(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 652 989 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
08.07.1998 Bulletin 1998/28

(21) Application number: **93901057.5**

(22) Date of filing: **06.01.1993**

(51) Int Cl.[6]: **D07B 1/16**

(86) International application number:
PCT/GB93/00008

(87) International publication number:
WO 94/03672 (17.02.1994 Gazette 1994/05)

(54) **IMPROVED CORE FOR WIRE ROPE**

VERBESSERTE SEELE FÜR DRAHTSEIL

AME PERFECTIONNEE POUR CABLE EN FILS D'ACIER

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(30) Priority: **03.08.1992 GB 9216482**

(43) Date of publication of application:
17.05.1995 Bulletin 1995/20

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EP 0 652 989 B1

Description

This invention relates to cores for wire ropes, particularly steel wire ropes.

GB-A-2 219 014 describes a core for wire rope comprising a fluted member of polymeric or elastomeric material having helical grooves symmetrically spaced around its outer surface, each groove in cross-section (in a plane normal to the longitudinal axis of the core) having the form of an arc of a ellipse. The properties and control of manufacture of the core may be substantially improved by incorporating within the extrusion a reinforcing member or cord constituted by a fibre core or independent wire rope.

However, the use of conventional types of reinforcing members such as are illustrated in GB-A-2 219 014, has certain drawbacks. Both fibre cores and independent wire rope cores, by the very nature of their helical construction, entrap a quantity of air which has a detrimental effect on the solidity of support that the core is able to provide in the rope. This is especially important in a wire rope, where the core is typically subjected to very high radial pressures; any compressibility of the core results in a reduction in rope diameter with tension and, hence, an increased rope stretch characteristic, which is often undesirable in service. Additionally, any pronounced reduction in rope diameter will result in the outer strands of the rope coming into contact with one another at the wire crowns, with very high stresses at the contact points. In a rope which is working backwards and forwards over sheaves or is otherwise repetitively flexed, these stresses will cause fretting damage to the outer wires, with a consequent loss of fatigue performance.

GB-A-2 219 014 discloses a core according to the preamble of claim 1, in which the fluted member is tubular with a cylindrical internal region for containing a reinforcing member. Practical experience with the conventional types of reinforcing member disclosed in GB-A-2 219 014 has revealed that it is possible for the reinforcing member to fail prematurely, before there has been any significant deterioration of the outer strands of the rope (which are readily inspectable). This mode of failure is not only undesirable from an inspection viewpoint, but can also lead to a loss of load carrying capacity and structural integrity of the wire rope.

What is desired is a core which avoids or mitigates these disadvantages.

The present invention provides a core for wire rope, the core being made of plastics material and comprising a tubular member of extruded plastics material having a cylindrical inner surface and having a fluted outer surface, formed by extrusion, with symmetrically-arranged spaced-apart helical grooves for receiving respective wire strands of the rope, characterised by a stiffer solid cylindrical central member of extruded plastics material, the inner surface of the tubular member being in intimate contact with the central member, the diameter of the central member being at least 70% of the root diameter of the fluted outer surface, and the cross-sectional area of the central member being at least 40% of that of the core.

Preferred and optional features are set forth in claims 2 *et seq.*

The invention will be described further, by way of example only, with reference to the accompanying drawings, in which :-

Figure 1 is a diagrammatic cross-section through a core for a wire rope; and
Figure 2 is a diagrammatic cross-section through a wire rope incorporating the core.

The core illustrated comprises a tubular outer member 1 of plastics material and a solid cylindrical central member 3 of plastics material. The outer member 1 has a cylindrical inner surface in intimate contact with the central member 3. Optionally there may be a film of lubricant or release agent at the interface between the members 1,3. The outer member 1 has a fluted outer surface with symmetrically spaced helical grooves 2 for receiving respective steel wire strands 4.

In the illustrated example of a wire rope, shown in Figure 2, there are six strands 4. However, it will be appreciated that a different number of strands may be used (e.g. 5, 7, or 8). Each strand 4 is a round strand whose circumscribing envelope E - in a cross-section perpendicular to the strand axis - is a circle of diameter d_1. Since each strand extends helically, the envelope E appears slightly elliptical in a cross-section in the plane of the drawings, which plane is perpendicular to the axis of the core. Each groove 2 - in a cross-section perpendicular to the groove - is an arc of a circle of diameter d_1.

To maximise the area of contact between the wires of one strand 4 and the core, the strand is a Dyform (Trade Mark - Bridon plc) strand which - in cross-section perpendicular to its axis - has a compacted structure in which the outer wires 6 have eternal edges 6a which are arcs of a circle of diameter d_1. However, conventional strands made up of round wires may be used instead. Also, non-round strands may be used, with grooves of suitable cross-section.

The core, having a solid cross-section, provides good support to the strands 4. By providing the core with a sufficiently large cross-section with grooves 2 of sufficient depth, a working clearance between the adjacent strands 4 can be ensured, even up to the breaking load of the rope. The use of two distinct (outer and central) members 1,3 enables one to select the properties of the members 1,3 to satisfy various requirements for the physical (and chemical) properties

of the core as a whole.

In order to define the preferred size of core, reference is made to Figure 1, wherein dimension d_1 represents tne diameter of the outer strands 4 of the rope and diameter d_2 denotes the root diameter of the fluted memoer 1, i.e. the minimum distance between the bottoms of any two diametrically opposing grooves. For any given rope type and construction the minimum root diameter d_2 may be expressed as a function of the outer strand diameter d_1. The exact relationship will depend primarily upon the number of outer strands in the rope and the lay angle (or pitch) at which they are closed together, although additional account may be taken of the strand construction and service duty. For example, different factors will be required for ropes in which the strands are of quasi-triangular shape. For the more common round-strand rope constructions and lays, the following relationships are recommended :

Table 1

Number of outer strands	6		8	
Lay ratios in closing	6	7	6	7
Mean lay angle (degrees)	19.5	17.0	21.0	18.2
Minimum diameter ratio (d_2/d_1)	1.20	1.18	1.90	1.87

The two members 1,3 may be made of the same type of plastics material or different types. In each case the plastics material may, for example, be selected from the following types:

Polypropylene
Polyethylene (medium to high density)
Polyester (such as Hytrel - Trade Mark of Pont)

Specific grades of material, and their characteristics physical properties, are shown in the following Table 2 :

Table 2

Type of plastic	Polypropylene	Polyethylene	Hytrel®6346
Density (g /cm^3)	0.90 - 0.91	0.93 - 0.95	1.22
Hardness (Shore D)	62 - 66	58 - 60	63
Yield Strength (MPa)	27 - 31	20 - 22	17
Flexural Modulus (MPa)	600 - 1000	600 - 800	350

The above properties are cited for the purpose of illustration only. Additional property enhancement may be obtained by going to harder grades of material or incorporating reinforcing fibres (e.g. glass-fibre) into the polymer, albeit with some loss of rope flexibility.

The optimum blend of core properties may be obtained by using two dissimilar materials to produce the core. For example, the outer member 1 may comprise a material with good elongation properties to accept the high bending strains and also be capable of deforming locally to provide close conformance with the surface geometry of the outer strands of the rope, whereas the central member 3 may be beneficially composed of a harder and more rigid material, perhaps incorporating reinforcing fibres.

Whatever the choice of materials, the core is preferably prepared in two separate extrusion operations, the first of which produces the solid cylindrical member 3. Optionally, a lubricant or a release agent is applied to the solid cylindrical member 3. This is then fed into an extruder for a further operation which produces the fluted member 1, the central member 3 greatly assisting in the control of the second extrusion operation.

The size of the central member 3 in relation to the size of the core may vary, so that one size of central member can be used for a range of core sizes, thereby achieving an economy in manufacturing costs. However, the cross-sectional area of the central member 3 is at least 40% (more preferably at least 45%) and preferably at most 60% (more preferably at most 55%) of the cross-sectional area of the core, a convenient ratio being about 50% (enabling extrusion speeds to be equalised). Accordingly, the central member 3 has a circular cross-section whose diameter d_1 is at least 70% (more preferably at least 75%) of the root diameter d_2; preferably d_3 is at most 90% (more preferably 85%) of d_2, a convenient ratio being about 80%.

Claims

1. A core for wire rope, the core being made of plastics material and comprising a tubular member (1) of extruded plastics material having a cylindrical inner surface and having a fluted outer surface, formed by extrusion, with symmetrically-arranged spaced-apart helical grooves (2) for receiving respective wire strands (4) of the rope, characterised by a stiffer solid cylindrical central member (3) of extruded plastics material, the inner surface of the tubular member (1) being in intimate contact with the central member (3), the diameter (d_3) of the central member (3) being at least 70% of the root diameter (d2) of the fluted outer surface, and the cross-sectional area of the central member (3) being at least 40% of that of the core.

2. A core as claimed in claim 1, in which the tubular member (1) is longitudinally slidable relative to the central member (3).

3. A core as claimed in claim 1 or 2, in which the plastics material of the central member (3) is harder than the plastics material of the tubular member (1).

4. A core as claimed in any preceding claim, in which the plastics material of the central member (3) contains discontinuous reinforcing fibres.

5. A core as claimed in any preceding claim, in which the plastics material of the central member (3) and the plastics material of the tubular member (1) are of the same type.

6. A core as claimed in any preceding claim, for a wire rope comprising rounds strands (4), each having a circumscribing circle, in which each groove (2) - in a cross-section perpendicular to the groove - describes a substantially circular arc.

7. A core as claimed in claim 6, which is of sufficient size to prevent contact between the strands (4) in the rope when the radius of the said circumscribing circle is equal to the radius of the said arc.

8. A method of manufacturing a core according to any preceding claim, in which the tubular member (3) is formed by extrusion, characterised in that the core is formed by two separate successive extrusion operations, the first of which forms the central member (3), and the second of which forms the tubular member (1) around the central member (3).

9. A wire rope comprising a core according to any of claims 1 to 7, and wire strands (4) received in the respective grooves (2).

10. A wire rope as claimed in claim 9, in which the core prevents contact between the strands (4).

11. A wire rope as claimed in claim 9 or 10, in which the strands (4) are round strands, each having a circumscribing circle.

Patentansprüche

1. Kern für ein Drahtseil, wobei der Kern aus Plastikmaterial hergestellt wird und ein rohrförmiges Element (1) aus stranggepreßtem Plastikmaterial umfaßt, das eine zylindrische Innenfläche hat und das eine gerippte Außenfläche hat, die durch Strangpressen gebildet werden, mit symmetrisch angeordneten, mit Zwischenraum verlaufenden schraubenförmigen Rillen (2) zur Aufnahme von entsprechenden Drahtlitzen (4) des Seils, gekennzeichnet durch ein steiferes kompaktes zylindrisches Mittelelement (3) aus stranggepreßtem Plastikmaterial, wobei sich die Innenfläche des rohrförmigen Elements (1) im innigen Kontakt mit dem Mittelelement (3) befindet, der Durchmesser (d_3) des Mittelelements (3) mindestens 70% des Fußkreisdurchmessers (d_2) der gerippten Außenfläche beträgt und die Querschnittsfläche des Mittel elements (3) wenigstens 40% der des Kerns beträgt.

2. Kern nach Anspruch 1, bei dem das rohrförmige Element (1) in der Längsrichtung im Verhältnis zum Mittelelement (3) gleitfähig ist.

3. Kern nach Anspruch 1 oder 2, bei dem das Plastikmaterial des Mittelelements (3) härter als das Plastikmaterial

des rohrförmigen Elements (1) ist.

4. Kern nach einem der vorhergehenden Ansprüche, bei dem das Plastikmaterial des Mittelelements (3) diskontinuierliche Verstärkungsfasern enthält.

5. Kern nach einem der vorhergehenden Ansprüche, bei dem das Plastikmaterial des Mittelelements (3) und das Plastikelement des rohrförmigen Elements (1) vom gleichen Typ sind.

6. Kern nach einem der vorhergehenden Ansprüche für ein Drahtseil, das runde Litzen (4) umfaßt, die jeweils einen umschreibenden Kreis haben, bei dem jede Rille (2) - in einem Schnitt senkrecht zu der Rille - einen im wesentlichen kreisförmigen Bogen beschreibt.

7. Kern nach Anspruch 6, der von ausreichender Größe ist, um den Kontakt zwischen den Litzen (4) im Seil zu verhindern, wenn der Radius des umschreibenden Kreises gleich dem Radius des genannten Bogens ist.

8. Verfahren zur Herstellung eines Kerns nach einem der vorhergehenden Ansprüche, bei dem das rohrförmige Element (3) durch Strangpressen geformt wird, dadurch gekennzeichnet, daß der Kern in zwei getrennten, aufeinanderfolgenden Strangpreßvorgängen geformt wird, wobei im ersten das Mittelelement (3) gebildet wird und wobei im zweiten das rohrförmige Element (1) um das Mittelelement (3) gebildet wird.

9. Drahtseil, das einen Kern nach einem der Ansprüche 1 bis 7 und Drahtlitzen (4) umfaßt, die in den entsprechenden Rillen (2) aufgenommen werden.

10. Drahtseil nach Anspruch 9, bei dem der Kern den Kontakt zwischen den Litzen (4) verhindert.

11. Drahtseil nach Anspruch 9 oder 10, bei dem die Litzen (4) runde Litzen sind, die jeweils einen umschreibenden Kreis haben.

Revendications

1. Ame pour câble métallique, l'âme étant formée d'une matière plastique et comprenant un élément tubulaire (1) en matière plastique extrudée ayant une surface interne cylindrique et une surface externe cannelée, formées par extrusion, pourvue de rainures hélicoïdales (2) situées à distance les unes des autres et agencées de manière symétrique, destinées à recevoir les torons (4) respectifs du câble, caractérisée par un élément central cylindrique solide plus raide (3) en matière plastique extrudée, la surface interne de l'élément tubulaire (1) étant en contact étroit avec l'élément central (3), le diamètre (d_3) de l'élément central (3) étant égal à au moins 70% du diamètre de base (d_2) de la surface externe cannelée et la superficie de la section de l'élément central (3) étant égale à au moins 40% de celle de l'âme.

2. Ame selon la revendication 1, dans laquelle on peut faire glisser l'élément tubulaire (1) de manière longitudinale par rapport à l'élément central (3).

3. Ame selon la revendication 1 ou 2, dans laquelle la matière plastique de l'élément central (3) est plus dure que la matière plastique de l'élément tubulaire (1).

4. Ame selon l'une quelconque des revendications précédentes, dans laquelle la matière plastique de l'élément central (3) contient des fibres de renforcement discontinues.

5. Ame selon l'une quelconque des revendications précédentes, dans laquelle la matière plastique de l'élément central (3) et la matière plastique de l'élément tubulaire (1) sont du même type.

6. Ame selon l'une quelconque des revendications précédentes, pour un câble métallique comprenant des torons ronds (4), chacun ayant un cercle de limitation, dans laquelle chaque rainure (2) - vue en coupe perpendiculaire par rapport à la rainure - décrit un arc essentiellement circulaire.

7. Ame selon la revendication 6, qui est de dimension suffisante pour empêcher le contact entre les torons (4) dans le câble lorsque le rayon dudit cercle de limitation est égal au rayon dudit arc.

8. Procédé de fabrication d'une âme selon l'une quelconque des revendications précédentes, dans lequel l'élément tubulaire (3) est formé par extrusion, caractérisé en ce que l'âme est formée par deux opérations d'extrusion successives séparées dont la première forme l'élément central (3) et la seconde forme l'élément tubulaire (1) autour de l'élément central (3).

9. Câble métallique comprenant une âme selon l'une quelconque des revendications 1 à 7, et des torons (4) reçus dans les rainures (2) respectives.

10. Câble métallique selon la revendication 9, dans lequel l'âme empêche le contact entre les torons (4).

11. Câble métallique selon la revendication 9 ou 10, dans lequel les torons (4) sont des torons ronds, chacun ayant un cercle de limitation.

FIG.1

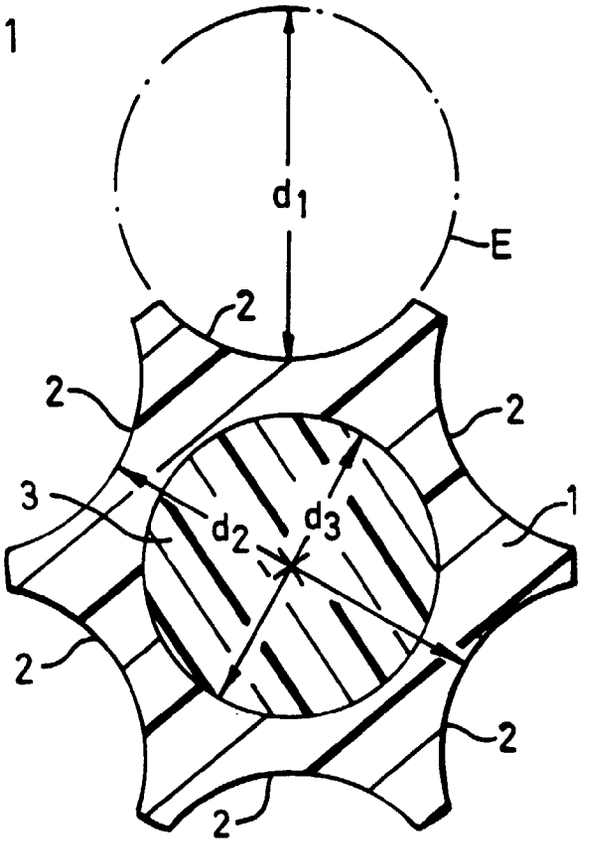

FIG.2