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(54) **ELASTIC LINEN YARN**

(57) The present invention relates to a linen yarn which is highly spinnable and with good elasticity and characterized by hygroscopicity, lightness, shine, permeability to air, antibacterial properties and mite-inhibiting properties. The invention also relates to fabrics obtained therefrom characterized by softness, high transpiration, ability to absorb sweat, antibacterial properties and good

elasticity.

In particular, the present invention relates to an elastic linen yarn (1), comprising a core (2) composed of an elastic thread (E) embedded in an outer linen-based body (3), in which said elastic linen yarn can be obtained by wet spinning a linen roving or a roving of an intimate mixture of linen with natural, artificial or synthetic fibers.

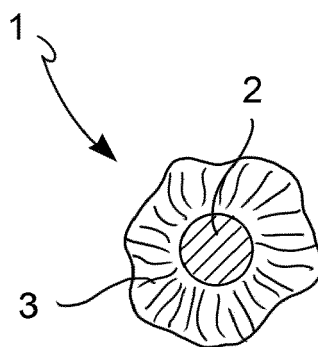


FIG. 5

Description

[0001] The present invention relates to a linen yarn which is highly spinnable and with good elasticity and characterized by hygroscopicity, lightness, shine, permeability to air, antibacterial properties and mite-inhibiting properties. The invention also relates to fabrics obtained therefrom characterized by softness, high transpiration, ability to absorb sweat, antibacterial properties and good elasticity.

Background art

[0002] Flax is an upright stemmed plant with smooth leaves and white or blue flowers which produce a capsule containing ten seeds. The botanical name thereof, *Linum usitatissimum*, indicates the most widely used type of flax. Lightly branched and with small flowers, the long-staple variety reaches a height of 80-120 cm and is grown to produce fiber.

[0003] The plant is uprooted from the ground in order to use the maximum length of the stalk and roots. The stalks undergo a series of processes to free the fibers from the rubbery substances binding them and to separate them from the wood residues and seeds. The number of fiber bundles present in the bark varies from 20 to 50 per stalk.

[0004] Maceration is a natural process which serves to break up the pectins, i.e., those rubbery substances enveloping the fibers, bringing them together in bundles and making them adhere to the cells of the bark. The pectins must be eliminated in order for the technical fibers, an agglomeration of elementary fibers collated by pectins and waxes, to be separated from the rest of the stalk. The maceration is due to special enzymes produced by micro-organisms (bacteria) which proliferate in the stalks spread on the fields after the uprooting (ground maceration) or soaked in water (water maceration).

[0005] The mechanical separation of the technical textile fibers from the rest of the macerated stalks is obtained by scutching. The scutched "long-staple" flax must be "combed" by means of combing machines which remove the impurities and shorter fibers. The combed fiber in web form is then mixed and refined by means of drawing frames to form, by means of a spindle bench, a roving which is wound on special spools and is hot bleached.

[0006] At this point the fiber is ready for spinning, which can be dry or wet, in the latter case by immersing the fiber in water at 25-30°C and passing it to the spinning machine to obtain thin and regular threads.

[0007] The weaving of the linen yarn leads to a fabric composed of 70% cellulose, solid, resistant to tearing and wear, hardly elastic and which does not lose the shape thereof. It has antistatic properties, absorbs moisture and lets skin breathe. Linen is so resistant that on average it withstands 35% more washes than cotton.

[0008] The poor elasticity of linen, which for certain applications can be seen as an advantage, such as in the

case of curtains or tablecloths, has the unpleasant consequence of having very little resistance to wrinkling, which is a problem felt above all in the field of clothing.

[0009] Linen yarns have been obtained by twisting or spiraling the linen yarn about an elastic fiber, but such yarns have shown a non-optimal behavior towards dyeing, since the color of the fabric is uneven.

Summary of the Invention

[0010] The problem addressed by the present invention is therefore that of providing a linen yarn which has good elasticity, but which retains the original color-taking properties unaltered during the dyeing process.

[0011] Such problem is overcome by an elastic linen yarn as delineated in the appended claims, the definitions of which form an integral part of the present description.

[0012] In particular, the object of the invention is an elastic linen yarn comprising a core consisting of an elastic thread embedded in an outer linen-based body or an intimate mixture of linen and natural, artificial or synthetic fibers and in which the elastic yarn is preferably a polyurethane elastomer, more preferably Elastane.

[0013] Another object of the invention is a fabric made with the elastic linen yarn of the invention and garments, such as jackets, trousers or skirts, made with this fabric.

[0014] A further object of the invention is a wet spinning method for manufacturing the elastic linen yarn, comprising the following steps:

- a) providing a linen roving or a roving consisting of an intimate mixture of linen and a natural, artificial or synthetic fiber;
- b) wetting said roving from step a);
- c) causing said wet roving from step b) together with an elastic thread to pass through a drafting zone comprising a retaining cylinder, a pre-drafting cylinder and a drafting cylinder, wherein the elastic thread is joined centrally to the roving at the drafting cylinder;
- d) applying a twist to said roving from step c) by means of a rotating spindle to form a reel of elastic linen yarn.

[0015] Still another object of the invention is a wet-spinner for spinning the elastic linen yarn of the invention, comprising a plurality of spinning units, in which each spinning unit comprises, in the order from top to bottom:

- at least one spool onto which the roving made of linen or intimate mixture of linen and a natural, artificial or synthetic fiber is wound, in the shape of a web;
- a pair of motorized rollers which act on a reel of elastic thread for unwinding the elastic thread;
- a tray filled with warm water for wetting the roving, a motorized cylinder synchronized with the unwinding speed of the roving from the spool being im-

mersed in the tray;

- a drafting zone comprising, in sequence, a first pair of cylinders, referred to as "retaining cylinders", a second pair of cylinders, referred to as "pre-drafting cylinders", and a third pair of cylinders, referred to as "drafting cylinders", in which the pairs of cylinders each comprise a motorized cylinder and an idly mounted pressure cylinder configured so as to be coupled to each other and so as to allow to drive the pressure cylinder by means of the controlled rotation of the motorized cylinder, in which the rotation speed of the third pair of cylinders is greater than the rotation speed of the first pair of cylinders, so as to produce a drafting of the fibers forming the roving;
- a guide roller for the elastic thread which slides outside the first and second pairs of cylinders, configured so as to feed the elastic thread immediately upstream of the third pair of cylinders and in a central position with respect to the web of the roving;
- a rotating spindle configured so as to apply a twist to the roving, thus transforming it into the elastic linen yarn.

[0016] Further features and advantages of the present invention will be more apparent from the description of embodiments, given here below by way of nonlimiting example, with reference to the following figures:

Figure 1 shows a sectional side view of a wet-spinner according to the invention;

Figure 2 shows a sectional side view of a detail of the wet-spinner of figure 1;

Figure 3 is a partial perspective view of the detail of figure 2;

Figure 4 is an enlarged perspective view of a detail of figure 3;

Figure 5 shows an enlarged sectional view of the elastic yarn according to the invention.

Detailed description of the invention

[0017] The elastic linen yarn according to the present invention, indicated with the number 1, comprises a core 2 consisting of an elastic thread embedded in an outer linen-based body 3.

[0018] The term "outer linen-based body" means a thread body consisting of 100% linen or an intimate mixture of linen and an artificial or synthetic fiber.

[0019] In preferred embodiments, the outer linen-based body 3 comprises a percentage by weight of linen from 70% to 100%, preferably from 77% to 100%, and a percentage by weight from 0% to 30%, preferably from 0% to 23%, of a natural, artificial or synthetic fiber, in which the natural fiber is preferably selected from cotton, hemp, silk, wool, angora, cashmere, mohair and vicuna, the artificial fiber is preferably selected from viscose rayon, cuprammonium rayon, cellulose nitrate, cellulose diacetate, cellulose triacetate, and the synthetic fiber is pref-

erably selected from acrylic, nylon (polyamide) and polyester.

[0020] More preferably, the outer linen-based body 3 consists of 100% linen or an intimate mixture comprising linen from 77% to 85% by weight and nylon fiber from 15% and 23% by weight.

[0021] In preferred embodiments, the elastic thread forming the core 2 is a polyurethane elastic fiber, more preferably Elastane (known by the brand name Lycra®).

[0022] In preferred embodiments, the elastic linen yarn 1 of the invention comprises a percentage of elastic yarn by weight from 5% to 15%, more preferably from 8% to 10%.

[0023] The elastic linen yarn 1 of the invention has a spinning yarn count from 24 to 28, preferably about 26 Nm (where Nm is the metric number, i.e., the number of kilometers of yarn needed to reach the weight of 1 kg) and has an average breaking strength from 500 to 600 g (standard ISO 2062) and an average elongation at break from 4% to 5% (standard ISO 2062).

[0024] The elastic linen yarn 1 of the invention is homogeneous to dyeing both in the form of yarn and fabric, i.e., there are no chromatic inhomogeneities due to a different degree of color-taking between the linen fiber and the elastic yarn, unlike what occurs with elastic linen yarns which are twisted, covered or spiraled according to the background art. This is due to the fact that the elastic thread core 2 is completely embedded in the outer linen-based body 3, as can be obtained with the method described below.

[0025] The method for preparing the elastic linen yarn 1 according to the present invention is a wet spinning method and comprises the following steps:

- a) providing a linen roving or a roving consisting of an intimate mixture of linen and a natural, artificial or synthetic fiber as described above;
- b) wetting said roving from step a);
- c) causing said wet roving from step b) together with an elastic thread to pass through a drafting zone comprising a retaining cylinder, a pre-drafting cylinder and a drafting cylinder, wherein the elastic thread is joined centrally to the roving at the drafting cylinder;
- d) applying a twist to said roving from step c) by means of a rotating spindle to form a reel of elastic linen yarn 1.

[0026] Step a) can be carried out in accordance with known methods which include the maceration of the flax stalks to obtain the fibers therefrom, the combing of the fibers to remove the impurities and the shorter fibers, which will form the tow, the formation of the roving on special spools using a spindle bench and bleaching by boiling in the presence of bleaching substances.

[0027] In the case of intimate mixtures of linen and other fibers as described above, the step of forming the roving on a spindle bench is the same.

[0028] The term "roving" means a very light linen web to which has been imparted, by means of the spindle bench, a small twist per meter (about 30-35 RPM). This twist prevents the roving from opening irregularly during the subsequent spinning stages, giving rise to uncontrolled elongations.

[0029] For the preparation of the elastic linen yarn 1 of the invention, "long-staple" linen fibers are used, i.e., fibers with a length of about 70 cm.

[0030] The wet spinning process according to the invention allows to have very fine counts and to produce a yarn with high features. In this process, the roving spool is previously wetted before being mounted on the spinning machine.

[0031] The steps b), c) and d) are carried out on a spinning machine 100, shown in figures 1-4, of the type usable for the wet spinning of linen, but which has been specifically designed for the method of the invention.

[0032] With reference to figures 1-4, the spinning machine 100 comprises a supply creel 101, visible in cross-section in figure 1, having the shape of a long rack which supports a plurality of spinning units 102 arranged specularly on both longitudinal sides 101a, 101b of the creel 101.

[0033] The supply creel 101 comprises a lower portion 101' and an upper portion 101'', in which said upper portion 101'' projects outwards, in a direction perpendicular to the longitudinal sides 101a, 101b, with respect to the lower portion 101'.

[0034] Each spinning unit 102 comprises a suspension bar 103 for the spools 104 on which the roving is wound. The suspension bars 103 are fixed specularly on a central structure 105 which comprises a base 106 for support on the ground.

[0035] The suspension bar 103 also supports a guide roller 107 for the roving S unwound from the spool 104.

[0036] On the central structure 105, below the suspension bar 103, a support 108 is positioned for a pair of motorized rollers 109a, 109b which act on a reel 110 of elastic thread E - which will form the core 2 of the yarn of the invention - for the winding thereof. The motorized rollers 109a, 109b are moved by a gearmotor (not shown) operated by an inverter which in turn receives the consent to operate from the control motor of the drafting assembly (not shown). The tension of the elastic thread can be adjusted by means of the inverter.

[0037] On the central structure 105 there is further fixed, under the support 108 for the pair of motorized rollers 109a, 109b, a tray 111 filled with warm water, for wetting the roving S. A motorized cylinder 112 is immersed in the tray 111, synchronized with the unwinding speed of the roving S from the spool 104, configured so as to assist the unwinding of the roving S and to direct the roving S so that it is immersed in the water and is therefore subjected to re-wetting. The edge 111a of the tray 111 allows the roving S to be redirected towards the drafting zone.

[0038] The drafting zone 113 is positioned below the

tray 111, better visible in figure 2. The term "drafting zone" means the member which performs the function of drafting and opening the fibers of the roving immediately upstream of the transformation thereof into yarn.

[0039] The drafting zone 113 comprises a support structure 114, which departs from the central structure 105 of the creel 101 and which comprises in sequence a first pair of cylinders 115, referred to as "retaining cylinders", a second pair of cylinders 116, referred to as "pre-drafting cylinders", and a third pair of cylinders 117, referred to as "drafting cylinders".

[0040] The pairs of cylinders 115, 116, 117 each comprise a motorized cylinder 115a, 116a, 117a and an idle pressure cylinder 115b, 116b, 117b, configured so as to be coupled to each other and so as to allow to drive the pressure cylinder 115b, 116b, 117b by means of the controlled rotation of the motorized cylinder 115a, 116a, 117a. The rotation speed of the third pair of cylinders 117 is greater than the rotation speed of the first pair of cylinders 115, so as to produce a drafting of the fibers forming the roving S.

[0041] The motorized cylinder 115a of the first pair of cylinders 115 is knurled on the surface, while the motorized cylinders 116a, 117b of the second and third pair of cylinders 116, 117 have a smooth surface. In particular, the pressure cylinder 117b of the third pair of cylinders 117 has an elastic surface made of rubber or other elastomer. Vice versa, the pressure cylinders 116b, 117b of the second and third pair of cylinders 116, 117 have a knurled surface.

[0042] The roving S passes through said pairs of cylinders 115, 116, 117, as shown in figures 2 and 3, so that the unwinding of the roving S is controlled by the first pair of cylinders 115, the second pair of cylinders 116 starts the opening and control of the fibers of the roving S and the third pair of cylinders 117 completes this action.

[0043] The support structure 114 of the drafting zone 113 also comprises a guide roller 118 for the elastic thread E which slides outside the first and second pair of cylinders 115, 116.

[0044] The guide roller 118 is idly mounted and comprises a base ring 118a from which a truncated cone-shaped body 118b protrudes, flaring away from the base ring 118a. In this way, the elastic thread E is kept at the connection groove 118c between the base ring 118a and the truncated cone-shaped portion 118b. Thereby, the elastic thread E can be suitably centered on the roving S at the third pair of cylinders 117, the elastic thread E being introduced immediately upstream of said third pair of cylinders 117, as shown in figure 4.

[0045] On the support structure 114, upstream of the guide roller 118 with respect to the unwinding direction of the elastic thread E, there is a balance wheel member 119 comprising an abutment rod 119a for the elastic thread E, so as to keep it tensioned before the passage on the guide roller 118 and subsequently between the third pair of cylinders 117. The latter adjust the unwinding of the elastic thread E in synchrony with the roving S.

[0046] With reference again to figure 1, the roving S, in which the fibers have been opened and drafted to form a substantially flat web and onto which, in a central position, the elastic thread E is coupled, is wound on the rotating spindle 120 configured so as to apply a twist to the roving S, thus transforming it into the elastic yarn 1 of the invention. This twist causes the linen fibers or an intimate mixture of linen and other natural, artificial or synthetic fibers to be wound onto the elastic thread E, which then remains embedded in the outer linen-based body 3 to form the core 2 thereof.

[0047] The result is a yarn which combines the properties of linen, including good dye-taking, with an appreciable elasticity.

[0048] The rotation speed of the spindle 120 is preferably from 6000 to 7000 rpm, more preferably about 6500 rpm.

[0049] The elastic yarn 1 can subsequently be woven according to conventional techniques, preferably by shuttle weaving, obtaining a fabric with a regular, smooth, clean, soft and flexible appearance, particularly adapted to dyeing and characterized by high freshness, antibacterial properties and limited aptitude to wrinkling.

[0050] The linen-based elastic yarn 1 of the present invention can even be worked according to circular knitting techniques, having the same advantages as the fabric.

[0051] During the fabric finishing step, a heat-setting step can be carried out at a temperature of about 190°C, so as to preserve the elastic properties conferred by the core 2 of elastic thread E.

[0052] The fabric obtained with the elastic yarn 1 of the invention is particularly adapted to making garments, such as jackets, trousers and shirts for men or women.

[0053] Clearly only a few particular embodiments of the present invention have been described, so an expert skilled in the art will be able to make all of the necessary changes for the adaptation thereof to particular applications, without thereby departing from the scope of protection defined by the claims of the present invention.

Claims

1. An elastic linen yarn (1), comprising a core (2) consisting of an elastic thread (E) embedded in an outer linen-based body (3).
2. The yarn (1) according to claim 1, wherein the outer body (3) is a thread body consisting of 100% linen or by an intimate mixture of linen and an artificial or synthetic fiber.
3. The yarn (1) according to claim 2, wherein the outer body (3) comprises a percentage by weight of linen from 70% to 100%, or from 77% to 100%, and a percentage by weight from 0% to 30%, or from 0% to 23%, of a natural, artificial or synthetic fiber.

4. The yarn (1) according to claim 3, wherein the natural fiber is selected from cotton, hemp, silk, wool, angora, cashmere, mohair and vicuna, the artificial fiber is selected from viscose rayon, cuprammonium rayon, cellulose nitrate, cellulose diacetate, cellulose triacetate, and the synthetic fiber is selected from acrylic, nylon (polyamide) and polyester.
5. The yarn (1) according to any one of claims 1 to 4, wherein the outer linen-based body (3) consists of an intimate mixture comprising linen from 77% to 85% by weight and nylon fiber from 15% to 23% by weight.
6. The yarn (1) according to any one of claims 1 to 5, wherein the elastic thread (E) forming the core (2) is an elastic polyurethane fiber, preferably Elastane.
7. The yarn (1) according to any one of claims 1 to 6, wherein the elastic yarn (1) comprises a percentage by weight of elastic thread from 5% to 15%, or from 8% to 10%.
8. The elastic yarn (1) according to any one of claims 1 to 7, wherein the elastic yarn (1) has a spinning yarn count from 24 to 28, or about 26 Nm, and an average breaking strength from 500 to 600 g (standard ISO 2062) and an average elongation at break from 4% to 5% (standard ISO 2062).
9. A fabric made from the elastic linen-based yarn (1) according to any one of claims 1 to 8.
10. An item of clothing made from the fabric according to claim 9.
11. A wet spinning method for manufacturing the elastic yarn (1) according to any one of claims 1 to 9, comprising the following steps:
 - a) providing a linen roving (S) or a roving (S) consisting of an intimate mixture of linen and a natural, artificial or synthetic fiber;
 - b) wetting said roving (S) from step a);
 - c) causing said wet roving (S) from step b) together with an elastic thread (E) to pass through a drafting zone comprising a retaining cylinder, a pre-drafting cylinder and a drafting cylinder, wherein the elastic thread (E) is joined centrally to the roving (S) at the drafting cylinder;
 - d) applying a twist to said roving (S) from step c) by means of a rotating spindle to form a reel of elastic linen yarn (1).
12. The method according to claim 11, wherein the linen in said roving (S) consists of "long-staple" linen fibers with a length of about 70 cm.

13. A wet-spinner (100) for carrying out the method according to claim 11 or 12, comprising a plurality of spinning units (101), wherein each spinning unit (101) comprises, in the order from top to bottom:

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- at least one spool (104) onto which the roving (S) made of linen or intimate mixture of linen and a natural, artificial or synthetic fiber is wound, in the shape of a web;
- a pair of motorized rollers (109a, 109b), which act on a reel (110) of elastic thread E for unwinding the elastic thread (E); 10
- a tray (111) filled with warm water for wetting the roving (S), a motorized cylinder (112) synchronized with the unwinding speed of the roving (S) from the reel (104) being immersed in the tray (111); 15
- a drafting zone (113) comprising, in sequence, a first pair (115) of cylinders, referred to as "retaining cylinders", a second pair (116) of cylinders, referred to as "pre-drafting cylinders", and a third pair (117) of cylinders, referred to as "drafting cylinders", wherein the pairs (115, 116, 117) of cylinders each comprise a motorized cylinder (115a, 116a, 117a) and an idly mounted pressure cylinder (115b, 116b, 117b), configured so as to be coupled to each other and so as to allow to drive the pressure cylinder (115b, 116b, 117b) by means of the controlled rotation of the motorized cylinder (115a, 116a, 117a), wherein the rotation speed of the third pair (117) of cylinders is greater than the rotation speed of the first pair (115) of cylinders, so as to produce a drafting of the fibers forming the roving (S); 20
- a guide roller (118) for the elastic thread (E) which slides outside the first and second pairs (115, 116) of cylinders, configured so as to feed the elastic thread (E) immediately upstream of the third pair (117) of cylinders and in a central position with respect to the web of the roving (S); 25
- a rotating spindle (120) configured so as to apply a twist to the roving (S), thus transforming it into the elastic yarn (1). 30

14. The wet-spinner (100) according to claim 13, wherein the guide roller (118) is idly mounted and comprises a base ring (118a), from which a truncated cone-shaped body (118b) protrudes, flaring away from the base ring (118a), a connection groove (118c) being defined between said base ring (118a) and said truncated cone-shaped portion (118b) for guiding and centering the elastic thread (E) on the roving (S). 35
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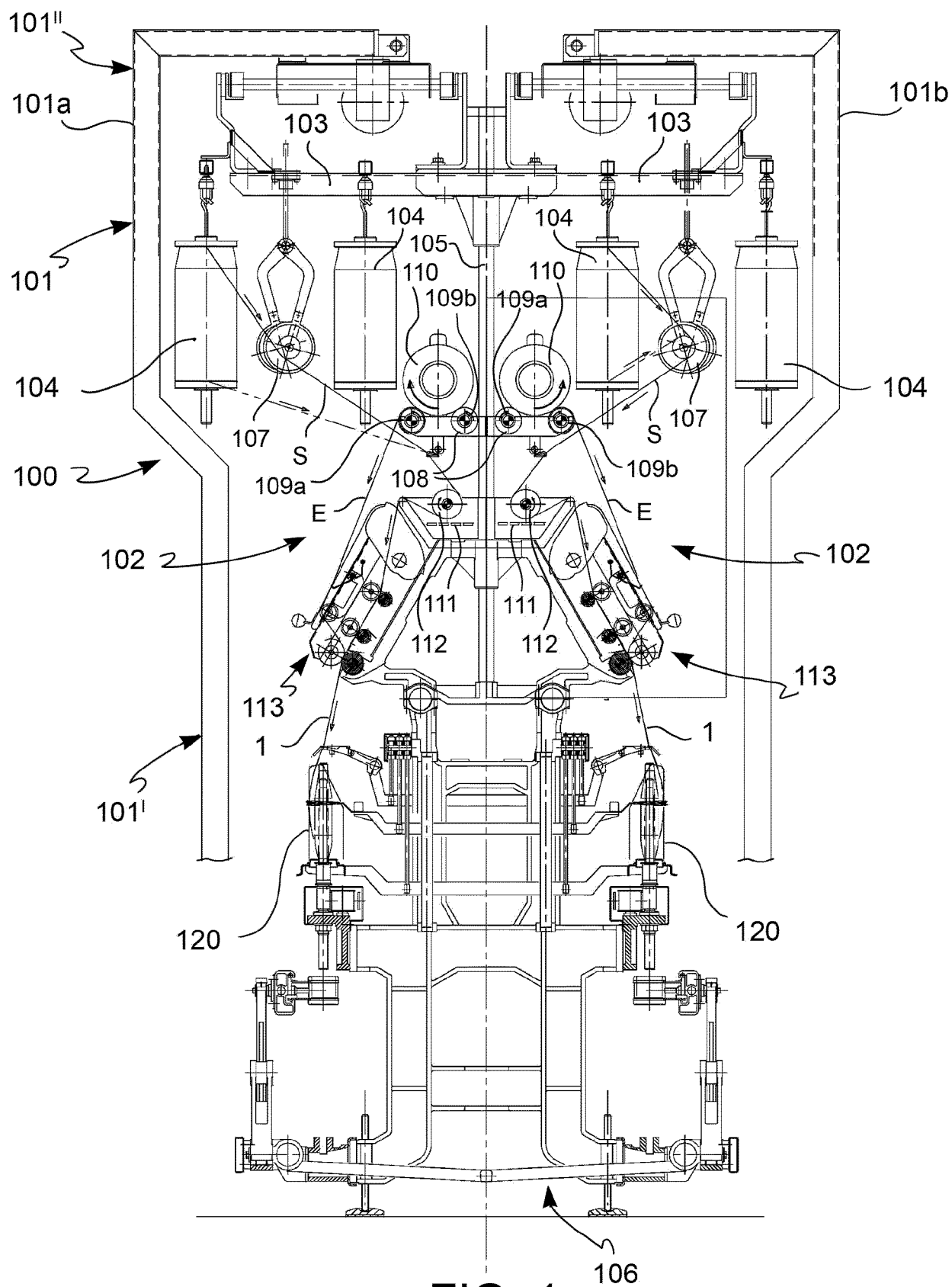


FIG. 1

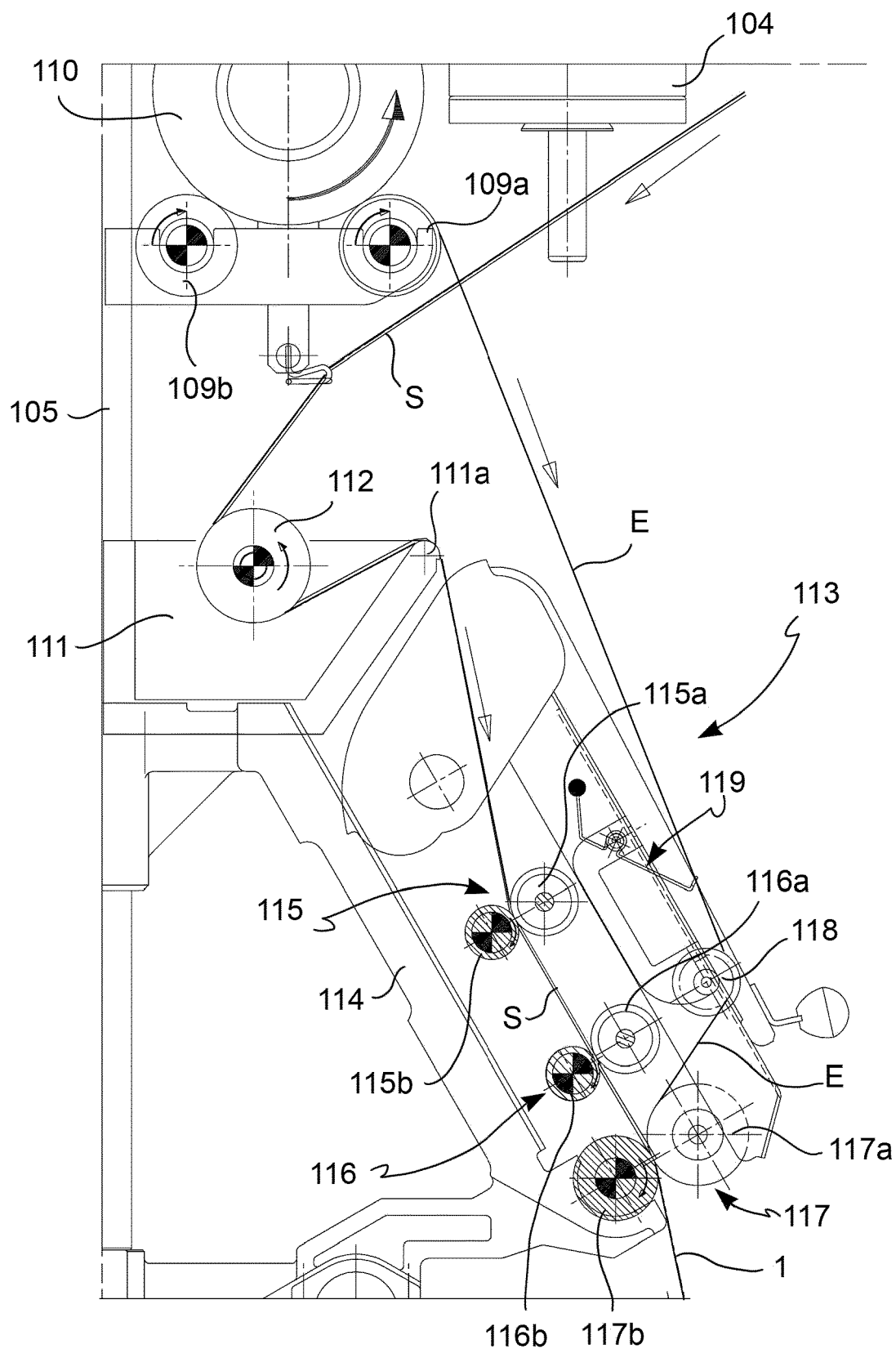


FIG. 2

FIG. 3

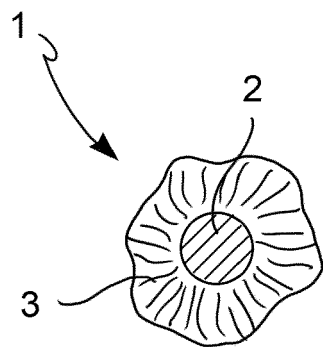
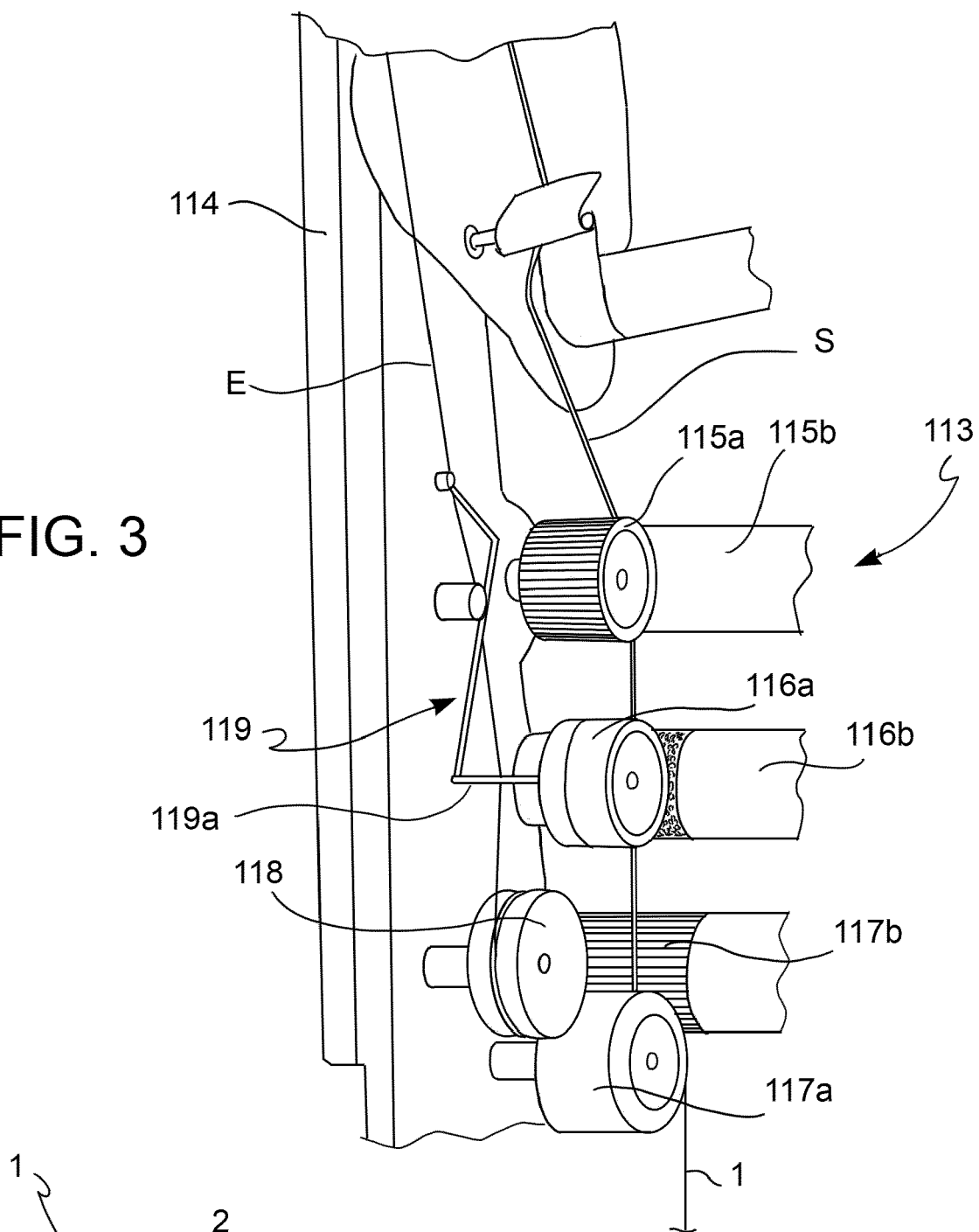


FIG. 5

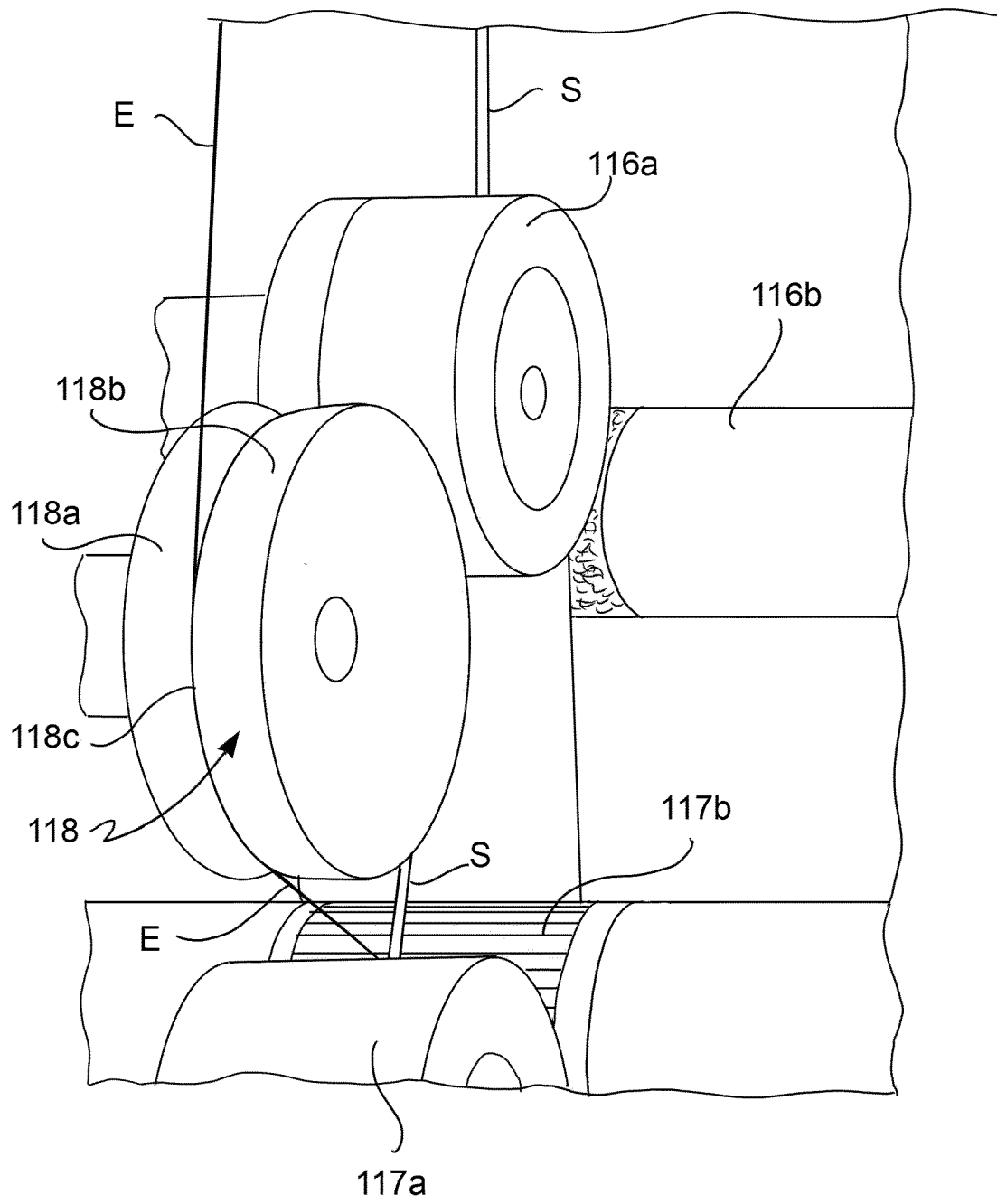


FIG. 4



EUROPEAN SEARCH REPORT

 Application Number
 EP 20 20 7817

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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			TECHNICAL FIELDS SEARCHED (IPC)
			D02G D01D D01F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		19 April 2021	Van Beurden-Hopkins
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			

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 EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 20 20 7817

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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