

Description:



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Synthetic Fiber Rope

- 5 The invention relates to a traction rope constructed of synthetic fibers, preferably of aromatic polyamide, according to the preamble to Claim 1.

10 In materials handling technology, especially on elevators, in crane construction, and in mining, moving ropes are an important element of machinery and subject to heavy use. An especially complex aspect is the loading of driven or over pulleys deflected ropes, for example as they are used in elevator construction.

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In conventional elevator installations the car sling of a car, which is moved in an elevator hoistway, and a counterweight are connected together by a steel rope. To raise and lower the car and the counterweight, the rope runs over a traction sheave which is driven by a drive motor. The drive torque is transferred by friction to the section of rope which at any moment is lying in the angle of wrap. At this point the rope is subjected to high transverse forces. As the loaded rope is reversed by passing over the traction sheave, the strands move relative to each other to compensate for differences in tensile stress. The same refers to ropes wound on drums as they are used in elevators or cranes.

30 On the other hand, on elevator installations the lengths of rope needed are large, and considerations of energy lead to the demand for smallest possible masses. High-tensile synthetic fiber ropes, for example of aromatic polyamides



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or aramides with highly oriented molecule chains, fulfil these requirements.

By comparison with conventional steel ropes of the same
5 cross sectional area, ropes constructed of aramide fibers have a substantially higher lifting capacity and only between one fifth and one sixth of the specific gravity. In contrast to steel, however, the atomic structure of aramide fiber causes it to have a low ultimate elongation and a low
10 shear strength.

From EP 0 672 781 A1 an aramide fiber rope with parallel lay has become known. Between the outermost and inner layers of strands there is an intersheath which prevents
15 contact between the strands of different layers and thereby reduces the wear due to their rubbing against each other. The aramide rope described so far has satisfactory values of service life, resistance to abrasion, and fatigue strength under reversed bending stresses; however, with the
20 stranded synthetic fiber rope there is a possibility that the strands move relative to the intersheath thereby resulting in an uneven loading of the strands. This change in structure can lead to a reduction in the breaking load of the rope or even to failure of the rope.

25 The objective of the invention is to avoid the disadvantages of the known synthetic fiber rope and to improve the internal transmission of force in a synthetic fiber rope.

30 According to the invention this objective is fulfilled by means of a rope with the characteristics stated in Claim 1. Advantageous developments and improvements of the invention stated in Claim 1 are stated in the dependent claims.

The advantages resulting from the invention relate to the fact that the intersheath, by having sheath surfaces adapted to the contours of adjacent layers of strands, creates a larger area of contact with the strands. The
5 tight bond between inner and outer layers of strands results in a higher torsional rigidity. When the rope is loaded, the contoured intersheath according to the invention prevents the rope from twisting irrespective of the type of torque acting on it. The intersheath according
10 to the invention bridges the interstices between the strands of the layers of strands adjacent to it and brings about an increase in the supporting and/or load bearing surface of the sheath when the rope is in the loaded state. This in turn results in a homogenized distribution of
15 torque over the entire circumferential area of the sheath to the interior of the rope. The constrictive force of the covering layer of strands no longer acts mainly as a transverse force on the highest points of individual strands but is spread widely over the entire
20 circumferential surface of the sheath. Due to its elasticity, the intersheath can absorb differing longitudinal movements of adjacent strands without the strands moving relative to the intersheath, from which advantages are derived in relation to the flexibility of
25 the rope and its behavior under reversed bending.

Further advantageous details are described below by reference to an embodiment of the intersheath according to the invention illustrated in the drawing. The drawings
30 show:

Figure 1 A perspective drawing of an traction rope with an intersheath according to the invention;

Figure 2 A view of a cross-section of the traction rope of Figure 1.

Figure 1 shows a rope 1 such as is used as a means of
5 suspension and hoisting in elevator installations. The rope
1 is constructed of a core strand 2 around which in a first
direction of lay 3 five identical strands 4 of a first
layer of strands 5 are laid helically, and on them ten
strands 4, 7 of a second layer of strands 8 are laid in
10 parallel lay are laid with a balanced ratio between the
direction of twist of the strands and the rope lay.

The second layer of strands 8 comprises an alternating
arrangement of two types of five identical strands 4, 7
15 each. The cross-section through a rope illustrated in
Figure 2 shows five further strands 7 with large diameter
which lie helically in the hollows of the first layer of
strands 5 which supports them, while five strands 4 with
the diameter of the strands 4 of the first layer of strands
20 5 lie on the highest points of the first layer of strands 5
that supports them and thereby fill the gaps between two
adjacent strands 7 having a greater diameter. In this way,
the doubly parallel laid rope core 9 receives a second
layer of strands 8 with an almost circular external
25 profile, which in combination with the intersheath 13
affords advantages which are subsequently described below.
When the rope 1 is loaded longitudinally, the parallel lay
of the rope core 9 creates a torque in the opposite
direction to the direction of lay 3. On the rope core 9,
30 seventeen strands 10 are laid in hawser manner in a second
direction of lay 11 opposite to the first direction of lay
3 to form a covering layer of strands 12. In the
illustrated embodiment, the ratio of the length of lay of
the strands lying on the outside 10 to the strands 4, 7 of

the inner layers of strands 5, 8 is 1.6. Under load, the lay of the covering layer of strands 12 develops a torque in the opposite direction to the second direction of lay 11.

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Between the covering layer of strands 12 laid in the second direction of lay 11 and the strands 4, 7 of the second layer of strands 8 is an intersheath 13. The intersheath 13 consists of an elastically deformable material such as
10 polyurethane or polyester elastomers and is molded or extruded onto the stranded rope core 9. During this process the freshly applied intersheath 13 is plastically deformed, lying tight against contours of the circumferential sheath of the layers of strands 8 and 12, filling all the
15 interstices, and retaining the grooves 18, 19 impressed on it by the adjacent layers of strands 8, 12.

The contoured intersheath 13 takes the form of a tube enveloping the second layer of strands 8 and thereby
20 prevents contact of the strands 4, 7 with the strands 10. In this way it prevents wear of the strands 4, 7, 10 being caused by the strands 4, 7, 10 rubbing against each other when relative movement occurs between them when the rope 1 runs over the traction sheave (not shown). By virtue of
25 friction and its shape, the intersheath 13 also transmits the torque which is developed in the covering layer of strands 12 when the rope 1 is under load to the second layer of strands 8, and thereby to the rope core 9, whose parallel lay develops a torque in the opposite direction to
30 the direction of lay 3.

At the same time, the frictional resistance $\mu > 0.15$ between the strands 4, 7, 10 and the intersheath 13 is so

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chosen that practically no relative movement occurs between the strands and the intersheath 13, but so that the intersheath 13 follows the compensating movements by deforming elastically. The elasticity of the intersheath 13 is greater than that of the strand impregnation and that of the supporting strand material and thereby prevents their becoming prematurely damaged. On the other hand, the overall extension of the material selected for the intersheath 13 is in all cases greater than the maximum movement that occurs of the strands 4, 7, 10 relative to each other.

The thickness 20 of the intersheath 13 can be used to set in a controlled manner the radial distance of the covering layer of strands 12 from the center of rotation of the rope 1 and thereby to neutralize the torque ratio between the torque of the covering layer of strands 12 and of the parallel laid rope core 9 which act in opposite directions to each other in the loaded rope 1. The thickness 20 selected for the intersheath 13 must be increased with increasing diameter of the strands 10 and/or the strands 4 and 7. In all cases, the thickness 20 of the intersheath 13 must be given such a dimension as to ensure that under load, when the interstices between the strands 21, 22 are completely filled, there is a remaining sheath thickness of 0.1 mm between strands 4, 7, and 10 of the adjacent layers of strands 8 and 12. The plastically deformed intersheath 13 causes a homogenized transmission of torque over the entire circumferential surface of the sheath. The volume of the interstices between the strands can be minimized by an alternating arrangement of strands of large diameter 7 and strands of smaller diameter 4 in the second layer of strands 8.

Beside in elevators and aerial cableways the rope according the invention is applicable in various installations for material handling, for example for elevators, hoisting, cranes for house construction, factories or ships, ski
5 lifts or for escalators. The rope can be driven either by a traction sheave or by a turning drum on which the rope is coiled up.

Claims:

1. Rope to be driven by a rope sheave or drum, consisting of at least an inner and an outer concentric layer of load-bearing synthetic fiber strands (2,4,7,10) laid together, and between the inner layer of strands (5,8) and the outer layer of strands (12) a tubular shaped intersheath (13) which surrounds the inner layer of strands (5, 8),
5 characterized in that the intersheath (13) has sheath surfaces which are adapted to the external contours of the adjacent layers of strands (8,12).
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- 15 2. Rope according to Claim 1,
characterized in that the coefficient of friction μ between the strands (4,7,10) and the intersheath (13) is greater than 0.15.
- 20 3. Rope according to Claim 1,
characterized in that the overall extension of the intersheath (13) is greater than the maximum movement of the strands (4,7,10) relative to each other.
- 25 4. Rope according to Claim 1,
characterized in that the sheath surfaces are fluted.
5. Rope according to Claim 1,
characterized in that the flutes (20) are helical in
30 shape, the direction of the helix (11) on the outside surface of the sheath being opposite to the direction of the helix (3) of the flutes (19) on the inner surface of the sheath.

6. Rope according to Claim 1,
characterized in that the thickness s of the sheath
(20) at its thinnest point is 0.1 mm.