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(54) **YARN FOR PROTECTIVE CLOTHING, METHOD FOR ITS PRODUCTION, GARMENT OR FABRIC**

GARN FÜR SCHUTZBEKLEIDUNG, HERSTELLUNGSVERFAHREN, KLEIDUNG UND TEXTILE FLÄCHENGEBILDE

FIL POUR VÊTEMENT DE PROTECTION, METHODE DE FABRICATION , VÊTEMENT OU TISSU

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(56) References cited:
EP-A1- 2 679 108
WO-A1-03/018890
JP-A- H01 139 835
US-A1- 2006 048 497

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Description

[0001] This invention relates to a yarn for protective fabrics, i.e. a yarn having high mechanical properties and wear resistance, a fabric or garment made with such yarn, and a method for the production of a yarn.

[0002] There are numerous types of "technical" yarns, i.e., yarns with high mechanical properties and wear resistance, such as to make them suitable for the production of safety and work clothing. E.g. document WO 03/018890 A1 discloses a yarn and a method according to the preamble of the enclosed independent claims. Furthermore, document EP 2 679 108 A1 belongs to the background art of the present invention.

[0003] For example, document US 4,777,789 discloses a yarn made from an inner core formed from a filament, to which an internal wire is superposed, for example stainless steel. The core and internal wire are covered by a first wire wound in a first winding direction that forms a first covering layer; the first covering layer is covered by a second wire wound in a second winding direction that forms a second covering layer.

[0004] Unfortunately, the yarns thus constructed are extremely delicate in the inevitable washing operations because the wound wires tend to slide along the respective core and, in some types of internal cores, the latter tend to break subsequently making the garment unusable.

[0005] The purpose of this invention is to provide a new type of yarn having high characteristics of mechanical stability and comfort, and further with a useful life longer than that of traditional yarns, even after numerous washings.

[0006] This purpose is achieved by a yarn according to claim 1, according to a fabric or garment according to claim 12, and by means of a manufacturing method according to claim 13. The claims dependent on these show preferred embodiments.

[0007] The purpose of this invention will now be described in detail, with the help of the accompanying drawings, in which:

- Figure 1 shows a schematic diagram of the production of the yarn of this invention, according to a first possible variant, where the fluoro-polymer layer has been partially omitted from the entering core (above), and where the production direction has been indicated with the letter P;
- Figures 2, 3 and 4 show schematic diagrams of the production of the yarn according to further variants;
- Figures 3a and 4a show, in this order, magnifications of the highlighted areas, respectively, in Figure 3 and Figure 4.

[0008] With reference to the aforesaid figures, reference numbers 1, 2, 4 and 6 identify a yarn in its entirety.

[0009] Preferably, the aforesaid yarn has been specifically designed for the production of protective fabrics or garments, in particular gloves.

[0010] Such yarn comprises a core 8 and a first covering 14 of the core 8.

[0011] The core 8 comprises at least one discontinuous or continuous filament 10, which extends along a filament axis X and which is at least partially coated (for example completely covered) with a fluoro-polymer layer 12.

[0012] According to a particularly advantageous embodiment, the filament 10 comprises a continuous filament.

[0013] Preferably, the filament 10 comprises at least a glass, steel and/or ceramic filament. The variant comprising glass is particularly advantageous.

[0014] According to further embodiments, the filament 10 could comprise a filament of ultra high molecular weight polyethylene or an aramid filament. In regard to the latter variant, filaments constituted by any of the materials known under the trade names of Dyneema®, Kevlar® or Technora® can be used.

[0015] According to an embodiment variant, the filament 10 has a linear density in the range of 22-2200 dtex, preferably 40-1600 dtex, still more preferably 40-680 dtex.

[0016] According to a variant, the core 8 comprises 2-1800 filaments (optionally continuous filaments), preferably of a diameter between 5-15 micrometres. For example, the core 8 could comprise 2-500 or 210-300 filaments, with a diameter of about 5-6 micrometres.

[0017] According to further variants, the core 8 comprises a single filament or at least a pair of filaments, for example arranged side by side or parallel to each other.

[0018] For the embodiments with a plurality of filaments, these filaments could be coated by a single fluoro-polymer layer, or each filament could be separately coated with such a layer.

[0019] Preferably, the fluoro-polymer layer 12 comprises PTFE or consists of PTFE.

[0020] The first covering 14 is obtained by winding at least a first yarn 16 or a first sliver 18, 18' in a first winding direction, so as to achieve a closed coiling.

[0021] In addition, at least a portion of said first yarn 16 or first sliver 18, 18' is incorporated in the fluoro-polymer layer 12 in order to anchor the first covering 14 to said filament 10.

[0022] It follows that the fluoro-polymer layer, in addition to - chemically and physically - protecting the filament that it at least partially covers, serves to promote the adhesion of the first covering 14 to the core 8.

[0023] According to a variant, the first yarn 16 has a linear density in the range of 22-2200 dtex, preferably 40-1600

dtex, still more preferably 40-680 dtex.

[0024] According to an embodiment, the fluoro-polymer layer 12 defines one or more retention seats which extend in a spiral around the filament axis X, to prevent longitudinal sliding of the first covering 14.

[0025] According to a further embodiment, the transversal cross-section (or diameter) of the filament 10 and the thickness of the fluoro-polymer layer 12 are mutually selected so that the weight of the fluoro-polymer is equal to or smaller than 20% of filament, for example about 1-20 wt%.

[0026] According to the embodiment schematically diagrammed in Figure 4a, the yarn 6 could comprise a pair of first slivers inserted in as many spiral retention seats delimited by the fluoro-polymer layer 12.

[0027] For the variants that provide for one or more slivers 18, 18', each of them comprises a plurality of discontinuous fibres 20 anchored to the fluoro-polymer layer 12.

[0028] According to a preferred embodiment, the yarn comprises a second covering 22 superposed on the first covering 14, obtained by winding at least a second yarn 24 in a second winding direction, opposite the first winding direction, so as to achieve a closed coiling (Figure 1) or an open coiling (variant not shown).

[0029] For example, the second yarn 24 could have a linear density in the range of 22-2200 dtex, preferably 40-1600 dtex, still more preferably 40-680 dtex.

[0030] Purely by of way of example, the first yarn 16 is wound with an "S"-type winding, while the second yarn 24 is wound with a "Z"-type winding.

[0031] For example, the schematic diagram of Figure 1 shows a closed coiling wherein, advantageously, a first number of windings per linear metre of the first yarn 16 and a second number of windings per linear metre of the second yarn 24 could be substantially corresponding, at least as an order of magnitude.

[0032] Advantageously, as shown in the figures, the yarn 1 with the second covering 22 realised as a closed coiling can be used in the production steps of the yarns shown in Figures 2 and 3.

[0033] For the variants with a closed coiling of the second covering, the yarn could comprise at least a third yarn wound around the second covering along the filament axis X, wound as an open coiling.

[0034] According to a particularly advantageous variant, the third yarn comprises a yarn of high tenacity, i.e. a tenacity of between 40 and 120 cN/tex, preferably about 70 cN/tex.

[0035] Independently of a closed or open coiling of the second covering 22, the yarn could comprise at least a third covering 26, which is superposed on the second covering 22 and comprising a pair of slivers 40, 40' or yarns 42, 42' that form a closed tubular coating on the second covering 22.

[0036] According to a preferred variant, the third covering 26 is obtained by a winding of slivers 40, 40' comprising discontinuous fibres 44.

[0037] For example, the variant that provides for a pair of yarns 42, 42', that realise a twisted structure, is represented in schematic form in Figure 2.

[0038] According to an embodiment, the pair of slivers 40, 40' or yarns 42, 42' is wound with an "S"-type winding.

[0039] According to a further variant, the realisation of the third covering is performed in the same winding direction as the second yarn, placing these fibres at least in the interspaces of the underlying open coiling (when present).

[0040] In this way, the realisation of the third covering involves two concomitant effects, i.e. a distancing of the coils of the first covering and a reduction in the interspaces of the open coiling to receive and hold the aforesaid discontinuous fibres.

[0041] Preferably, first and second yarn are respectively wound with a first NW1 and a second NW2 number of windings per linear metre, where the sliver has a third number of windings per linear metre NW3 such that the relationship applies:

$$0.90 \leq (NW1 - NW3)/(NW2 + NW3) \leq 1.10$$

[0042] According to further variants, irrespective of the type of filament 10 selected, the first yarn, the second yarn, the sliver and/or the third yarn may be independently selected from the group consisting of polyethylene, polyamide, polyester, (para-)aramide, ultra high molecular weight polyethylene and mixtures thereof.

[0043] According to other embodiments, the first yarn, the second yarn, the sliver and/or the third yarn may be independently selected from natural fibres (for example cotton, wool) and mixtures thereof, optionally mixed with the synthetic fibres or with the filaments illustrated above.

[0044] This invention further relates to a fabric or garment comprising a yarn 1, 2, 4, 6 according to any of the preceding embodiments, or obtained through a variant of the method illustrated below.

[0045] Finally, this invention relates to a method for the production of a yarn, preferably for protective fabrics or garments.

[0046] Since this method can be used for the manufacture of the yarn described previously, even if this is not expressly indicated, this method may comprise any manufacturing step deducible - even implicitly - from the structure of the aforesaid yarn 1, 2, 4, 6.

[0047] This method comprises the steps of:

i) providing at least one continuous or discontinuous filament 10, which extends along a filament axis X;
ii) coating the filament 10 with a fluoro-polymer layer 12 by immersing at least part of the filament in a bath of liquid fluoro-polymer, thereby producing a core 8 of said yarn 1, 2, 4, 6;
iii) when the fluoro-polymer layer 12 is still wet, winding at least a first yarn 16 or a first sliver 18, 18' in a first winding direction so as to make a closed coiling, to obtain a first covering 14 of the filament 10;

wherein, during step iii), at least a portion of the first yarn 16 or the first sliver 18, 18' penetrates into the fluoro-polymer layer 12 remaining therein incorporated;

iv) solidifying the fluoro-polymer layer 12 in order to anchor the first covering 14 to the filament 10.

[0048] According to a preferred variant, in step iii), the winding tension applied to the first yarn 16 or to the first sliver 18, 18' is related to the wetness of the fluoro-polymer layer 12 to obtain a desired incorporation of the yarn or of the sliver, wherein - preferably - at least three quarters of the cross-section of the latter protrudes from the fluoro-polymer layer 12.
[0049] Obviously, especially for the variant comprising a sliver, the winding tension must be low enough as not to tear it during winding around the core.
[0050] According to a further preferred variant, step iv) comprises a cross-linking of the fluoro-polymer performed via sub-steps of heating and microwave irradiation to prevent yellowing of the glass filament (where provided).
[0051] In addition, in order to prevent yellowing, in addition to the combined action of heating and irradiation it is advisable that the heating be sufficiently slow.
[0052] Obviously, although for variants with filaments other than glass, the phenomenon of yellowing is less marked, step iv) may, in any case, comprise the cross-linking of the fluoro-polymer via the sub-steps discussed above, since this variant allows combining a satisfactory cross-linking of the polymer layer with an optimal adhesion of the first covering.
[0053] The yarn, fabric/garment and the method of this invention overcome the drawbacks noted in relation to the prior art.
[0054] More precisely, the yarn of this invention shows a high stability, a remarkable workability in weaving the garments and significant wearing comfort for the user.
[0055] Advantageously, the yarn and the fabric/garment of this invention can be subjected to an indefinite number of washings, since the filament does not run any risk of tearing or crack as a result of these operations.
[0056] Advantageously, in the yarn of this invention, the first covering undergoes a considerable adhesion effect with respect to the filament, so as to prevent the unravelling of the yarn during use or during washing.
[0057] Advantageously, the aforesaid yarn can also be used in chemically corrosive environments.
[0058] Advantageously, the method of this invention allows maintaining intact the properties of the internal core.

Claims

1. Yarn (1, 2, 4, 6) comprising:

- a core (8) which comprises at least one discontinuous or continuous filament (10) which extends along a filament axis (X) and which is at least partially coated with a fluoro-polymer layer (12), for example a layer of PTFE;
- a first covering (14) of the core (8), obtained by winding at least a first yarn (16) or a first sliver (18, 18') in a first winding direction, so as to achieve a closed coiling;

said yarn being **characterized in that** at least a portion of said first yarn (16) or first sliver (18, 18') is incorporated in the fluoro-polymer layer (12) in order to anchor the first covering (14) to said filament (10).

2. Yarn according to claim 1, wherein the fluoro-polymer layer (12) defines one or more retention seats which extend in a spiral around the filament axis (X), to prevent longitudinal sliding of the first covering (14).

3. Yarn according to any of the previous claims, wherein the fluoro-polymer layer (12) completely covers the filament (10), and wherein the transversal cross-section or diameter of the filament (10) and the thickness of the fluoro-polymer layer (12) are mutually selected so that the weight of the fluoro-polymer is equal to or smaller than 20% of said filament, for example about 1-20 wt%.

4. Yarn according to any of the previous claims, comprising a pair of first slivers (18, 18') inserted in as many spiral retention seats delimited by the fluoro-polymer layer (12), each sliver (18, 18') comprising a plurality of discontinuous fibres (20) anchored to the fluoro-polymer layer (12).

5. Yarn according to any of the previous claims, wherein the core (8) comprises 2-1800 optionally continuous filaments, of a diameter between 5-15 micrometres, said filaments being coated by a single fluoro-polymer layer (12).

6. Yarn according to any of the previous claims, comprising a second covering (22) superposed on the first covering (14), obtained by winding at least a second yarn (24) in a second winding direction, opposite the first winding direction, so as to achieve a closed or open coiling.

7. Yarn according to the previous claim, wherein the coiling of the second covering is open, and comprising at least a third covering, made by winding at least one sliver comprising discontinuous fibres in the same winding direction as the second yarn, placing said fibres at least in the interspaces of said open coiling, the realisation of the third covering entailing a distancing of the coils of the first covering and a reduction in the interspaces of the open coiling to receive and retain said fibres.

8. Yarn according to the previous claim, wherein the first (16) and the second (24) yarn are respectively wound with a first (NW1) and a second (NW2) number of windings per linear metre, and wherein the sliver has a third number of windings per linear metre (NW3) such that the relationship applies:

$$0.90 \leq (NW1 - NW3)/(NW2 + NW3) \leq 1.10$$

9. Yarn according to claim 6, comprising a third covering (26) superposed on the second covering (22), said third covering comprising a pair of slivers (40, 40') or yarns (42, 42') forming a closed tubular coating on the second covering (22).

10. Yarn according to claim 6, wherein the coiling of the second covering is closed, and comprising at least a third yarn wound around the second covering along the filament axis (X), wound with an open coiling.

11. Yarn according to the previous claim, wherein the third yarn has a tenacity of between 40 and 120 cN/tex, preferably about 70 cN/tex.

12. Textile or garment comprising a yarn (1, 2, 4, 6) according to any of the previous claims.

13. Method of making a yarn (1, 2, 4, 6) comprising the steps of:

i) providing at least one discontinuous or continuous filament (10) which extends along a filament axis (X); said method being **characterized in** comprising steps of:
ii) coating the filament (10) with a fluoro-polymer layer (12) immersing at least part of the filament in a bath of liquid fluoro-polymer, thereby producing a core (8) of said yarn (1, 2, 4 , 6);
iii) when the fluoro-polymer layer (12) is still wet, winding at least a first yarn (16) or a first sliver (18, 18') in a first winding direction so as to make a closed coiling, to obtain a first covering (14) of the filament (10) ;

wherein, during the step iii), at least a portion of said first yarn (16) or first sliver (18, 18') penetrates into the fluoro-polymer layer (12) remaining therein incorporated;

iv) solidifying the fluoro-polymer layer (12) in order to anchor the first covering (14) to said filament (10).

14. Method according to the previous claim, wherein, in step iii), the winding tension applied to the first yarn (16) or to the first sliver (18, 18') is related to the wetness of the fluoro-polymer layer (12) to obtain a desired incorporation of the yarn or of the sliver, wherein at least three quarters of the cross-section of the latter protrudes from the fluoro-polymer layer (12).

15. Method according to claims 13 or 14, wherein at least one filament (10) is made of glass, and wherein the step iv) comprises a cross-linking of the fluoro-polymer performed via sub-steps of heating and microwave irradiation to

prevent yellowing of said glass filament.

Patentansprüche

1. Garn (1, 2, 4, 6), umfassend:

   - einen Kern (8), der wenigstens eine diskontinuierliche oder kontinuierliche Faser (10) umfasst, die sich entlang einer Faserachse (X) erstreckt und die zumindest teilweise mit einer Fluorpolymerschicht (12), zum Beispiel einer PTFE-Schicht, beschichtet ist;
   - eine erste Umhüllung (14) des Kerns (8), die durch Wickeln wenigstens eines ersten Garns (16) oder eines ersten Faserbands (18, 18') in einer ersten Wickelrichtung erhalten wird, sodass eine geschlossene Wickelung erzielt wird;

   wobei das Garn **dadurch gekennzeichnet ist, dass** wenigstens ein Abschnitt des ersten Garns (16) oder ersten Faserbands (18, 18') in die Fluorpolymerschicht (12) eingebettet ist, um die erste Umhüllung (14) an der Faser (10) zu verankern.

2. Garn nach Anspruch 1, wobei die Fluorpolymerschicht (12) einen oder mehrere Haltesitze definiert, die sich in einer Spirale um die Faserachse (X) erstrecken, um ein Gleiten der ersten Umhüllung (14) in Längsrichtung zu verhindern.

3. Garn nach einem der vorhergehenden Ansprüche, wobei die Fluorpolymerschicht (12) die Faser (10) vollständig bedeckt und wobei der transversale Querschnitt oder Durchmesser der Faser (10) und die Dicke der Fluorpolymerschicht (12) gegenseitig derart so ausgewählt sind, dass das Gewicht des Fluorpolymers kleiner gleich 20 % zu dem das der Faser, zum Beispiel etwa 1-20 Gew.-% davon, beträgt.

4. Garn nach einem der vorhergehenden Ansprüche, umfassend ein Paar erste Faserbänder (18, 18'), die in ebenso viele Spiralhaltesitze eingebracht sind, die durch die Fluorpolymerschicht (12) begrenzt sind, wobei jedes Faserband (18, 18') eine Mehrzahl von diskontinuierlichen Fasern (20) umfasst, die an der Fluorpolymerschicht (12) verankert sind.

5. Garn nach einem der vorhergehenden Ansprüche, wobei der Kern (8) 2-1800 gegebenenfalls kontinuierliche Fasern mit einem Durchmesser zwischen 5-15 Mikrometern umfasst, wobei die Fasern mit einer einzigen Fluorpolymerschicht (12) beschichtet sind.

6. Garn nach einem der vorhergehenden Ansprüche, umfassend eine zweite Umhüllung (22), welche die erste Umhüllung (14) überlagert und durch Wickeln wenigstens eines zweiten Garns (24) in einer zweiten Wickelrichtung erhalten wird, die zur ersten Wickelrichtung entgegengesetzt ist, sodass eine geschlossene oder offene Wickelung erhalten wird.

7. Garn nach dem vorhergehenden Anspruch, wobei die Wickelung der zweiten Umhüllung offen ist, und wenigstens eine dritte Umhüllung umfasst, die durch Wickeln wenigstens eines diskontinuierliche Fasern umfassenden Faserbands in der gleichen Wickelrichtung wie das zweite Garn hergestellt wird, wobei die Fasern wenigstens in den Zwischenräumen der offenen Wickelung angeordnet werden, wobei die Umsetzung der dritten Umhüllung zu einer Beabstandung der Windungen der ersten Umhüllung und einer Verkleinerung der Zwischenräume in der offenen Wickelung führt, um die Fasern aufzunehmen und zu halten.

8. Garn nach dem vorhergehenden Anspruch, wobei das erste (16) und das zweite (24) Garn mit einer ersten (NW1) bzw. einer zweiten (NW2) Anzahl von Windungen je laufendem Meter gewickelt sind und wobei das Faserband eine dritte Anzahl von Windungen je laufendem Meter (NW3) aufweist, sodass folgende Beziehung gilt:

$$0{,}90 \leq (NW1 - NW3) / (NW2 + NW3) \leq 1{,}10$$

9. Garn nach Anspruch 6, umfassend eine dritte Umhüllung (26), welche die zweite Umhüllung (22) überlagert, wobei die dritte Umhüllung ein Paar Faserbänder (40, 40') oder Garne (42, 42') umfasst, das eine geschlossene röhrenförmige Beschichtung auf der zweiten Umhüllung (22) bildet.

10. Garn nach Anspruch 6, wobei die Wickelung der zweiten Umhüllung geschlossen ist, und wenigstens ein drittes Garn umfasst, das um die zweite Umhüllung entlang der Faserachse (X) gewickelt ist und mit einer offenen Wickelung gewickelt ist.

11. Garn nach dem vorhergehenden Anspruch, wobei das dritte Garn eine Zugfestigkeit zwischen 40 und 120 cN/tex, bevorzugt etwa 70 cN/tex, aufweist.

12. Textilie oder Kleidungsstück, umfassend ein Garn (1, 2, 4, 6) nach einem der vorhergehenden Ansprüche.

13. Verfahren zum Herstellen eines Garns (1, 2, 4, 6), umfassend die Schritte:

i) Bereitstellen wenigstens einer diskontinuierlichen oder kontinuierlichen Faser (10), die sich entlang einer Faserachse (X) erstreckt;

wobei das Verfahren **dadurch gekennzeichnet ist, dass** es folgende Schritte umfasst:

ii) Beschichten der Faser (10) mit einer Fluorpolymerschicht (12), wobei wenigstens ein Teil der Faser in ein Bad mit flüssigem Fluorpolymer getaucht wird, wodurch ein Kern (8) des Garns (1, 2, 4, 6) erzeugt wird;
iii) wenn die Fluorpolymerschicht (12) noch nass ist, Wickeln wenigstens eines ersten Garns (16) oder eines ersten Faserbands (18, 18') in einer ersten Wickelrichtung, um eine geschlossene Wickelung herzustellen, um eine erste Umhüllung (14) der Faser (10) zu erhalten;

wobei während des Schritts iii) wenigstens ein Abschnitt des ersten Garns (16) oder ersten Faserbands (18, 18') in die Fluorpolymerschicht (12) eindringt und darin eingebettet bleibt;

iv) Verfestigen der Fluorpolymerschicht (12), um die erste Umhüllung (14) an der Faser (10) zu verankern.

14. Verfahren nach dem vorhergehenden Anspruch, wobei in Schritt iii) die auf das erste Garn (16) oder das erste Faserband (18, 18') ausgeübt Wickelspannung in einer Beziehung zur Nässe der Fluorpolymerschicht (12) steht, um eine gewünschte Einbettung des Garns oder des Faserbands zu erhalten, wobei wenigstens drei Viertel des Querschnitts des Letzteren aus der Fluorpolymerschicht (12) vorragt.

15. Verfahren nach den Ansprüchen 13 oder 14, wobei wenigstens eine Faser (10) aus Glas besteht und wobei der Schritt iv) ein Vernetzen des Fluorpolymers umfasst, das durch Teilschritte zur Erwärmung und Mikrowellenbestrahlung durchgeführt wird, um ein Vergilben der Glasfaser zu verhindern.

Revendications

1. Fil (1, 2, 4, 6), comprenant :

- un coeur (8) qui comprend au moins un filament discontinu ou continu (10) qui s'étend le long d'un axe de filament (X), et qui est au moins partiellement revêtu par une couche de polymère fluoré (12), par exemple une couche de polytétrafluoroéthylène ;
- un premier revêtement (14) du coeur (8), obtenu par enroulement d'au moins un premier fil (16) ou un premier brin (18, 18') dans une première direction d'enroulement, de façon à réaliser un enroulement à spires jointives ;

ledit fil étant **caractérisé en ce qu'**au moins une partie dudit premier fil (16) ou dudit premier brin (18, 18') est incorporée dans la couche de polymère fluoré (12) de façon à ancrer le premier revêtement (14) sur ledit filament (10).

2. Fil selon la revendication 1, dans lequel la couche de polymère fluoré (12) définit un ou plusieurs sièges de rétention qui s'étendent selon une spirale autour de l'axe de filament (X), de façon à empêcher un glissement longitudinal du premier revêtement (14).

3. Fil selon l'une quelconque des revendications précédentes, dans lequel la couche de polymère fluoré (12) recouvre complètement le filament (10), et dans lequel la section transversale ou le diamètre du filament (10) et l'épaisseur de la couche de polymère fluoré (12) sont mutuellement sélectionnées de telle sorte que le poids du polymère fluoré soit inférieur ou égal à 20% dudit filament, par exemple d'environ 1 à 20% en poids.

4. Fil selon l'une quelconque des revendications précédentes, comprenant une paire de premiers brins (18, 18') insérés dans autant de sièges de rétention en spirale (12) délimités par la couche de polymère fluoré (12), chaque brin (18, 18') comprenant une pluralité de fibres discontinues (20) ancrées sur la couche de polymère fluoré (12).

5. Fil selon l'une quelconque des revendications précédentes, dans lequel le coeur (8) comprend de 2 à 1800 filaments, continus de façon optionnelle, d'un diamètre compris entre 5 et 15 micromètres, lesdits filaments étant revêtus par une couche de polymère fluoré unique (12).

6. Fil selon l'une quelconque des revendications précédentes, comprenant un deuxième revêtement (22) superposé sur le premier revêtement (14), obtenu par enroulement d'au moins un deuxième fil (24) dans une deuxième direction d'enroulement, opposée à la première direction d'enroulement, de façon à obtenir un enroulement à spires jointives ou à spires non-jointives.

7. Fil selon la revendication précédente, dans lequel les spires de l'enroulement du deuxième revêtement sont non-jointives, et comprenant au moins un troisième revêtement, réalisé par l'enroulement d'au moins un brin comprenant des fibres discontinues dans la même direction d'enroulement que le deuxième fil, et la disposition desdites fibres au moins dans les espaces interstitiels dudit enroulement à spires non-jointives, la réalisation du troisième revêtement mettant en oeuvre une mise à distance des spires du premier revêtement et une réduction dans les espaces interstitiels de l'enroulement à spires non-jointives de façon à recevoir et à maintenir lesdites fibres.

8. Fil selon la revendication précédente, dans lequel le premier (16) et le deuxième (24) fils sont respectivement enroulés avec un premier (NW1) et un deuxième (NW2) nombres d'enroulements par mètre linéaire, et dans lequel le brin comporte un troisième nombre d'enroulements par mètre linéaire (NW3), de telle sorte que la relation suivante s'applique :

$$0{,}90 \leq (NW1 - NW3)/(NW2 + NW3) \leq 1{,}10.$$

9. Fil selon la revendication 6, comprenant un troisième revêtement (26) superposé sur le deuxième revêtement (22), ledit troisième revêtement comprenant une paire de brins (40, 40') ou de fils (42, 42') formant un revêtement tubulaire fermé sur le deuxième revêtement (22).

10. Fil selon la revendication 6, dans lequel les spires de l'enroulement du deuxième revêtement sont jointives, et comprenant au moins un troisième fil enroulé autour du deuxième revêtement le long de l'axe de filament (X), enroulé avec un enroulement à spires non-jointives.

11. Fil selon la revendication précédente, dans lequel le troisième fil a une ténacité comprise entre 40 et 120 cN/tex, de préférence, d'environ 70 cN/tex.

12. Textile ou vêtement comprenant un fil (1, 2, 4, 6) selon l'une quelconque des revendications précédentes.

13. Procédé de réalisation d'un fil (1, 2, 4, 6) comprenant les étapes consistant à :

i) disposer au moins un filament discontinu ou continu (10) qui s'étend le long d'un axe de filament (X) ;

ledit procédé étant **caractérisé en ce qu'**il comprend les étapes consistant à :

ii) revêtir le filament (10) avec une couche de polymère fluoré (12) par immersion d'au moins une partie du filament dans un bain de polymère fluoré liquide, de façon à produire ainsi un coeur (8) dudit fil (1, 2, 4, 6) ;
iii) lorsque la couche de polymère fluoré (12) est encore humide, enrouler au moins un premier fil (16) ou un premier brin (18, 18') dans une première direction d'enroulement de façon à réaliser un enroulement à spires jointives, de façon à obtenir un premier revêtement (14) du filament (10) ;

dans lequel, durant l'étape iii), au moins une partie dudit premier fil (16) ou du premier brin (18, 18') pénètre dans la couche de polymère fluoré (12), restant incorporée à l'intérieur de celle-ci ;

iv) solidifier la couche de polymère fluoré (12) de façon à ancrer le premier revêtement (14) sur ledit filament (10).

14. Procédé selon la revendication précédente, dans lequel, dans l'étape iii), la tension d'enroulement appliquée au premier fil (16) ou au premier brin (18, 18') est associée à l'humidité de la couche de polymère fluoré (12) de façon à obtenir une incorporation désirée du fil ou du brin, au moins trois quarts de la section transversale de ce dernier faisant saillie à partir de la couche de polymère fluoré (12).

15. Procédé selon les revendications 13 ou 14, dans lequel au moins un filament (10) est fait en verre, et dans lequel l'étape iv) comprend une réticulation du polymère fluoré, effectuée par l'intermédiaire de sous-étapes de chauffage et d'irradiation par des micro-ondes afin d'éviter un jaunissement dudit filament de verre.

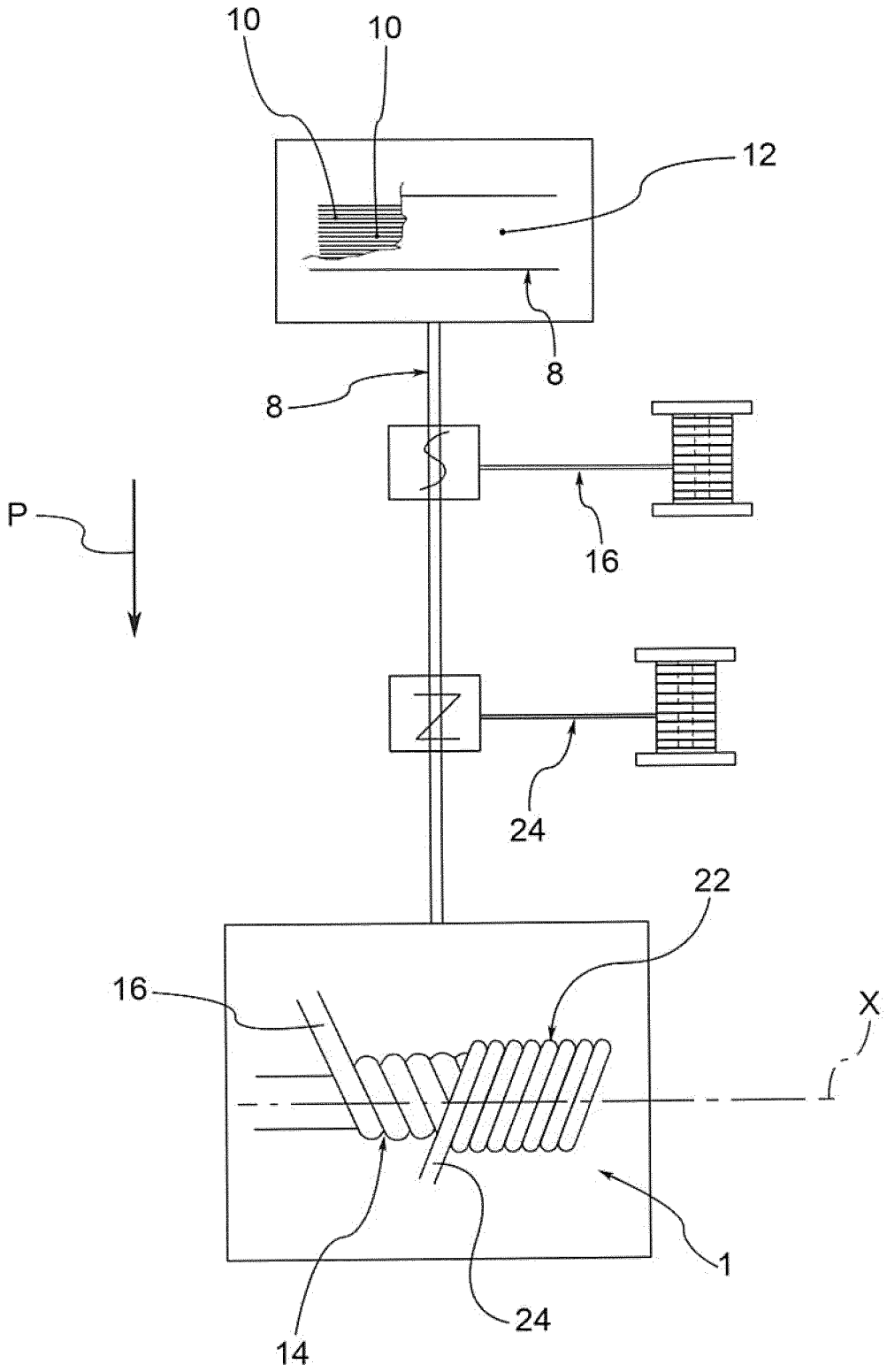

FIG.1

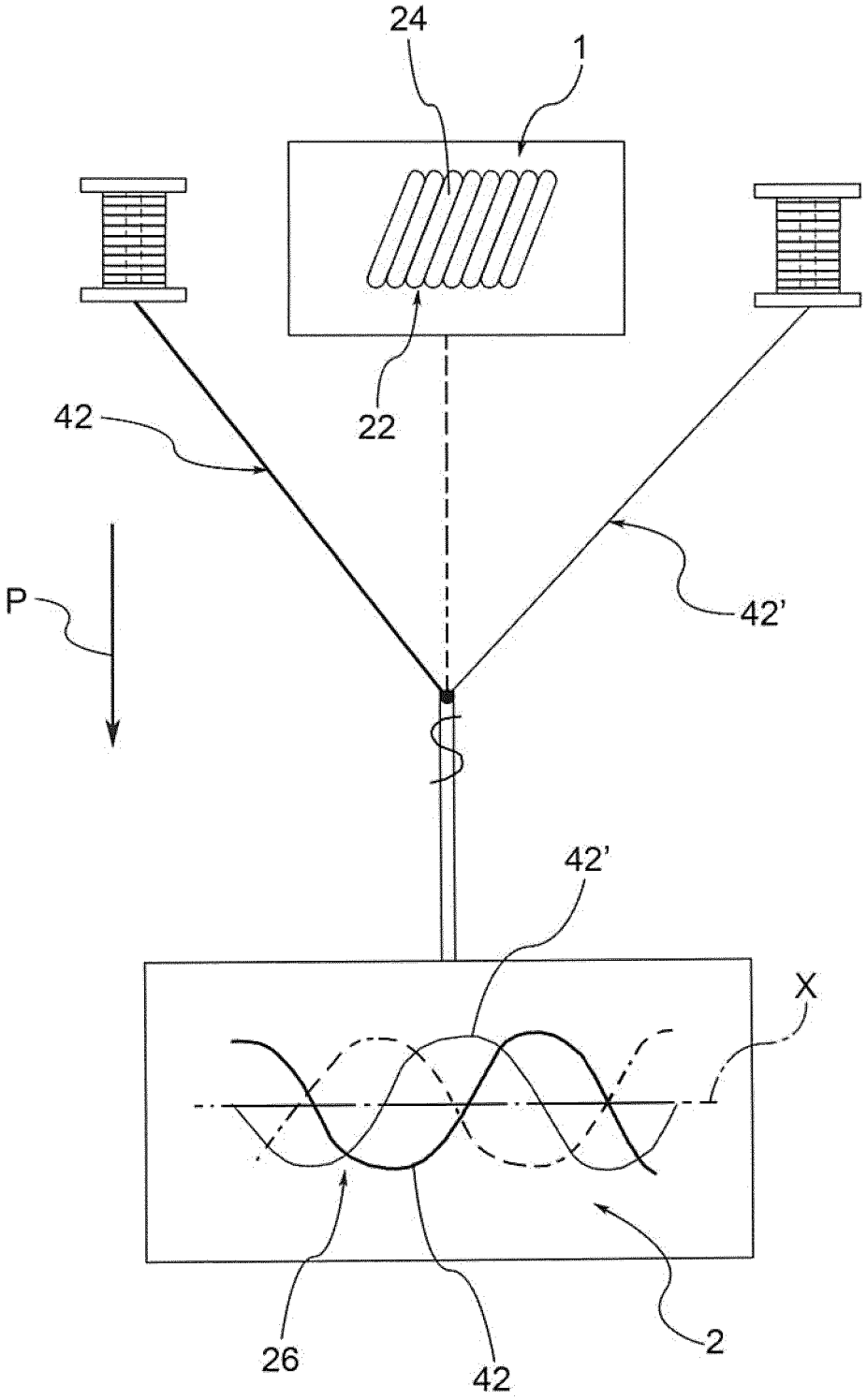

FIG.2

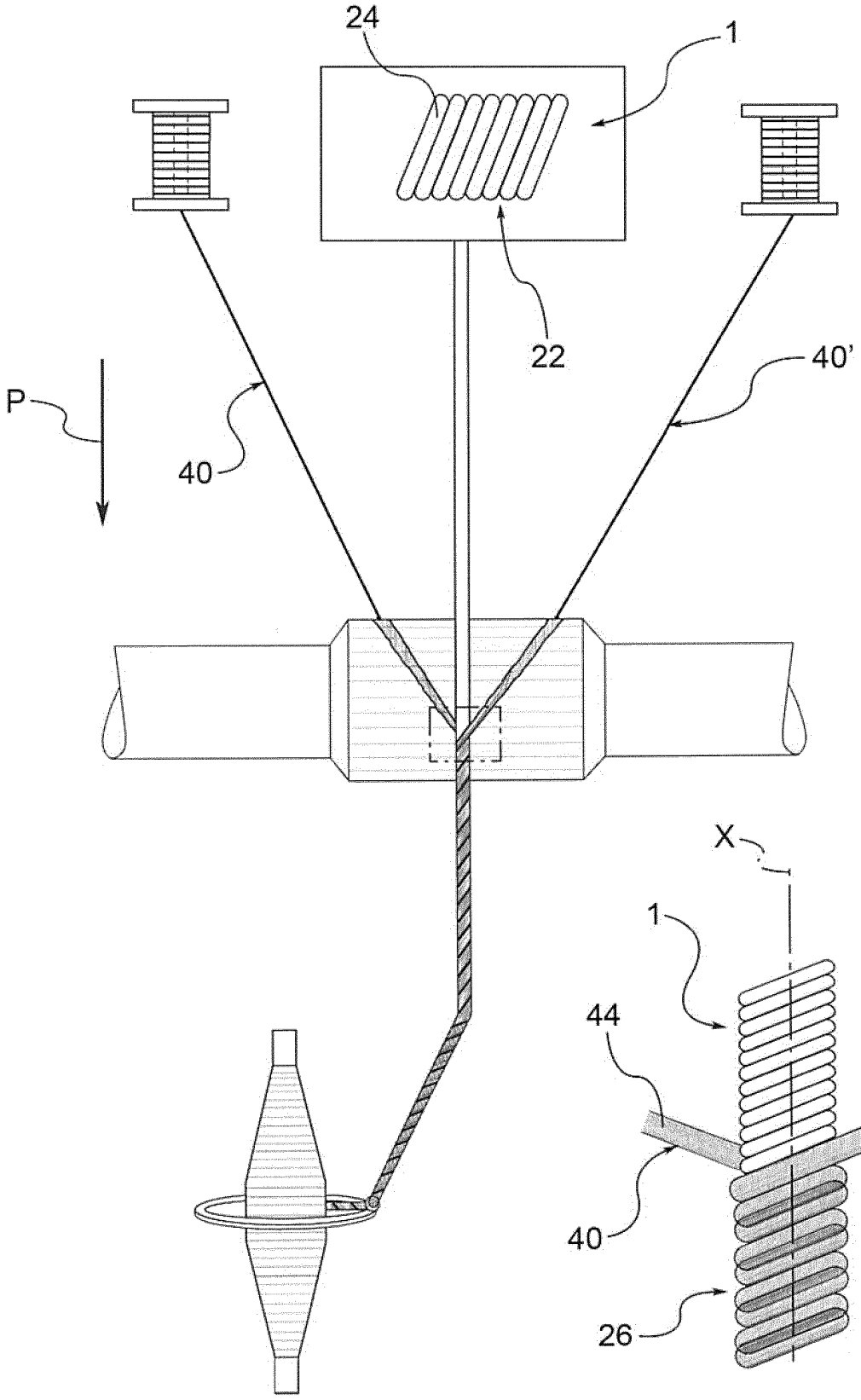

FIG.3

FIG.3a

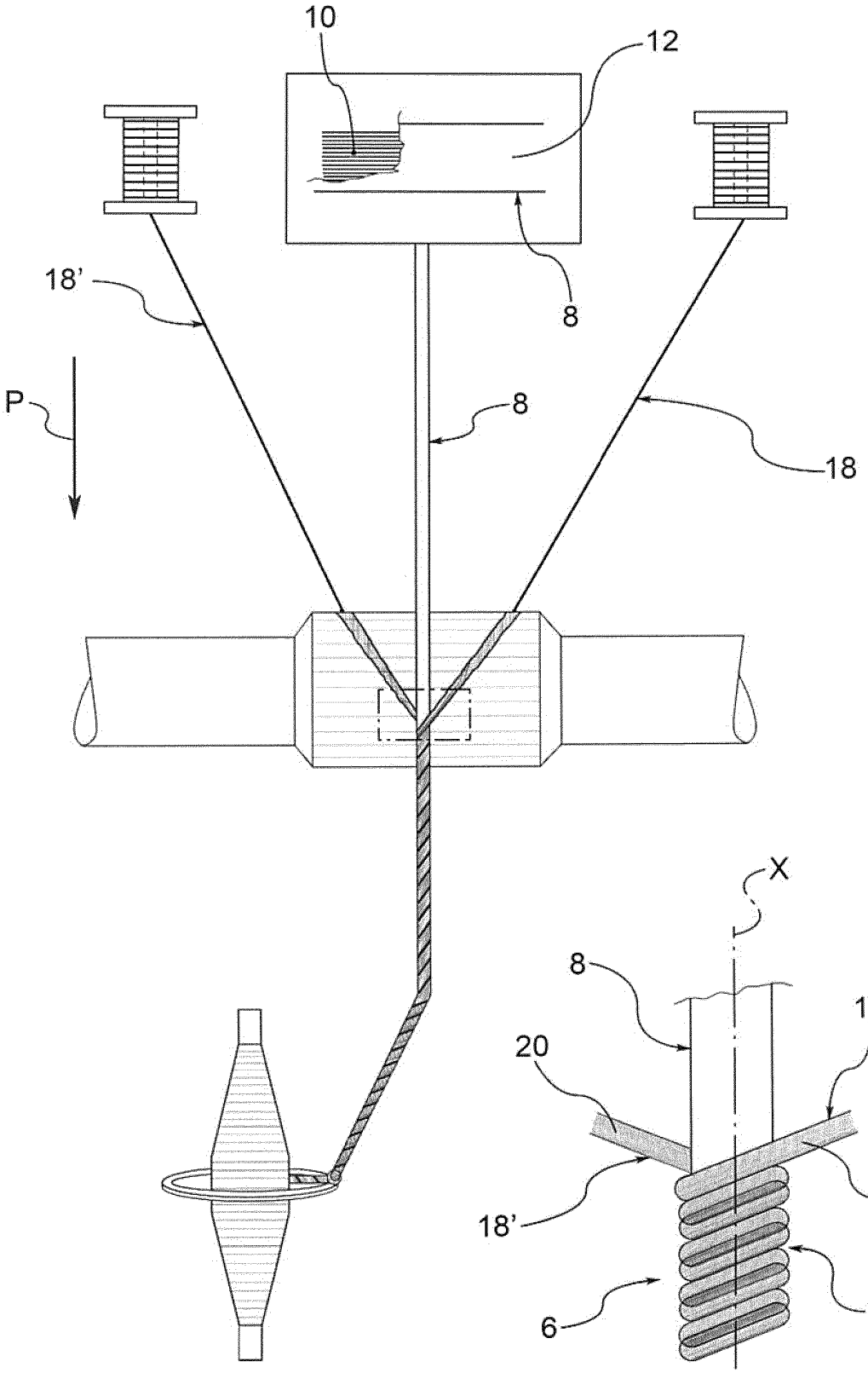

FIG.4

FIG.4a

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 03018890 A1 **[0002]**
- EP 2679108 A1 **[0002]**
- US 4777789 A **[0003]**