] The term "synthetic polymer" as used herein refers to human-made polymers, in particular to polymers synthesized by polymerizing one or more kinds of monomers under laboratory/industrial conditions. Processes for preparing a variety of synthetic polymers, in particular the specific synthetic polymers mentioned below, are well known in the art.

[0020] The control filament may comprise the synthetic polymer in an amount of at least 50 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 60 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 70 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 80 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 90 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 95 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 98 %-wt., with respect to the total weight of the control filament. The control filament may comprise the synthetic polymer in an amount of at least 99 %-wt., with respect to the total weight of the control filament. The control filament may consist of the synthetic polymer. The inventors have found that supplementing the natural complementary threads known from WO 2020/084361 A1 by the at least one inventive control filament comprising a synthetic polymer, the stability of the process for manufacturing the filamentary core and the yarn comprising the core can be increased. One reason for this seems to be that control filaments with synthetic polymers can be provided with a relatively flat surface compared to, for instance hairy cotton threads. It seems that the hairy nature of these cotton threads leads to unintended intermingling or sticking with the rubber filament and/or with the sheath, which can lead to interruption of the manufacturing, in particular spinning, process. Further, by the use of synthetic polymers the characteristics of the control filament and thereby of the filamentary core can be adjusted in a wide range so that the filamentary core can be used in more fields of application. In particular, the above described increased elastic recovery can be adjusted more precisely by the wide range of polymers and their very different characteristics in terms of for instance elasticity, breaking elongation and tensile strength.

[0021] Preferably, the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterephthalate (preferably a polybutyleneterephthalate, polytrimethyleneterephthalate, a polyethyleneterephthalate (PBT)), a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyalkyleneterephthalate or a mixture of two or more thereof, most preferred is a polyester.

[0022] It has been found that the combination of polyester as synthetic polymer with the rubber filament is of particular advantage to provide the filamentary core with the desired elastic recovery. In particular it has been found that the higher tensile strength and breaking elongation of polyester compared to for instance cotton used in the complementary thread in the prior art enables to increase the elastic recovery of the filamentary core and of the elastic composite yarns produced thereof.

[0023] The polyester may be a biodegradable polyester, in particular may be an aliphatic polyester. Preferably, the polyester is selected from the group consisting of polylactic acid (PLA), polyglycolic acid (PGA), poly-e-caprolactone (PCL), polyhydroxybutyrate (PHB), poly(3-hydroxy valerate), poly(ethylene succinate) (PESu), poly(propylene succinate) (PPSu), poly(butylene succinate) (PBSu), poly(adipate), a copolymer of two or more thereof or a mixture of two or more thereof.

[0024] In another embodiment, the polyester may be a copolymer of at least one aliphatic polyester, such as polylactic acid (PLA), polyglycolic acid (PGA), poly-e-caprolactone (PCL), polyhydroxybutyrate (PHB), poly(3-hydroxy valerate), poly(ethylene succinate) (PESu), poly(propylene succinate) (PPSu), or poly(butylene succinate) (PBSu), poly(adipate), and at least one aromatic polyester, such as polybutyleneterephthalate, polytrimethyleneterephthalate, a polyethyleneterephthalate (PBT).

[0025] Preferably, the elastic filament contains at least 80 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament contains at least 85 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament contains at least 90 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament contains at least 95 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament contains at least 98 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament contains at least 99 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament. Preferably, the elastic filament consists of cis-1,4-polyisoprene.

[0026] The cis-1,4-polyisoprene may be obtained from a plant preferably selected from the group consisting of Hevea Brasiliensis; Hevea Guianensis; and Hevea Benthamiana.

[0027] Preferably, the elastic filament further contains one or more of the group consisting of a vulcanization agent; a vulcanization accelerator; a vulcanization activator; an anti-tacking agent; an antioxidant agent; and a stabilization agent.

[0028] Preferably, vulcanization agent is sulfur. In the rubber of the elastic filament, sulfur may act as a vulcanization agent in the form of sulfur bridges between two different polymer chains of the rubber. It may be provided that the vulcanization agent is used in an amount of 0.5 to 5 %.-wt., preferably 1 to 2.5 %.-wt, based on the total weight of rubber in the elastic filament.

[0029] The vulcanization accelerator may be a thiazolic vulcanization accelerator. The vulcanization accelerator may be used in an amount of 0.1 to 2 %.-wt, based on the total weight of rubber in the elastic filament.

[0030] The vulcanization activator may comprise or may be a fatty acid, preferably stearic acid. The vulcanization activator may be used in an amount of 0.5 to 15 %.-wt, preferably 1 to 10 %.-wt, based on the total weight of rubber in the elastic filament.

[0031] The anti-tacking agent may comprise talc. The anti-tacking agent may be used in an amount of 0.5 to 1 %.-wt, preferably 1 to 5 %.-wt, based on the total weight of rubber in the elastic filament.

[0032] Preferably, the control filament further comprises a biodegradability enhancing additive. Preferred embodiments of the biodegradability enhancing additives are described below in the context of a further aspect of the invention. Surprisingly, it has been found that the use of the biodegradability enhancing additives does not harm the performance of the control filament to such an extent that the above described benefits of the synthetic polymer disappear. Thus, surprisingly, a filamentary core was invented which uses for the elastic filament and for the control filament biodegradable material while keeping the performance advantages of synthetic polymers.

[0033] Another aspect of the invention, which can be combined with the previous aspect of the invention and vice versa, also relates to a filamentary core for an elastic composite yarn for a woven fabric. The filamentary core comprises at least one elastic filament. The at least one elastic filament can comprise or consist of synthetic polymers, can in particular be made of elastane. In particular the elastic filament can be a lycra filament. However, preferably, the at least one elastic filament comprises rubber, preferably natural rubber. In particular, the at least one elastic filament can be realized as the at least one elastic filament described in the context of the previous aspect of the invention.

[0034] Further, the filamentary core comprises at least one control filament comprising a synthetic polymer. The control filament can be realized as described with respect to the previous aspect of the invention and its preferred embodiments. According to this aspect of the invention, the at least one control filament is biodegradable. The biodegradability of the control filament can for instance be realized by using biodegradability enhancing additives and/or by the use of a material, such as a polymer, forming the control filament, which is biodegradable itself, for example by using an appropriate aliphatic polyester, for instance as those described above.

[0035] As described above, it has surprisingly been found that the use of a biodegradable control filament, in particular of biodegradability enhancing additives, does not harm the performance of the synthetic polymer to such an extent that the above described benefits of the synthetic polymer disappear. In particular, it has been found that biodegradable control filaments with synthetic polymers and in particular biodegradability enhancing additives cannot only be used advantageously in combination with rubber filaments but also with synthetic elastic filaments thereby largely increasing the field of application of filamentary cores being at least partially biodegradable.

[0036] Preferably, the biodegradability enhancing additive comprises (or consists of) one or more selected from the group consisting of starch; a bioaugmentation additive, preferably a microbial strain; a pro-oxidant, preferably a transition metal complex and/or a transition metal ion, wherein the transition metal is preferably iron, manganese or cobalt; and a composition comprising 2-hydroxy-3-(trimethylammonio)propyl ether.

[0037] Preferably, the biodegradability enhancing additive comprises starch or consists of starch, alternatively is a composition comprising starch and ether.

[0038] Preferably, the at least one elastic filament and/or control filament according to any of the previous aspects of the inventions or its embodiments is biodegradable. In particular, the biodegradability of the at least one elastic filament can be provided by the use of rubber, in particular natural rubber, in particular as specified above. The biodegradability of the control filament can in particular be provided by the use of biodegradability enhancing additives as described above or by the use of a material, such as a polymer, forming the control filament, which is biodegradable itself, for example by using an appropriate aliphatic polyester.

[0039] Preferably, a biodegradable material within the meaning of the present invention shall be a material poised to pass ASTM D6400. A biodegradability enhancing additive in terms of a present disclosure is suitable to provide a biodegradability to a material, such as a polymer, comprising the additive allowing the material to pass ASTM D6400.

[0040] Additionally or alternatively, the at least one control filament, in any of the previously described aspects of the invention, is biodegradable in that at least 10%, 20%, 30%, 40% or 45% of the at least one control filament can be biodegraded, measured according to ASTM D5511, within 500 days, in particular 517 days- In particular, a biodegradation of 45,2 % according to ASTM D5511 within 517 days was measured for a sample of a control filament comprising polyester as synthetic polymer. In particular, the following parameters have been measured:

EP 4 155 443 A1

Biodegradability measured according to ASTM D5511				
	Inculum	Negative	Positive	Sample
Cumulative Gas Volume (mL)	1759,9	1650,4	9589,3	13374,5
Percent CH ₄ (%)	43,7	35,6	39,6	52,8
Volume CH ₄ (mL)	768,8	587,9	3801,5	7057,2
Mass CH ₄ (g)	0,55	0,42	2,72	5,04
Percent CO ₂ (%)	39,5	39,5	43,2	36,7
Volume CO ₂ (mL)	695,9	651,5	4145,1	4911,3
Mass CO ₂ (g)	1,37	1,28	8,14	9,65
Sample Mass (g)	10	10	10	20
Theoretical Sample mass (g)	0,0	8,6	4,2	12,5
Biodegraded Mass (g)	0,78	0,66	4,26	6,41
Percent Biodegraded (%)		-1,4	82,3	45,2

[0041] Additionally or alternatively, the at least one control filament, in any of the previously described aspects of the invention, is biodegradable in that at least 10%, 15%, 20%, 25% or 30% of the at least one control filament can be biodegraded, measured according to ASTM 6691, within 500 days, in particular 507 days. In particular, a biodegradation of 32,4 % measured according to ASTM 6691 within 507 days was measured for a sample of a control filament comprising polyester as synthetic polymer. In particular, the following parameters have been measured.

Biodegradability measured according to ASTM 6691				
	Inculum	Negative	Positive	Sample
Cumulative Gas Volume (mL)	15,1	15,2	75,9	47,7
Percent CO ₂ (%)	89,4	77,9	87,5	91,6
Volume CO ₂ (mL)	13,5	11,8	66,4	43,7
Mass CO ₂ (g)	0,027	0,023	0,13	0,086
Sample Mass (g)		0,08	0,08	0,08
Theoretical Sample mass (g)		0,069	0,034	0,05
Biodegraded Mass (g)	0,007	0,006	0,036	0,023
Percent Biodegraded (%)		-1,3	83,9	32,4

[0042] It has been found that the preferred biodegradability according to ASTM D551 and ASTM D6691 can be achieved for a plurality of different synthetic polymers by the addition of the above-described biodegradability enhancing additives.

[0043] Preferably, the at least one elastic filament has a linear mass density of less than 200 dtex, 180 dtex, 160 dtex or 140 dtex or 130 dtex and/or of at least 30 dtex, 40 dtex, 50 dtex, 60 dtex or 70 dtex, 80 dtex, 90 dtex or 100 dtex. Particularly preferred, the at least one elastic filament has a linear mass density between 50 dtex and 190 dtex, even more preferred between 80 dtex and 170 dtex, most preferably between 100 dtex and 150 dtex. As explained above, the at least one elastic filament is preferably a one-piece monofilament having a linear mass density within this ranges. However in cases in which it is realized as a one-piece multifilament, the sum of the linear mass density of the multitude of one-piece strands of the multifilament can be in this preferred range. For instance, in case of two strands, each strand most preferably has a linear mass density between 50 dtex and 75 dtex. The same applies for cases in which the at least one elastic filament comprises for instance two elastic filaments being spun together into the filamentary core. For instance, in cases in which the at least two elastic filaments are provided, the sum of linear mass density of these at least two elastic filaments can be within the previously described preferred range. Thereby, each of the at least two filaments can again be realized as monofilaments or multifilaments as described above.

[0044] In particular in cases in which the at least one elastic filament comprises rubber as described above, the above ranges for the linear mass density have been found to enable the spinning of the elastic filament with the at least one control filament in a ring spinning machine. Thereby, the filamentary core can be produced by more spinning arrangements. It has been found that rubber filaments having a density within the above ranges can be produced by extrusion. Thereby, two positive effects are achieved at the same time. On the one hand, the rubber filament becomes processible in ring spinning arrangements. On the other hand, the rubber filament can be produced with a circular cross section thereby further stabilizing the process for the reasons explained above.

[0045] In less preferred embodiments, the maximum linear mass density of the rubber filament can be up to 1000 dtex, 800 dtex, 600 dtex, 400 dtex, 300 dtex or 250 dtex.

[0046] Preferably, the at least one control filament has a linear mass density of at least 20 dtex, 30 dtex, 35 dtex, 40 dtex or 50 dtex and/or of maximally 500 dtex, 420 dtex, 400 dtex, 300 dtex, 200 dtex or 150 dtex. Particularly preferred, the at least one control filament has a linear mass density between 50 dtex and 180 dtex, even more preferred between 80 dtex and 150 dtex. Preferably, the at least one control filament is realized as at least one multifilament, preferably as at least one one-piece multifilament. Preferably, the at least one multifilament comprises between 10 and 60, more preferably between 20 and 50, most preferably between 30 and 40, in particular 36, filaments having in sum the above defined preferred linear mass density. It has been found that using the control filament within the above preferred ranges represents a good compromise between too thin filaments being not thick enough to stabilize the elastic filament, in particular the rubber filament, during spinning and too thick filaments making the process themselves prone to failure. In this regard, it has been found to be particularly preferred to use two control filaments, each of which having the above preferred linear mass density.

[0047] Preferably, the at least one elastic filament is elastic in that it is capable of being stretched at least about 2 times its package length and having at least 90 % up to 100 % elastic recovery after having being released from a stretching 2 times its package length.

[0048] The elastic recovery is a parameter for the elastic performance of the at least one elastic filament as mentioned above. The elastic recovery in percent represents a ratio of the length of the elastic filament following the release of tension stress with respect to the length of the elastic performance filament prior to be subjected to said tension stress (package length). An elastic recovery having a high percentage, i.e. between 90 % and 100 %, is to be considered as providing an elastic capability of returning substantially to the initial length after the stress was applied. In this regard, the control filament, as will be mentioned below, is preferably defined by a low percentage elastic recovery, i.e. the control filament will not be able to return substantially to its initial length, if a stretching of at least two times of its initial length is realized. Said percent elastic recovery of filaments can be tested and measured according to the standard ASTM D3107, the entire content of which is expressively incorporated hereinto by reference. Said test method ASTM D3107 is a testing method for a fabric made from yarns. A yarn testing method and testing device can be used for individual measuring filaments and/or yarns. For instance, USTER TENSOR RAPID-3 device (Uster, Switzerland) is able to measure elasticity, breaking force, etc. of yarns or filaments. An example of said testing device is described in WO 2012/062480 A2 which shall be incorporated hereinto by reference.

[0049] Additionally or alternatively, an elastic filament within the meaning of the present invention can be understood as a filament having, at the maximum tensile strength according to DIN EN ISO 2062:2010-04, an elongation compared to its package length of at least 150%, 180%, 210 %, 230 % or 260%. In particular, for a rubber core in the form of a one-piece monofilament having a linear mass density of 118 dtex, an average elongation of 221 % was measured. Compared thereto, a Lycra multifilament with a linear mass density of 78 dtex had an average elongation of 261 %. In both tests, the average was calculated based on 20 tests.

[0050] Preferably, the at least one control filament is less elastic than the elastic filament, in particular it is not capable of being stretched beyond a maximum length without permanent deformation said maximum length being less than 1.5 times of its package length.

[0051] In particular, the less elastic control filament provides a safety function, which avoids overstretching of the yarn, and thereby the above described growth effect. Thereby, the elastic recovery of the filamentary core can be increased. It has been found that the use of control filaments with synthetic polymers are of particular advantage in combination with the natural rubber core in that the elastic/inelastic behavior of the control filament can be perfectly tailored to compensate differences in the elastic behavior of rubber filaments compared to elastane filaments. Thereby, at least partially biodegradable filamentary cores can be provided which, contrary to the biodegradable cores known in the art, provide similar elongation and recovery characteristics as the filamentary cores described in EP 2 145 034 B1 and in WO 2016/135211.

[0052] In particular, the less elastic control filament is less elastic in that it is not capable of being stretched about 1.5, 1.6, 1.7, 1.8, 1.9 or 2 times its package length while having at least 90 % up to 100 % elastic recovery after having being released from a stretching of 1.5, 1.6, 1.7, 1.8, 1.9 or 2 times its package length.

[0053] Preferably, the at least one control filament cannot be stretched beyond a maximum length without permanent deformation said maximum length being less than 1.5 times of its original package length. In this case, the at least one

less elastic control filament can also be called inelastic filament. Suitable inelastic control filaments include filaments formed of synthetic polymer such as polyamide, particularly nylon 6, nylon 66, PBT and the like. Further, also polyesters, polyolefins (e.g. polypropylene, polyethylene) and the like as well as mixtures and copolymers of the same can be used. For the inelastic control filament, polyester, nylon or any other synthetic with the above-mentioned definition of elasticity can be used. For instance, an elastomultiester or an elastomerel, as T400®, being a bicomponent elastic polyester can be used. T400® is produced by Invista for which two different polyesters can be extruded together.

[0054] The at least one control filament and the at least one elastic filament are spun into the filamentary core by ring spinning or by hollow spindle spinning.

[0055] Preferably, the at least one control filament is helically wrapped around the at least one elastic filament. It has been found that thereby, the control filament stabilizes the elastic filament, which improves the process stability of the manufacturing process of the filamentary core and of the subsequent yarn or fabric. The helical wrapping can in particular be realized by spinning the filamentary core by hollow spindle spinning.

[0056] It has been found to be particularly preferred to use at least two control filaments being helically wrapped around or twisted with the at least one elastic filament. In particular, the at least two control filaments are helically wrapped in particular by hollow spindle spinning in an alternating manner around the elastic filament in that each coil of one control filament is followed in length direction by a coil of the other control filament. In other words, both control filaments extend in a spiral manner around the core, wherein the inner diameter of the spirals of both control filaments are substantially equal. In yet other words preferably both of the at least two control filaments preferably contact the elastic filament in a spiral line contact. Alternatively, an inner control filament can be helically wrapped around the elastic filament thereby providing an inner protective coat while an outer control filament can be helically wrapped around the inner protective coat thereby forming an outer protective coat. The inner and the outer control filaments can be helically wrapped in the same direction or in opposing direction around the elastic filament.

[0057] It has been found that the use of two control filaments is of particular advantage in that the same stabilization of the elastic filament can be achieved as with one control filament however without making the resulting core too stiff. This can in particular be explained in that the use of two control filaments enables to increase the number of stabilizing windings per length around the elastic filament without having to increase the number of winding per length of the control filament, which seems to make the resulting core at some point to stiff.

[0058] Preferably, in a not tensioned state of the core, the at least one control filament extends relatively loose compared to the elastic filament. Such relative loose extension of the control filament allows the elastic filament to be stretched until a point is reached at which the control filament reaches its extension limit (i.e. a point where the relative looseness of the control filament has been removed in that the control filament is under tension). When reaching the extension limit, the at least one control filaments provides a resistance against further elongation thereby reducing the risk of overstretching of the elastic filament. If a tensioning force on the core is further increased, the core might further be elongated without substantial permeant deformation until a point where the at least one elastic filament and/or the control filament reach their extension limit without substantial permanent deformation as defined above.

[0059] The invention further relates to a yarn comprising a filamentary according to one or both previously explained aspects of the invention. In particular, the filamentary core can be realized according to one or more of the previously described preferred embodiments.

[0060] The yarn further comprises a fibrous sheath surrounding the filamentary core. Preferably, the filamentary core and the fibrous sheath are spun into the elastic composite yarn by ring spinning or core spinning. The fibrous sheath can comprise staple fibers and/or filaments. Preferably, the fibrous sheath consists to at least 50%, 60%, 70%, 80%, 90% or 100 % of staple fibers.

[0061] In particular, the fibrous sheath can comprise cellulosic and/or synthetic fibers (filaments and/or staple fibers). Cellulosic fibers are in particular made with ethers or esters of cellulose, which can be obtained from the bark, wood or leaves of plants, or from other plant-based material. In addition to cellulose, the fibers may particularly comprise hemi-cellulose and lignin. The cellulosic fibers can particularly be natural cellulosic fibers or manufactured (regenerated) cellulosic fibers. For instance, natural cellulosic fibers in the form of cotton fibers, silk fibers and/or linen fibers can be used. Manufactured cellulose fibers are particularly produced by processing plants into a pulp and then extruding the pulp in the same ways as synthetic fibers, such as polyester or nylon. For instance, manufactured cellulose fibers can be used in the form of rayon, lyocell (tencel), modal and/or viscose fibers. In particular, synthetic fibers are fibers made by humans with chemical synthesis. In general, synthetic fibers and/or filaments are created by extruding fiber-forming materials through spinnerets into air and water for forming the fiber. Synthetic fibers can for instance be made from crudes and intermediates including petroleum, coal, limestone and water. As synthetic fibers, for instance nylon fibers, polyester fibers, acrylic fibers, spandex fibers, aramid fibers, T400 and/or glass fibers can be used.

[0062] Particularly preferred, at least 50%, 60%, 70%, 80%, 90% or 100 % of the fibers are biodegradable fibers, in particular poised to pass ASTM D6400 as described above. In particular, such amount of fibers can be selected for instance from the group of cotton, wool, silk, flax, hemp, jute, sisal, raffia, ramie and linen. In particular if the core consists of biodegradable fibers, for instance an elastic rubber filament and at least one biodegradable control filament, the entire

yarn can be biodegradable. Additionally or alternatively, the sheath can comprise or consist of synthetic fibers, such as polyester.

[0063] Preferably, the elastic composite yarn is colored, in particular with indigo. In particular, the elastic composite yarn is ring dyed, in particular by vat dyes.

[0064] Preferably, the fibrous sheath has a linear mass density of at least 3 Ne, 3,5 Ne, 4 Ne, 5 Ne, 6 Ne, 8 Ne or 10 Ne and/or of maximally 80 Ne, 60 Ne, 55 Ne, 50 Ne, 40 Ne, 30 Ne or 20 Ne. Particularly preferred, the linear mass density is between 4 Ne and 55 Ne, more preferably between 6 Ne and 40 Ne, most preferably between 8 Ne and 30 Ne or between 10 Ne and 20 Ne.

[0065] The invention further relates to a fabric comprising a filamentary core and/or a yarn as described above. Preferably, the fabric is a woven fabric. In particular, the yarn is used in the woven fabric as at least one warp yarn and/or weft yarn, in particular for at least 10%, 25%, 50%, 75% or 100% of the warp yarns and/or the weft yarns of the fabric. Preferably, the fabric is a denim fabric. In particular, the fabric is an indigo dyed denim fabric.

[0066] A further aspect of the invention relates to a method for manufacturing a filamentary core or an elastic composite yarn. In particular, the method can be performed in that a filamentary core and/or an elastic composite yarn as previously described can be produced. Further, the filamentary core and/or the elastic composite yarn can be designed in that they can be produced with the inventive method.

[0067] The method comprises the step of spinning, in particular ring spinning or hollow spindle spinning, at least one elastic filament and the at least one control filament comprising a synthetic polymer into a filamentary core.

[0068] The skilled person knows how to conduct ring spinning and hollow spindle spinning and how to differentiate a filamentary core made by ring spinning from a core made by hollow spindle spinning. In particular, when using ring spinning, the at least one elastic filament and the at least one control filament are merged and subsequently twisted in S or Z direction by the ring-traveler system of the ring spinning frame. Thereby both, the at least one elastic filament and the at least one control filament are twisted. By using hollow spindle spinning, the at least one control filament can be helically wrapped around the at least one elastic filament in particular without twisting the at least one elastic filament.

[0069] In particular, hollow spindle spinning can be conducted as disclosed in WO2020/084361 A1 which is hereby incorporated by reference. In particular, the hollow spindle spinning can be realized as described with respect to figures 1 and 2 of WO2020/084361, wherein the elastic fiber used therein shall be exchanged by at least one of the previously described at least one elastic filament and the covering yarn described therein shall be exchanged by at least one of the previously described at least one control filament. In particular, the at least one control filament is helically wrapped around the at least one elastic filament by hollow spindle spinning.

[0070] In particular, the synthetic polymer can be selected as described above. According to one option of this aspect of the invention, the at least one elastic filament comprises rubber, preferably natural rubber. The rubber core can in particular be selected, in particular its material and/or linear mass density, as described above. According to a second option of this aspect of the invention, which can be combined with the previous option, the at least one control filament is biodegradable. The biodegradability can be realized by the use of biodegradability enhancing additive which can be selected as described above and/or by the use of a material, such as a polymer, forming the control filament, which is biodegradable itself, for example by using an appropriate aliphatic polyester, for instance as those described above.

[0071] Preferably, during spinning, the at least one elastic filament is drafted with a draft ratio between 1,5 and 5,0, more preferably between 1,9 and 4,2, most preferably between 2,5 and 3,5. Additionally or alternatively, the control filament is drafted within a range of 1,0 (i.e. no draft) and 1,2, more preferably between 1,05 and 1,15, most preferably between 1,07 and 1,12. Additionally or alternatively, the draft ratio of the at least one elastic filament is preferably at least 0,3, 0,5, 0,7, 1,0, 1,2 or 1,5 larger than the draft ratio of the at least one control filament.

[0072] In particular, the draft ratio is the ratio between the length of a stock filamentary strand from a package thereof which is fed into a spinning machine to the length of the filamentary strand delivered from the spinning machine. A draft ratio of greater than 1.0 is thus a measure of the reduction in bulk and weight of the stock filamentary strand. In particular, package length is the length of a tensioned filament or yarn forming a package of the same.

[0073] Preferably, the at least one control filament and the at least one elastic filament are spun, in particular ring spun or hollow spindle spun, in such a manner that, after the spinning process, the at least one control filament has a length surplus compared to the at least one elastic filament, in other words is in a relatively loose state. Thus, between the initiation of stretching up to a certain point of stretching, the filamentary core can be stretched while only the elastic filament but not the control filament provides a recovery force. After that point, the control filament becomes active in providing a recovery force thereby protecting the core from overstretching and the resulting undesired growth. Such relatively loose state of the at least one control filament can in particular be realized by choosing a respective draft ratio difference, for instance as described above, in combination with a respective rotational speed of the spinning arrangement

[0074] Preferably, the method further comprises the step of spinning, in particular ring spinning, a fibrous sheath around the filamentary core. In particular, the fibrous sheath is designed as explained above. Preferably the fibrous sheath is spun around the filamentary core by core spinning. Core spinning particularly comprises the introduction of the filamentary core into a stream of staple fibers so that the staple fibers of the resulting yarn more or less cover the

filamentary core.

[0075] In particular, the filamentary core is produced in a first step and surrounded with the fibrous sheath in a second step. For instance, the filamentary core is produced in a first step by hollow spindle spinning and the fibrous sheath is covered in a second step around the filamentary core by core spinning.

[0076] Alternatively, the filamentary core and the fibrous sheath surrounding the filamentary core can be realized in one step. For instance, the at least one elastic filament and the at least one control filament can be merged and conveyed together into the middle of a sliver which is then spun around both filaments by core spinning thereby forming the filamentary core and the fibrous sheath surrounding the filamentary core in one step.

[0077] Further aspects, properties and features of the invention will become apparent and more appreciated from the following description of exemplary embodiments, taken in conjunction with the accompanying drawings, in which are dedicated:

Fig. 1: a schematic drawing of a filamentary core produced by hollow spindle spinning;

Fig. 2 a schematic drawing of an elastic composite yarn comprising the filamentary core of figure 1;

Fig. 3 a schematic drawing of an alternative filamentary core produced by hollow spindle spinning;

Fig. 4 a schematic drawing of a filamentary core produced by ring spinning

Fig. 5 a schematic illustration of a S-twist in an elastic filament spun into a filamentary core by ring spinning; and

Fig. 6 a schematic illustration of a Z-twist in an elastic filament spun into a filamentary core by ring spinning.

[0078] In Fig. 1, a filamentary core 1 produced by hollow spindle spinning is shown in which the elastic filament is dedicated with reference sign 3. In the example of Fig. 1, the at least one control filament comprises two control filaments which are dedicated with reference signs 5 and 7. In this illustrated embodiment, the elastic filament 3 and each of the control filaments 5 and 7 are one-piece monofilaments.

[0079] The two control filaments 5, 7 are helically wrapped around the elastic filament 3 thereby forming a protective coat which stabilizes the core for the further processing into a yarn and for the further processing of the yarn into a fabric. In Fig. 1, the at least two control filaments 5, 7 are wrapped in an alternating manner around the elastic filament 3 in that each coil 5C of one control filament 5 is followed in length direction by a coil 7C of the other control filament 7. In other words, both control filaments 5, 7 extend in a spiral manner around the core 4, wherein the inner diameter of the spirals of both control filaments are substantially equal. In yet other words preferably both of the at two control filaments 5, 7 contact the elastic filament in a spiral line contact.

[0080] Figure 3 schematically shows an alternative embodiment of a filamentary core produced by hollow spindle spinning, in which an inner protective coat is formed by an inner control filament 5 being helically wrapped around the elastic filament 3 and an outer protective coat is formed by an outer control filament 7 being helically wrapped on the outside of the inner protective coat. In the example shown in figure 3, the inner control filament 5 is helically wrapped in anti-clockwise direction while the outer control filament 7 is helically wrapped in clockwise direction. In alternative embodiments (not shown), the inner control filament 5 can be helically wrapped in clockwise direction while the outer control filament 7 can be helically wrapped in anti-clockwise direction. In yet other embodiments (not shown), both control filaments 5, 7 can be helically wrapped in the same direction.

[0081] Figure 4 is intended to schematically illustrates differences between a filamentary core 1 produced by ring spinning, as shown in figures 1 and 3, and of a filamentary core produced by ring spinning, as schematically sketched in figure 4. While hollow spindle spinning provides the filamentary core 1 with a protective coat of coils 5c, 7c, helically surrounding the elastic filament 3, ring spinning provides a filamentary core 1 in which both, the elastic filament and the control filament 5 are twisted with respect to each other around a twist axis (dotted line in figure 4). Depending on the material used for the elastic filament 3 and the control filament 5 and the spinning parameters, the filaments 3, 5 can retract to a different degree after spinning so that one filament might extend looser than another one. In Figure 4, an example is illustrated in which the elastic filament 3 retracts stronger after spinning, leaving the control filaments 5 with a length surplus, in other words in a relatively loose state compared to the elastic filament. In figure 4, as a result of the ring spinning operation, the elastic filament 3 is not completely straight but slightly helically twisted.

[0082] Another difference between a filamentary core 1 being spun by hollow spindle spinning compared to a filamentary core being spun by ring spinning can be seen in the twist of the elastic filament 3. In particular, when using ring spinning, the at least one elastic filament 3 and the at least one control filament 5 are merged and subsequently twisted in S direction (figure 5) or Z direction (figure 6) by the ring-traveler system of the ring spinning frame. Thereby both, the at least one elastic filament 3 and the at least one control filament 5 are twisted. Even if the elastic filament 3 completely

retracts to a straight filament after spinning, as schematically illustrated in figures 5 and 6, the elastic filament will remain twisted around its own longitudinal axis (indicated in figures 5 and 6 by the inclined lines in the elastic filament 3). Contrary thereto, when using hollow spindle spinning, the elastic filament 3 remains untwisted. Further, as indicated by the S and Z in figures 5 and 6, when using ring spinning, the control filament 5 being twisted with the elastic filament 3, will be twisted in the same direction as the elastic filament 3.

[0083] Figure 2 illustrates an exemplary embodiment of the elastic composite yarn 9 comprising the filamentary core 1 shown in Fig. 1 and a sheath 11 of staple fibers surrounding the fibrous core 1, wherein the sheath 11 was spun around the core by core spinning.

[0084] The features disclosed in the above description, the figures and the claims may be significant for the realisation of the invention in its different embodiments individually as in any combination.

Reference signs:

[0085]

- 1 filamentary core
- 3 elastic filament
- 5, 7 control filament
- 5C coil of control filament 5
- 7C coil of control filament 7
- 9 composite yarn

Claims

1. A filamentary core (1) for a composite yarn (9) for a woven fabric, comprising
 - at least one elastic filament (3) comprising rubber, preferably natural rubber, and
 - at least one control filament (5, 7) comprising a synthetic polymer.
2. The filamentary (1) core according to claim 1, wherein the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, a polybutyleneterephthalate, polyalkyleneterephthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate (PBT), a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyethyleneterephthalate or a mixture of two or more thereof, most preferred is a polyester.
3. The filamentary core (1) of claim 2, wherein the polyester is an aliphatic polyester.
4. The filamentary core (1) according to one of the preceding claims, wherein the elastic (3) filament contains at least 80 wt.% of cis-1,4-polyisoprene with respect to the total weight of the elastic filament (3).
5. The filamentary core (1) according to one of the preceding claims, wherein the elastic filament (3) further contains one or more of the group consisting of a vulcanization agent; a vulcanization accelerator; a vulcanization activator; an anti-tacking agent; an antioxidant agent; and a stabilization agent.
6. The filamentary core (1) according to one of the preceding claims, wherein the control filament (5, 7) further comprises a biodegradability enhancing additive.
7. A filamentary core (1), in particular according to one of the preceding claims, for a composite yarn for a woven fabric, comprising
 - at least one elastic filament (3), and
 - at least one biodegradable control filament (5, 7) comprising a synthetic polymer.
8. The filamentary core (1) of claim 7, wherein the at least one biodegradable control filament comprises a biodegradability enhancing additive and/or wherein the synthetic polymer is an aliphatic polyester.

9. The filamentary core (1) according to one of the claims 6 or 8, wherein the biodegradability enhancing additive comprises one or more selected from the group consisting of starch; a bioaugmentation additive, preferably a microbial strain; a pro-oxidant, preferably a transition metal complex and/or a transition metal ion, wherein the transition metal is preferably iron, manganese or cobalt; and a composition comprising ether.
10. The filamentary core (1) according to any of the of the claims 6, 8 or 9, wherein the biodegradability enhancing additive comprises starch, preferably is a composition comprising starch and ether.
11. The filamentary core (1) according to one of the preceding claims, wherein the at least one elastic filament (3) and/or control filament (5, 7) is biodegradable, in particular has a biodegradability poised to pass ASTM D6400.
12. The filamentary core (1) according to any of the preceding claims, wherein the at least one elastic filament (3) has a linear mass density of less than 200 dtex, 180 dtex, 160 dtex or 140 dtex or 130 dtex and/or of at least 30 dtex, 40 dtex, 50 dtex, 60 dtex or 70 dtex, 80 dtex, 90 dtex or 100 dtex.
13. The filamentary core (1) according to any of the preceding claims, wherein the at least one control filament (5, 7) has a linear mass density of at least 20 dtex, 30 dtex, 35 dtex, 40 dtex or 50 dtex and/or of maximally 500 dtex, 420 dtex, 400 dtex, 300 dtex, 200 dtex, or 150 dtex.
14. The filamentary core (1) according to any of the preceding claims, wherein the at least one elastic filament (3) is elastic in that it is capable of being stretched at least about 2 times its package length and having at least 90 % up to 100 % elastic recovery after having being released from a stretching 2 times its package length.
15. The filamentary core (1) according to any of the preceding claims, wherein the at least one control filament (5, 7) is less elastic than the elastic filament, in particular is not capable of being stretched beyond a maximum length without permanent deformation said maximum length being less than 1.5 times of its package length.
16. The filamentary core (1) according to one of the preceding claims, wherein the at least one control filament and the at least one elastic filament are spun into the filamentary core by ring spinning.
17. The filamentary core (1) according to one of the preceding claims, wherein the at least one control filament and the at least one elastic filament are spun into the filamentary core by a hollow spindle spinning.
18. The filamentary core (1) according to any of the preceding claims, wherein the at least one control filament (5, 7) is helically wrapped around the at least one elastic filament (3), in particular wherein the at least one control filament (5, 7) comprises at least two control filaments (5, 7) being helically wrapped around the at least one elastic filament (3).
19. An elastic composite yarn (9) comprising
 - a filamentary core (1) according to any of the preceding claims, and
 - a fibrous sheath (11) surrounding the filamentary core (1), in particular wherein the filamentary core and the fibrous sheath are spun into the elastic composite yarn by ring spinning or core spinning.
20. The elastic composite yarn (1) according to claim 19, wherein the sheath has a linear mass density of at least 3 Ne, 3,5 Ne, 4 Ne, 5 Ne, 7 Ne or 10 Ne and/or of maximally 80 Ne, 60 Ne, 55 Ne, 50 Ne, 30 Ne or 20 Ne.
21. A fabric, in particular a woven fabric, such as a denim fabric, comprising a filamentary core (1) according to any of the claims 1 to 18 or an elastic composite yarn (9) according to claim 19 or 20.
22. A method for manufacturing a filamentary core (1), in particular according to one of the claims 1 to 18, or an elastic composite yarn (9), in particular according to one of the claims 19 or 20, comprising the step of
 - spinning, in particular ring spinning or hollow spindle spinning, at least one elastic filament (3) and at least one control filament (5, 7) comprising a synthetic polymer into a filamentary core (1), wherein the at least one elastic filament (3) comprises rubber, preferably natural rubber, and/or the at least one control filament is biodegradable, and optionally the step of
 - spinning, in particular ring spinning or core spinning, a fibrous sheath (11) around the filamentary core (1) to obtain an elastic composite yarn (9).

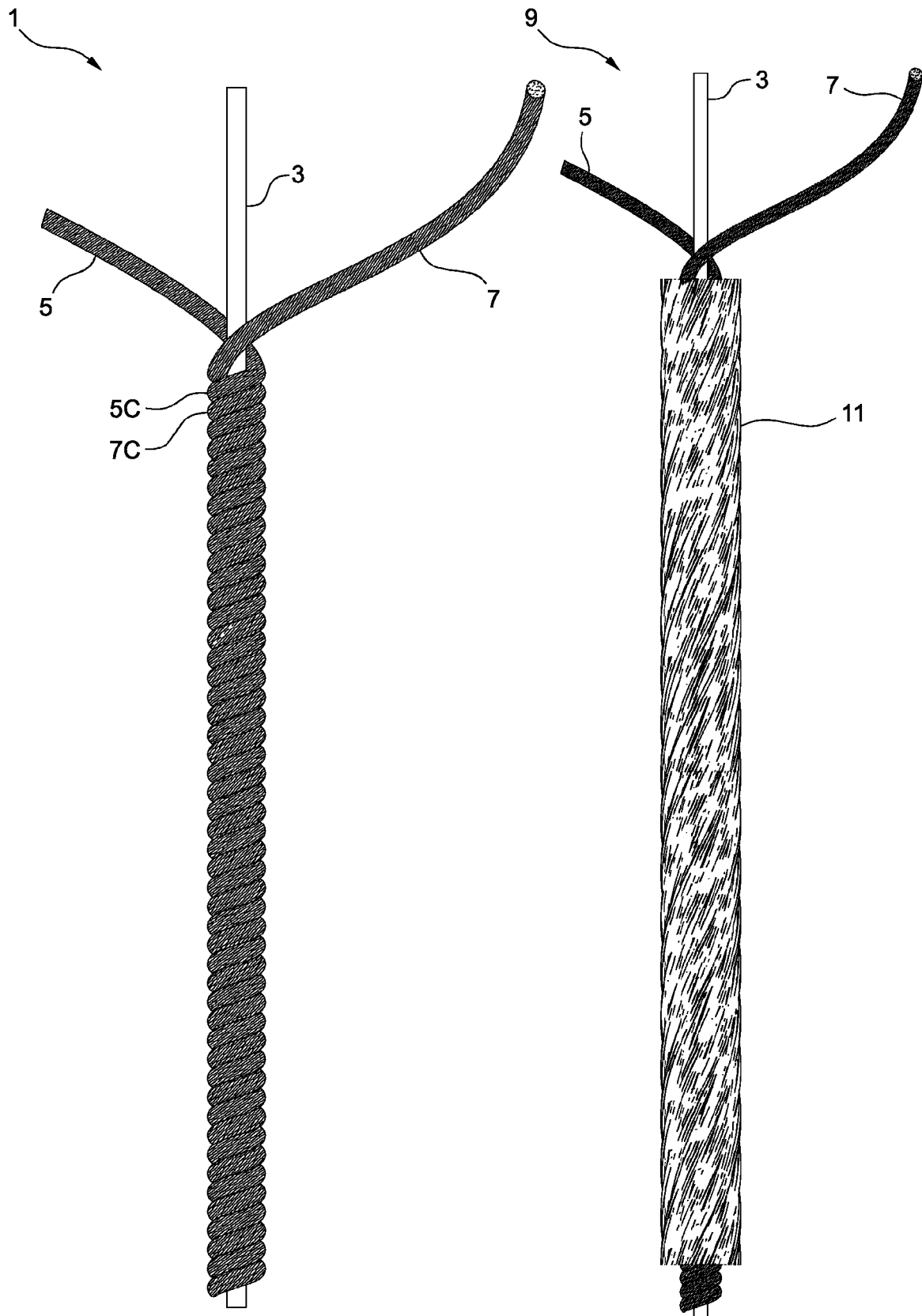


Fig. 1

Fig. 2

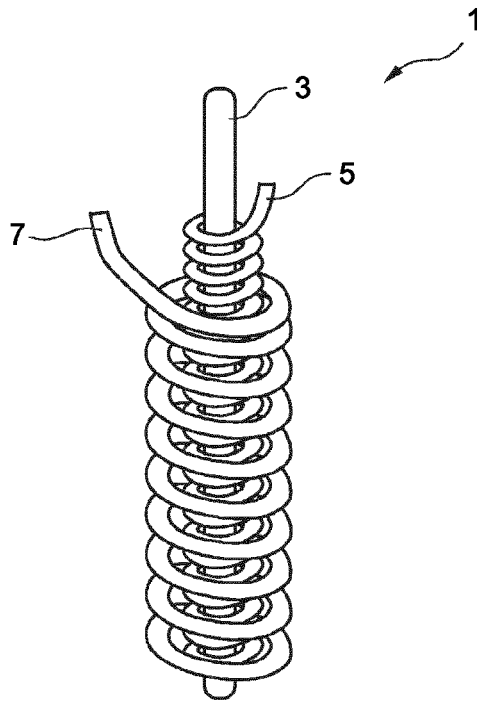


Fig. 3

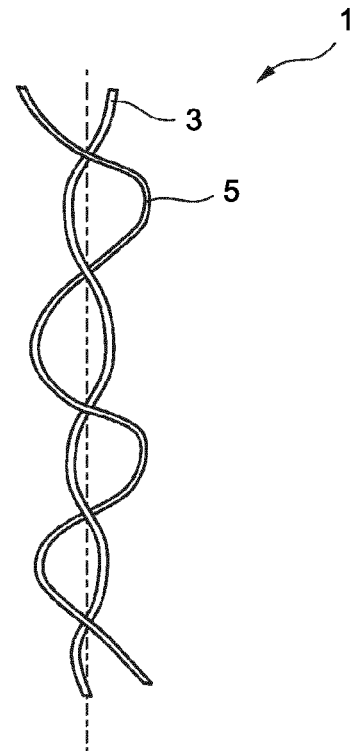


Fig. 4

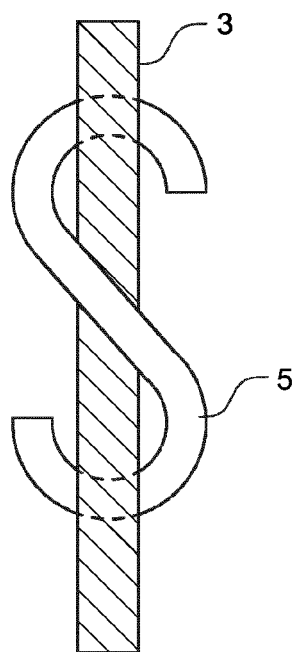


Fig. 5

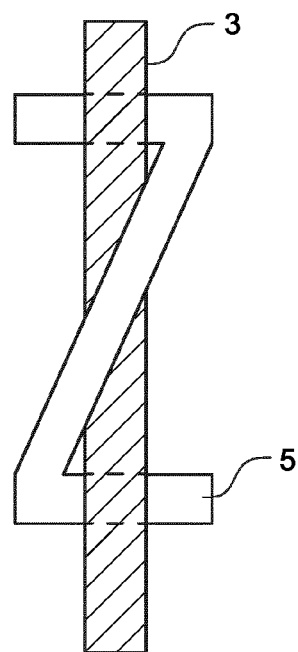


Fig. 6



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 22 March 2022	Examiner Pollet, Didier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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