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IMPROVED CORE FOR WIRE ROPE

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(56) Prior Art Documents
AU 631552 36877/89 D07B 1/16
GB 1592841
AU 5721/32 58.1

(57) Claim 1. A core for a wire rope, comprising a fluted tubular outer member of extruded plastics material and a stiffer solid-cylindrical central member of extruded plastics material, the outer member having a cylindrical inner surface in intimate contact with the central member and having a fluted outer surface, formed by extrusion, with symmetrically-arranged spaced-apart continuous helical grooves for receiving respective wire strands of the wire rope, 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.

8. A method of manufacturing a core according to claim 1, in which the core is formed by two separate successive extrusion operations, the first of which forms the central member, and the second of which forms the outer member around the central member.

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

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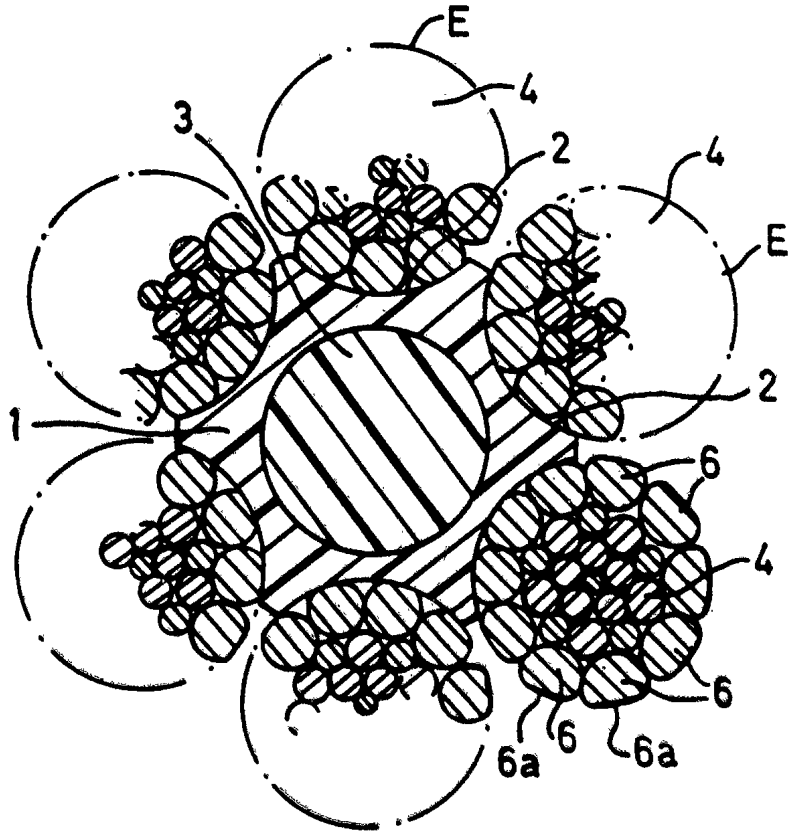

(57) Abstract

A tubular outer member (1) of plastics material is extruded onto a solid cylindrical central member (3) of plastics material. The outer member (1) has symmetrically spaced grooves (2) for receiving respective wire strands (4).

Improved Core for Wire Rope

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.

Practical experience with the conventional types of reinforcing member disclosed in GB-A-2 219 014 has also 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 a wire rope, comprising a fluted tubular outer member of extruded plastics material and a stiffer solid-cylindrical central member of extruded plastics material, the outer member having a cylindrical inner surface in intimate contact with the central member and having a fluted outer surface, formed by extrusion, with symmetrically-arranged spaced-apart continuous helical grooves for receiving respective wire strands of the wire rope, 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 the subsidiary claims.

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.

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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 the 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 the diameter of the outer strands 4 of the rope and diameter d_2 denotes the root diameter of the fluted member 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

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 DuPont)

Specific grades of material, and their characteristic 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% (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% (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%.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A core for a wire rope, comprising a fluted tubular outer member of extruded plastics material and a stiffer solid-cylindrical central member of extruded plastics material, the outer member having a cylindrical inner surface in intimate contact with the central member and having a fluted outer surface, formed by extrusion, with symmetrically-arranged spaced-apart continuous helical grooves for receiving respective wire strands of the wire rope, 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.

2. A core as claimed in claim 1, in which the outer member is longitudinally slidable relative to the central member.

3. A core as claimed in claim 1 or 2, in which the central member is harder than the outer member.

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

5. A core as claimed in any preceding claim, in which the plastics material of the central member and the plastics material of the outer member are of the same type.

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

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7. A core as claimed in claim 6, which is of sufficient size to prevent contact between the strands 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 claim 1, in which the core is formed by two separate successive extrusion operations, the first of which forms the central member, and the second of which forms the outer member around the central member

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

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

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

12. A core for a wire rope, substantially as described herein with reference to Figure 1 of the accompanying drawings.

13. A wire rope substantially as described herein with reference to Figure 2 of the accompanying drawings.

14. A method of manufacturing a core for wire rope, substantially as described herein with reference to the accompanying drawings.

DATED this 23rd day of October 1996

BRIDON plc

By their Patent Attorneys

GRIFFITH HACK

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FIG.1

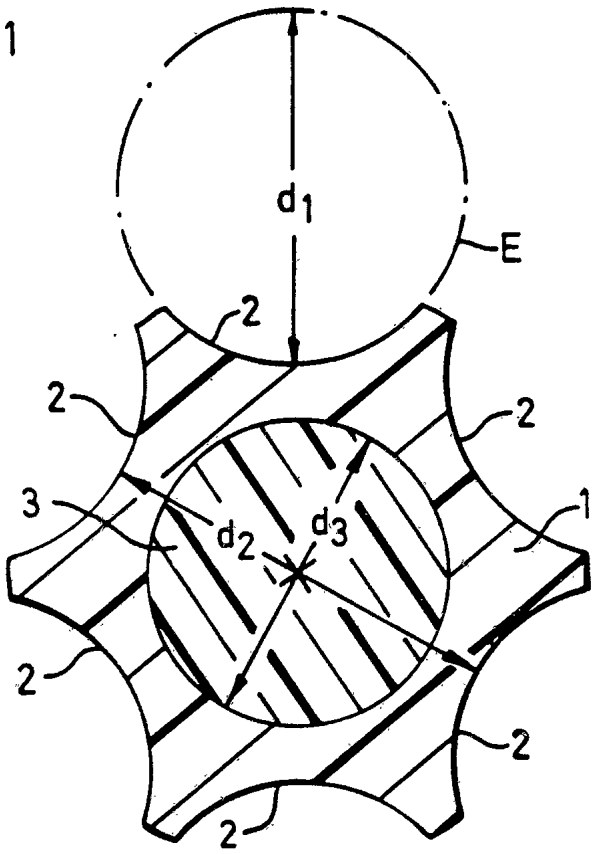
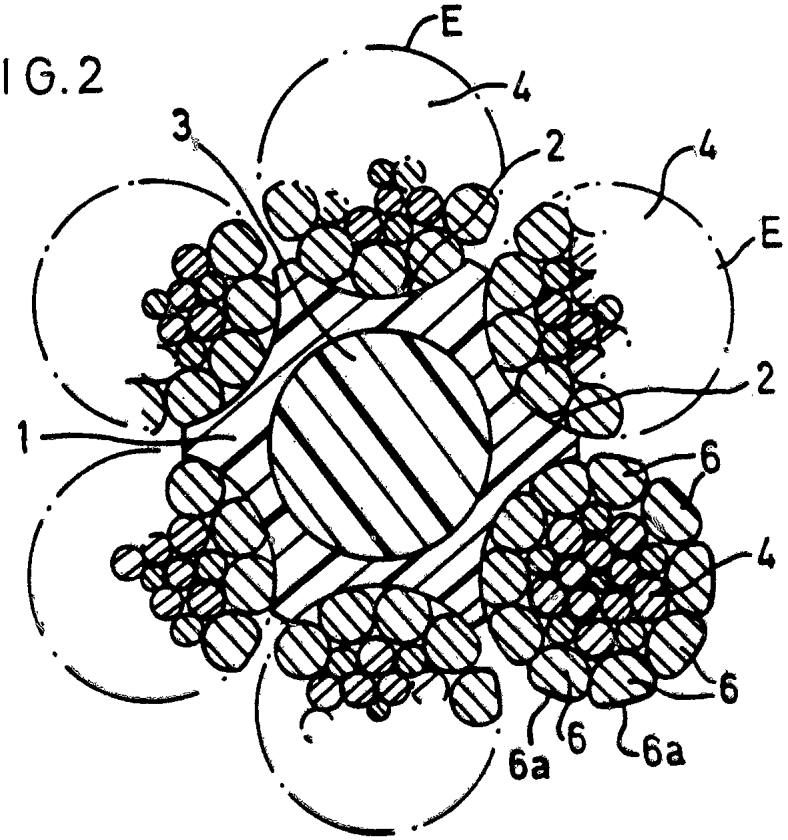


FIG.2



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 93/00008

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 D07B1/16

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	D07B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
Y	GB,A,2 219 014 (BRIDON PLC) 29 November 1989 cited in the application see page 5, line 1 - page 6, line 2; figures 1,3A-C	1,11
A		4,8-10, 12,13
Y	CA,A,570 733 (A.W.KOON) 17 February 1959 see column 2, line 12 - line 25 see column 5, line 26 - line 29 see claim 3	1,11
A		3,10,13
A	FR,A,2 378 894 (DRAHTSEILWERK SAAR GMBH) 25 August 1978 see page 6, line 3 - line 30; figure 2	1,3,10, 12,13

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° Special categories of cited documents : [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28 APRIL 1993	24. 05. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	GOODALL C.J.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	GB,A,408 291 (W.C. & J.A.S.ROBERTSON) 3 May 1934 see page 1, line 70 - page 2, line 25	1,3

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9300008
SA 68283

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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CA-A-570733		None		
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