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Description

This invention relates to braiding, and in particular to a method of forming a braid from inorganic single-yarns.

Yarns are formed from filaments, or fibres, and are of two basic types: continuous filament and staple filament. Silk fibres and extruded man-made organic or inorganic fibres are examples of continuous filaments. Each individual filament of a continuous filament yarn is of such length that it extends substantially throughout the entire length of the filament strand. Wool and cotton filaments, as well as man-made organic or inorganic fibres, if cut to a short, defined length, are examples of staple filaments. Individual filaments, of typically 20 to 35 cms in length, form the staple filaments, which must be spun (i.e. plied and twisted) together to form a yarn, or cord. Yarns used for braiding may be of the continuous or staple filament type, depending on the particular product required.

Braiding on modern machines is carried out at a speed, typically of about 250 or 420 yarn interlacings (or picks) per minute, and braiding at such speeds can cause breakage of the filaments, which results in the formation of fibrils, or whiskers, that project laterally from the braid. Fibrillation is due, for example, to the frictional, tensional and shear stresses encountered by the yarns as they are braided, and is thus predictably more prevalent in staple filament yarns, in lighter weight yarns, and in yarns of more brittle materials, especially inorganic materials. Fibrillation can be reduced by braiding at a lower speed, but the process then becomes progressively more uneconomical, at least for large-scale applications. Conventionally, fibrillation is minimised by twisting yarn filaments together, to form twisted-pair-yarns for example. A braid formed from such twisted yarn is considerably more expensive to produce, and is heavier than a braid formed from single-yarn, but may still be more economical than production of a braid at low speed, i.e. at less than about 100 interlacings per minute, from single-yarns. The greater expense of twisted-pair-yarn is mainly due to the separate twisting and plying operations on specialised machinery that are required to produce the yarn. If a balanced yarn, i.e. one that will not unravel, is required, these operations are more complex and more expensive. Furthermore, a greater quantity of filaments is required for twisted yarn than for single-yarn because of the loss of yarn length that occurs on twisting, and because the width-to-depth ratio is much less for twisted-pair-yarns, which requires that a greater density of filaments is used to obtain an equivalent braiding surface for overcoating.

For many applications fibrillation is not objectionable, and in some instances is encouraged as preferable, but this is not the case for braids which are to be overcoated, particularly where a smooth outer surface is required; Overcoating may be carried out, for example, to enhance the

electrical, thermal, or other physical properties of the braid. Broken continuous filaments, or staple filaments that have become untwisted, tend to project laterally from the braid and interfere with the overcoating process, thereby detracting from the physical or aesthetic properties of the braid. Since a continuous filament yarn inherently contains appreciably fewer ends than a staple filament yarn, the former type is preferably used for braids that are to be overcoated, and particularly for braids formed of inorganic material. Typical overcoating materials are curable organic liquid, such as varnishes, polyvinylchloride polymers, acrylic polymers, silicone polymers, or urethane polymers. Application of an overcoat may require pretreatment of the braid with an adhesion-promoting primer.

Solid waxy substances have long been used to unify yarns and to reduce frictional breakage. Wet lubrication with, for example, soap-solutions or hydrocarbon and other oils, as a means of softening and lubricating natural fibres and man-made organic fibres is also well known, and lubricants used in this way are known as size formulations. Inorganic yarn materials such as glass, being relatively impervious, are usually given a solid, starch-oil based size coating during their formation and assembly into yarns. Manufacturers typically spray a size formulation solution on to the extruded filaments, and this dries to a finely divided, powdery solid and improves subsequent handling and fabrication operations. The size formulation is starch-based and usually contains solid lubricants such as silanes or hydrocarbon waxes.

Sized continuous filament, inorganic single-yarns are braided for applications that do not require overcoating, but it has been a long-standing problem in producing overcoatable braids of inorganic yarn materials that the level of filament breakage which occurs at modern braiding speeds is sufficient to detract significantly and intolerably from the properties of the coated braid as aforesaid. This problem is especially severe with light to medium weight yarns (less than 600 tex). Variations in size formulations and coating weights have failed to provide satisfactorily overcoatable braid surfaces from inorganic single yarns at machine speeds sufficiently high to be economically viable on a large scale.

In accordance with one aspect of the present invention, there is provided a method of forming a braid from a plurality of substantially untwisted continuous multifilament inorganic single-yarns, comprising (i) applying to said single yarns a lubricant liquid to prevent fibrillation caused by breakage, during braiding, of filaments that from the yarns, and (ii) braiding the lubricated yarns on a high speed braiding machine operating at a rate above 100 interlacings per minute.

It is to be understood that the term "lubricant liquid" is not restricted to liquids traditionally regarded as lubricants, e.g. liquids that are utilised in metal to metal contact. The term "lubricant liquid" is to be construed as covering any formu-

lation of liquid or liquids which facilitates the braiding of single-yarns by suppressing displacement or breakage thereof thereby substantially reducing or preventing the occurrence of projecting filament portions. Liquids such as the salt of a fatty acid amide and a fatty acid ester, glycol polyalkylene ethers, fatty acid amide plus polyglycol ether, sulphonated fatty acids, fatty acid amides, polyglycol ether sulphates, polyethylene emulsions, acrylic polymers, polyvinyl acetate emulsions, and silicone oils are suitable "lubricant liquids" for use with particular yarns to be braided. Unsatisfactory performance of certain combinations of yarns and lubricants, for example silicone oils on glass fibre yarns, is believed to be due to excessive static electrical generation. Such unsatisfactory performance can sometimes be overcome by formulation with electrically conductive additives designed to alter the electrostatic characteristic of the interaction between the liquid and fibre, such additive may be quaternary ammonium salts dissolved in a suitable solvent. This is a matter to be determined by simple trial and error for each particular kind of yarn to be braided.

The lubricant liquid applied according to the present invention will generally be different from, and in addition to, any material which may be applied for the purpose of which may be applied for the purpose of initially forming the yarns themselves, for example size formulations as described hereinbefore.

It will be appreciated that, although applying a lubricant liquid in accordance with the present invention greatly reduces the amount of filament breakage, and hence fibrillation, that occurs during braiding of the inorganic single yarns, a certain, insignificant amount of fibrillation may still occur. References to the braid being "substantially free from", or to the lubricant "substantially preventing", projecting individual filament portions will be understood by persons familiar with the field of braiding technology. It is impracticable to specify exactly what is an acceptable level of projecting filament portions but the normal criteria in this field for judging satisfactory braid surfaces, subsequent coating quality, and performance of the overcoated braid, will readily enable suitably skilled workers to determine whether the occurrence of projecting filament portions has been suppressed to an acceptable degree.

The lubricant liquid material is preferably an oily material having a relative density of at least 0.8 at 20°C. The lubricant preferably has a kinematic viscosity of from about 3 to about 35 centistokes at 20°C.

The most preferred lubricant comprises saturated hydrocarbon oils i.e. hydrocarbons containing less than about 5% of aromatic hydrocarbons and having a relative density within the range from 0.8 to 0.9 at 20°C and a kinematic viscosity within the range from about 3 to about 35 centistokes at 20°C. These preferred hydrocarbons are known commercially as "paraffinic oils" or

"Codex Vaseline" or "semi-white and white Vaseline oils".

The lubricant is preferably applied to the yarns at a temperature above about 25°C, the temperature influencing to some extent the amount of lubricant picked up by the yarn.

The lubricant liquid may be applied alone or in mixtures with other lubricants or diluents to suit each particular case. It will also be understood that the term "liquid" includes formulations which are not liquid or semi-liquid at normal ambient temperature, but which are liquid under the conditions of their application to the yarns and of the braiding operation.

When it is required to apply a primer to the yarn to promote adhesion of subsequently-applied coatings to the braid, the primer may conveniently be applied, for some yarns, during the winding of the yarn on to the braiding bobbins, preferably in combination with the application of the lubricant material.

The present invention can be utilised to improve the braiding of substantially any multi-filament yarns which withstand badly the stresses to which they are subjected on braiding machines, and the present invention is therefore particularly useful in connection with low-torsion yarns of materials such as carbon fibre or of brittle, abrasive or fragile materials, such as ceramic, silica, carbon, and glass. Yarns containing 300 to 400 filaments per yarn are commonly used. It may be advantageous to form braids from a combination of different types of inorganic materials. Thus, each yarn may be a combination of filaments of two or more inorganic material types or alternately two or more discrete types of inorganic yarns may be combined.

At least some, and preferably all, of the single-yarns are less than 600 tex in weight.

The present invention is applicable when braiding at high speed, because commercially unacceptable levels of filament breakage, leading to fibril formation, would otherwise occur during the braiding of inorganic single yarns. The term "high speed" braiding as used herein is understood to be braiding at a speed appreciably greater than 100 interlacings per minute. The invention is particularly advantageous at speeds of about 250 interlacings per minute or about 420 interlacings per minute, at which modern braiding machines operate, but it will be appreciated that it is also applicable to even higher speed operation.

Fibrillation is particularly disadvantageous when the braid is to be overcoated and when a smooth outer finish is required. Where the overcoated braid is to form an electrically insulating sleeving, it will be appreciated that fibrils extending therefrom could give rise to electrical problems.

It is preferable to remove the lubricant liquid after the braid has been formed, particularly where the braid is to be overcoated. It is known to remove any sizing from a braid, by heat treatment, for example using a flame, and this has been found to be a convenient way of also

removing the lubricant liquid. Such a treatment has the associated advantage that any fibrils that may have been produced by the braiding are also removed. Other removal methods, such as solvent extraction, may be used.

It is a significant commercial advantage of the present invention that untwisted multi-filament single-yarns are used. The term "untwisted" is intended to encompass yarns, whether mono-filament or multi-filament, having fewer than about 40 twists per metre, such yarns also being commonly referred to as "low-torsion" yarns or producer's low twist yarns.

In practising the present invention, substantially all the yarns utilised in forming the braid may be continuous filament single-yarns, and preferably multi-filament, continuous single yarns, the term "yarns" including rovings. Suitable multi-filament yarns can contain any convenient number of individual filaments, 300 to 400 filaments per yarn being conventional.

The braided yarns, if desired, can be treated with primer to promote adhesion of any coating to be subsequently applied to the braid, particularly in the case of glass fibre yarns or yarns of other materials to which many types of coating have difficulty in adhering without prior surface treatment of the yarn. Indeed the lubricant liquid used in the method of the present invention may serve in some cases as the adhesion-promoting primer, with or without additional chemical treatment.

The braiding of single yarns as opposed to twisting-yarn-pairs has the advantages of surprisingly increasing production efficiency, and reducing cost. Since the single-yarns intrinsically tend to have a greater width to depth ratio than their equivalent twisted-pair-yarns, the resulting braid had a finer hand (i.e. is softer and smoother to the touch) and can be more smoothly coated, resulting in improved characteristics and further contributing to production efficiency. Twisted-pair-yarns are denser in the sense of compactness. They provide a surface veneer with less width and hence, comparatively, are heavier in weight and cannot ordinarily be as smoothly coated.

The yarns preferably have the lubricant material applied thereto during winding of the yarns on to braiding machine bobbins, which bobbins are subsequently inserted in the braiding machine in the usual way. Alternatively, but less preferably, the lubricant liquid may be applied to the yarn either after it leaves the bobbin but before it enters the braider, or during braiding, by means of, for example, a spray nozzle.

The amount of lubricant liquid material to be applied, and the other operating conditions are adjusted to suit the yarn being braided. Pick-up of about 2% to 6%, preferably at least about 3%, of lubricant liquid by weight, based on the dry weight of the yarn, is preferred for glass filament yarns using an oily hydrocarbon lubricant, for example. The lubricant may be applied to the fibres in any suitable way, one convenient

method involving the use of a "licking" roller rotating in a bath of a lubricant liquid material (preferably warmed to a temperature above 25°C), whereby the yarn touches against the "licking" roller to pick up a coating of the lubricant. However, other methods such as spraying or complete submersion of the yarn in the lubricant material can be used. Alternatively, a bobbin wound with the yarn may be partially or totally immersed in the lubricant liquid. The amount of lubricant picked up by the yarn may in any event be adjusted by mechanical or pneumatic means if desired.

Several embodiments of the methods of the present invention, and braids formed thereby, will now be described, by way of example, with reference to Figure 1 of the accompanying drawing, which shows, in diagrammatic form, steps in the production of the braid.

Referring to Figure 1, the already-sized yarn 2 is unwound from a bobbin 1 on which it is supplied and is fed through a braking and tensioning device 3. From there it passes, via a guide member 11, to contact a licking roller 10 and thence to guides 9 and 8. The guide 8 moves to and fro as indicated by the arrows to distribute the yarn to the braiding machine bobbin 7 in the usual way.

Between the guide members 11 and 9 the yarn contacts the licking roller 10 that is partly immersed in a bath of lubricant liquid material and which is rotating in a direction counter to the direction of movement of the yarn, as indicated by the curved arrow. The lubricant material is maintained at a suitable temperature, for example 30°C, by control means illustrated by a heater 6 and a thermometer 5. An adequate level of the lubricant liquid is maintained by a reservoir 4.

The braiding machine bobbins containing the wet lubricated yarns are then placed on the spindles of a braiding machine, and the yarn is transformed into braids on a braiding machine in the usual way, with a substantially reduced degree of filament breakage compared with unlubricated sized single-yarns or even in some cases with twisted-pair-yarns.

Specific Examples of the method will now be described in more detail, as a further illustration of the invention.

Example 1

Sized glass filament single-yarns identified by the manufacturer's No. EC9 102 Z 20 (ECG 49 1/0 0.5 Z) were wound on to braiding bobbins in the manner generally described above with reference to Figure 1, using a suitable braking tension determined by the usual criteria. The yarn was wound at a linear speed of 200 to 300 metres per minute, and was coated with the aforementioned lubricant hydrocarbon oil MPW 2H (from ETS Z Moulins) at a temperature of 30°C, the licking roller having a diameter of 60 mm and rotating at a speed of 10 revolutions per minute.

Under these conditions, the glass filament yarn picked up 3% by weight of the lubricant, based on the yarn dry weight, and was successfully braided

on a braiding machine operating at 420 yarn interlacings per minute. After annealing and de-sizing by flame treatment, the braid was found to be substantially free of the lubricant liquid and substantially free of projecting filament ends, and was considered to be quite satisfactory for application of further coatings in known manner.

The aforementioned single yarn was able to be used in place of twisted equivalent yarns EC9 34X x 35 150 (ECG 15 C 1/3 3.8 S).

Example 2

The method of Example 1 was repeated, except that the MPW 2H oil was replaced as lubricant by the Codex Vaseline oil known as "SIDEPALENE 316" (from S.T.E. Chimiques de Gerland). Satisfactory results were again achieved, despite a tendency for a slightly increased occurrence of projecting filament ends.

Example 3

The method of Example 1 was repeated with the lubricant replaced by a blend of polyglycol ether and condensed fatty acids known as DURAN KG (from Hansa Werke). Acceptable results were again achieved, although the level of projecting filament ends was noticeably higher than in Example 1.

Claims

1. A method of forming a braid from a plurality of substantially untwisted continuous multi-filament inorganic single yarns, comprising (i) applying to said single-yarns a lubricant liquid in order to prevent fibrillation caused by breakage, during braiding, of filaments that form the yarns, and (ii) braiding the lubricated yarns on a high speed braiding machine operating at a rate above 100 interlacings per minute.

2. A method according to Claim 1, wherein the braiding machine is operated at substantially 250 to 420 interlacings per minute.

3. A method according to any preceding Claim, wherein the lubricant liquid comprises an oily material.

4. A method according to any preceding Claim, wherein the lubricant liquid comprises an oily hydrocarbon, preferably a saturated hydrocarbon.

5. A method according to any preceding Claim, wherein the lubricant liquid comprises a blend of polyglycol ether and condensed fatty acids.

6. A method according to any preceding Claim, wherein said lubricant liquid is liquid or semi-liquid at 15°C.

7. A method according to any preceding Claim, wherein the relative density of the lubricant liquid is at least 0.8, and preferably within the range from 0.8 to 0.9, at 20°C.

8. A method according to any preceding Claim, wherein the kinematic viscosity of the lubricant liquid is within the range from 3 to 35 centistokes at 20°C.

9. A method according to any preceding Claim,

wherein the amount of lubricant liquid applied to the yarns is between about 2 and 6 percent, and preferably at least 3 percent, by weight of the dry yarn weight.

10. A method according to any preceding Claim, wherein the lubricant liquid is applied to the yarns immediately prior to or during braiding.

11. A method according to any preceding Claim, wherein the lubricant liquid is at or above about 25°C when applied to the yarns.

12. A method according to any preceding Claim, wherein the filaments of the single-yarns are continuous filaments.

13. A method according to any preceding Claim, wherein substantially all the yarns to be braided are multifilament single-yarns.

14. A method according to any preceding Claim wherein substantially all of the yarns to be braided are single-yarns.

15. A method according to any preceding Claim, where at least some of said single-yarns comprise glass filaments, or silica filaments, or ceramic filaments, or carbon filaments.

16. A method according to any preceding Claim, wherein at least some of said single-yarns comprise filaments of two or more inorganic materials.

17. A method according to any preceding Claim, wherein the plurality of single-yarns comprises yarns of two or more discrete types.

18. A method according to any preceding Claim, comprising removing the lubricant liquid after braiding.

19. A method according to Claim 18, wherein the lubricant liquid is removed by heat treatment of the braid.

20. A method according to any preceding Claim, comprising applying an overcoat to the braid.

21. A method according to Claim 20, wherein said overcoat is of electrically insulating material.

Patentansprüche

1. Ein Verfahren zur Bildung eines Geflechts aus mehreren im wesentlichen ungedrehten kontinuierlichen anorganischen Multifilament-Single-Garnen, umfassend (i) den Auftrag auf die Single-Garne, von einer Gleitmittelflüssigkeit, um die Fibrillenbildung zu verhindern, die durch Brechen der Filamente, die die Garne bilden, während des Flechtens, bewirkt werden, und (ii) Flechten der mit Gleitmittel versehen Garne auf einer Hochgeschwindigkeits-Flechtmaschine, die mit einer Rate von über 100 Verflechtungen pro Minute arbeitet.

2. Ein Verfahren nach Anspruch 1, worin die Flechtmaschine bei im wesentlichen 250 bis 420 Verflechtungen pro Minute betrieben wird.

3. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit ein öliges Material umfaßt.

4. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit

keit einen öligen Kohlenwasserstoff, vorzugsweise einen gesättigten Kohlenwasserstoff, umfaßt.

5. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit eine Mischung von Polyglykolether und kondensierten Fettsäuren umfaßt.

6. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit flüssig oder halbflüssig bei 15°C ist.

7. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die relative Dichte der Gleitmittelflüssigkeit mindestens 0,8 und vorzugsweise im Bereich von 0,8 bis 0,9, bei 20°C, ist.

8. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die kinematische Viskosität der Gleitmittelflüssigkeit im Bereich von 3 bis 35 Centistokes bei 20°C ist.

9. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Menge der Gleitmittelflüssigkeit, die auf die Garne aufgetragen wird, zwischen etwa 2 und 6 % und vorzugsweise mindestens 3 %, bezogen auf das Gewicht, des Trockengargewichts, beträgt.

10. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit auf die Garne unmittelbar vor oder während des Flechtens aufgetragen wird.

11. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Gleitmittelflüssigkeit bei oder über etwa 25°C ist, wenn sie auf die Garne aufgetragen wird.

12. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die Filamente der Single-Garne kontinuierliche Filamente sind.

13. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin im wesentlichen alle zu verflechtenden Garne Multifilament-Single-Garne sind.

14. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin im wesentlichen sämtliche zu flechtende Garne Single-Garne sind.

15. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin mindestens einige der Single-Garne Glasfilamente oder Siliziumdioxid-filamente oder keramische Filamente oder Kohlenstoffilamente umfassen.

16. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin mindestens einige der Single-Garne Filamente von zwei oder mehreren anorganischen Materialien umfassen.

17. Ein Verfahren nach einem der vorhergehenden Ansprüche, worin die mehreren Single-Garne Garne von zwei oder mehreren verschiedenen Typen umfassen.

18. Ein Verfahren nach einem der vorhergehenden Ansprüche; welches das Entfernen der Gleitmittelflüssigkeit nach dem Flechten umfaßt.

19. Ein Verfahren nach Anspruch 18, worin die Gleitmittelflüssigkeit durch Wärmebehandlung des Geflechts entfernt wird.

20. Ein Verfahren nach einem der vorhergehenden Ansprüche, das den Auftrag eines Überzugs auf das Geflecht umfaßt.

21. Ein Verfahren nach Anspruch 20, bei dem

der Überzug aus elektrisch isolierendem Material besteht.

Revendications

1. Procédé de formation d'une tresse à partir d'une multi-plicité de fils simples inorganiques, multifilaments et continus, sensiblement détordus, consistant (i) à appliquer auxdits fils simples un liquide lubrifiant afin de prévenir une fibrillation provoquée par une rupture, en cours de tressage, des filaments qui forment les fils, et (ii) à tresser les fils lubrifiés sur une machine de tressage à vitesse élevée fonctionnant à une cadence supérieure à 100 entrelacements par minute.

2. Procédé selon la revendication 1, dans lequel on fait, fonctionner la machine de tressage à sensiblement 250 à 420 entrelacements par minute.

3. Procédé selon une revendication précédente quelconque dans lequel le liquide lubrifiant comprend une matière huileuse.

4. Procédé selon une revendication précédente quelconque, dans lequel le liquide lubrifiant comprend un hydrocarbure huileux, de préférence un hydrocarbure saturé.

5. Procédé selon une revendication précédente quelconque, dans lequel le liquide lubrifiant comprend un mélange de polyglycol éther et d'acides gras condensés.

6. Procédé selon une revendication précédente quelconque, dans lequel ledit liquide lubrifiant est liquide ou semi-liquide à 15°C.

7. Procédé selon une revendication précédente quelconque, dans lequel la densité relative du liquide lubrifiant est au moins de 0,8 et de préférence dans la gamme de 0,8 à 0,9, à 20°C.

8. Procédé selon une revendication précédente quelconque, dans lequel la viscosité cinématique du liquide lubrifiant est dans la gamme de 3 à 35 centistokes à 20°C.

9. Procédé selon une revendication précédente quelconque, dans lequel la proportion de liquide lubrifiant appliqué sur les fils est entre environ 2 et 6 %, et de préférence d'au moins 3 %, en poids du poids de fil sec.

10. Procédé selon une revendication précédente quelconque, dans lequel le liquide lubrifiant est appliqué sur les fils immédiatement avant le, ou au cours du, tressage.

11. Procédé selon une revendication précédente quelconque, dans lequel le liquide lubrifiant est à ou au-dessus d'environ 25°C lorsqu'on l'applique sur les fils.

12. Procédé selon une revendication précédente quelconque dans lequel les filaments des fils simples sont des filaments continus.

13. Procédé selon une revendication précédente quelconque, dans lequel pratiquement tous les fils à tresser sont des fils simples multifilaments.

14. Procédé selon une revendication précédente quelconque, dans lequel pratiquement tous les fils à tresser sont des fils simples.

15. Procédé selon une revendication précédente quelconque, dans lequel au moins certains desdits fils simples comprennent des filaments de verre, ou des filaments de silice, ou des filaments de céramique ou des filaments de carbone.

16. Procédé selon une revendication précédente quelconque, dans lequel au moins certains desdits fils simples comprennent des filaments de deux matières inorganiques ou plus.

17. Procédé selon une revendication précédente quelconque, dans lequel la multiplicité de fils simples comprend des fils de deux types distincts ou plus.

18. Procédé selon une revendication précédente quelconque, comprenant le retrait du liquide lubrifiant après tressage.

19. Procédé selon la revendication 18, dans lequel on retire le liquide lubrifiant par traitement thermique de la tresse.

20. Procédé selon une revendication précédente quelconque, consistant à appliquer une enduction superficielle sur la tresse.

21. Procédé selon la revendication 20, dans lequel ladite enduction superficielle est en une matière électriquement isolante.

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Fig. 1.

