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

(11) **EP 3 348 510 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.07.2018 Bulletin 2018/29

(51) Int Cl.:
B66B 7/08 *(2006.01)* ***B66B 7/12*** *(2006.01)*

(21) Application number: **17151188.4**

(22) Date of filing: **12.01.2017**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **KONE Corporation**
00330 Helsinki (FI)

(72) Inventors:
- **Helenius, Juha**
  00330 Helsinki (FI)
- **Renvall, Jani**
  00330 Helsinki (FI)

(74) Representative: **Kolster Oy Ab**
(Salmisaarenaukio 1)
P.O. Box 204
00181 Helsinki (FI)

(54) **TERMINATING ARRANGEMENT FOR A ROPE OF A HOISTING APPARATUS**

(57) The invention relates to a terminating arrangement for a rope (1) of a hoisting apparatus, preferably of an elevator for transporting passengers and/or goods. The terminating arrangement for a rope (1) of a hoisting apparatus according to the present invention, in which the rope (1) comprises a plurality of adjacent conductive load bearing members (3-6) for bearing the load exerted on the rope (1) in longitudinal direction, wherein the terminating arrangement comprises an electrically resistive wedge element (15), (19), said wedge element (15), (19) comprising a top wedge component (16), (20) and a bottom wedge component (17), (21) for clamping said wedge element (15), (19) to both sides of said rope (1), and at least one connection interface (10-13); so that upon clamping said top wedge component (16), (20) and said bottom wedge component (17), (21) together, said top wedge component (16), (20) and said bottom wedge component (17), (21) enable forming of an electrical connection between said conductive load bearing members (3-6) of said rope (1) and said at least one connection interface (10-13).

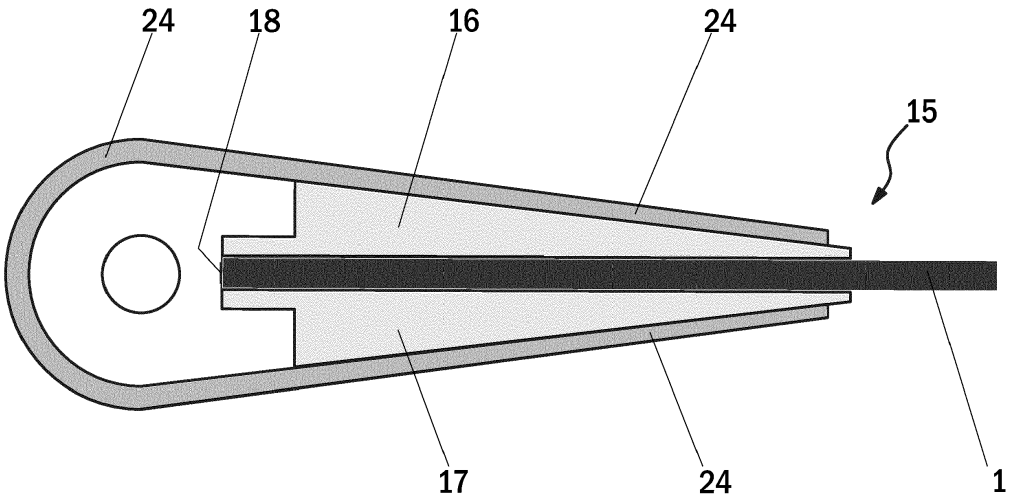

Fig. 11

EP 3 348 510 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a terminating arrangement for a rope of a hoisting apparatus. Said rope is preferably a hoisting rope which has electrically conductive properties. Said hoisting apparatus is preferably an elevator for transporting passengers and/or goods.

BACKGROUND OF THE INVENTION

[0002] Ropes of a hoisting apparatus typically include one or several load bearing members that are elongated in the longitudinal direction of the rope, each load bearing member forming a structure that continues unbroken throughout the length of the rope. Load bearing members are the members of the rope which are able to bear together the load exerted on the rope in its longitudinal direction. The load, such as a weight suspended by the rope, causes tension on the load bearing member in the longitudinal direction of the rope, which tension can be transmitted by the load bearing member in question all the way from one end of the rope to the other end of the rope. Ropes may further comprise non-bearing components, such as an elastic coating, which cannot transmit tension in the above described way.

[0003] In prior art, such ropes exist where the load bearing members are embedded in non-conducting coating, such as polymer coating, forming the surface of the rope and extending between adjacent load bearing members thereby isolating them from each other both mechanically and electrically.

[0004] For facilitating awareness of condition of the ropes, and thereby for improving safety of the hoisting apparatus, monitoring of the condition of the load bearing members has been proposed. The visual inspection of the internal tensile elements is generally not possible and hence the need arises for non-visual inspection. The condition monitoring has been proposed to be arranged by monitoring electrical parameters of the load bearing members.

[0005] One known method for checking the condition of the tensile elements is the resistance-based inspection, which is based on a measure of the electrical resistance of the tensile elements. A change in the electrical resistance or a deviation from an expected value is interpreted as a damage of the tensile elements.

[0006] In the prior art there is one prior art solution for a terminating arrangement which uses separate steel wedges. There are some drawbacks to this prior art terminating arrangement. The steel wedges are relatively complex, large and heavy. The prior art steel wedges are made by machining which limits the design and increases costs. The prior art steel wedges have excellent thermal conductivity, which is disadvantageous in terms of terminal heat resistance during building fire.

[0007] It has been found, that the prior art steel wedges may also jam due to rust, which reduces the load bearing capability of the terminal. Furthermore, the stiff steel used in wedges doesn't allow for any geometrical inaccuracies which always exist especially in the welded wedge housing. Another drawback of the prior art steel wedges is that they typically have an uneven tension distribution to the non-conducting coating of the rope.

[0008] Another drawback of the prior art terminating arrangement is that the on-site installation of the prior art electrical connection is troublesome and time-consuming.

BRIEF DESCRIPTION OF THE INVENTION

[0009] The object of the invention is to introduce a terminating arrangement for a rope of a hoisting apparatus, which provides a secure termination of a rope and provides a reliable electrical connection to a rope of a hoisting apparatus. Advantageous embodiments are furthermore presented, inter alia, wherein qualitative information about the damage magnitude is provided.

[0010] It is brought forward a new terminating arrangement for a rope of a hoisting apparatus, which rope comprises a non-conductive coating, and a plurality of adjacent conductive load bearing members for bearing the load exerted on the rope in longitudinal direction thereof embedded in the coating and extending parallel to each other and to the longitudinal direction of the hoisting rope, the coating forming the surface of the rope and extending between adjacent load bearing members thereby isolating them from each other, in which terminating arrangement comprises: an electrically resistive wedge element, said wedge element comprising a top wedge component and a bottom wedge component for clamping said wedge element to both sides of said hoisting rope, and at least one connection interface; so that upon clamping said top wedge component and said bottom wedge component together, said top wedge component and said bottom wedge component enable forming of an electrical connection between said conductive load bearing members of said rope and said at least one connection interface. Hereby, one or more of the above mentioned advantages and/or objectives are achieved. These advantages and/or objectives are further facilitated with the additional preferred features and/or steps described in the following.

[0011] In a preferred embodiment, said at least one connection interface leads to a condition monitoring device.

[0012] In a preferred embodiment, said wedge element also comprises a hinge portion, said hinge portion allowing the turning of said top wedge component and the turning of said bottom wedge component.

[0013] In a preferred embodiment, said hinge portion is an elastic hinge portion.

[0014] In a preferred embodiment, said hinge portion is placed between the end of said top wedge component and the end of said bottom wedge component.

[0015] In a preferred embodiment, said hinge portion is placed between the side of said top wedge component and the side of said bottom wedge component.

[0016] In a preferred embodiment, said wedge element is made of non-metal material, said non-metal material preferably being fibre-reinforced plastic or plastic.

[0017] In a preferred embodiment, said conductive load bearing members are made of non-metal material.

[0018] In a preferred embodiment, said conductive load bearing members are made of composite material comprising electrically conducting reinforcing fibers in polymer matrix, said reinforcing fibers preferably being carbon fibers.

[0019] In a preferred embodiment, said rope is belt-shaped, i.e. larger in width direction than thickness direction.

[0020] In a preferred embodiment, said top wedge component and said bottom wedge component of said wedge element also comprise at least one fixing bolt and at least one nut, said at least one fixing bolt and at least one nut arranged to hold said top wedge component and said bottom wedge component together.

[0021] In a preferred embodiment, said top wedge component and said bottom wedge component of said wedge element also comprise one or more securing clips for securing said top wedge component and said bottom wedge component to said rope.

[0022] In a preferred embodiment, said terminating arrangement comprises a wedge housing so that said top wedge component and said bottom wedge component of said wedge element clamped on both sides of said rope are placed inside said wedge housing.

[0023] In a preferred embodiment, said terminating arrangement is connected to a condition monitoring device.

[0024] In a preferred embodiment, said terminating arrangement forwards information for quantifying the severity of the defect such as e.g. fiber damage to a condition monitoring device.

[0025] It is also brought forward a new use of a terminating arrangement in an arrangement for condition monitoring of a rope of a hoisting apparatus, which rope comprises a non-conductive coating, and a plurality of adjacent conductive load bearing members for bearing the load exerted on the rope in longitudinal direction thereof embedded in the coating and extending parallel to each other and to the longitudinal direction of the hoisting rope, the coating forming the surface of the rope and extending between adjacent load bearing members thereby isolating them from each other, in which terminating arrangement comprises: an electrically resistive wedge element, said wedge element comprising a top wedge component and a bottom wedge component for clamping said wedge element to both sides of said hoisting rope, and at least one connection interface; so that upon clamping said top wedge component and said bottom wedge component together, said top wedge component and said bottom wedge component enable forming of an electrical connection between said conductive load bearing members of said rope and said at least one connection interface.

[0026] It is also brought forward a new elevator for transporting passengers and/or goods, wherein said elevator comprises a terminating arrangement for a rope of said elevator, which rope comprises a non-conductive coating, and a plurality of adjacent conductive load bearing members for bearing the load exerted on the rope in longitudinal direction thereof embedded in the coating and extending parallel to each other and to the longitudinal direction of the hoisting rope, the coating forming the surface of the rope and extending between adjacent load bearing members thereby isolating them from each other, in which terminating arrangement comprises: an electrically resistive wedge element, said wedge element comprising a top wedge component and a bottom wedge component for clamping said wedge element to both sides of said hoisting rope, and at least one connection interface; so that upon clamping said top wedge component and said bottom wedge component together, said top wedge component and said bottom wedge component enable forming of an electrical connection between said conductive load bearing members of said rope and said at least one connection interface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] In the following, the present invention will be described in more detail by way of example and with reference to the attached drawings, in which:

Figure 1 illustrates an arrangement for condition monitoring of a rope of a hoisting apparatus according to one embodiment of the present invention.

Figure 2 illustrates a preferred inner structure of the load bearing member according to the present invention.

Figure 3 illustrates a three dimensional view of a section of the load bearing member according to the present invention.

Figure 4 illustrates an arrangement for condition monitoring of a rope of a hoisting apparatus according to another embodiment of the present invention having a defect in the rope of the hoisting apparatus.

Figure 5 illustrates a side view of a wedge element of a terminating arrangement for a rope of a hoisting apparatus according to one embodiment of the present invention.

Figure 6 illustrates a side view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to one embodiment of the present invention.

Figure 7 illustrates an end view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to one embodiment of the present invention.

Figure 8 illustrates an end view of a wedge element of a terminating arrangement for a rope of a hoisting apparatus according to another embodiment of the

present invention.

Figure 9 illustrates a side view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to another embodiment of the present invention.

Figure 10 illustrates an end view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to another embodiment of the present invention.

Figure 11 illustrates a cross-sectional view of a terminating arrangement for a rope of a hoisting apparatus according to one embodiment of the present invention.

The foregoing aspects, features and advantages of the invention will be apparent from the drawings and the detailed description related thereto.

DETAILED DESCRIPTION

[0028] Figure 1 illustrates an arrangement for condition monitoring of a rope of a hoisting apparatus according to one embodiment of the present invention. The rope 1 is belt-shaped, i.e. larger in width direction than thickness direction and has a first end 7 and other end 8. The rope 1 comprises a non-conductive coating 2, and a plurality of conductive load bearing members 3-6 for bearing the load exerted on the rope 1 in longitudinal direction thereof, which are adjacent in width direction of the rope 1. The load bearing members 3-6 are embedded in the non-conductive coating 2 and extend parallel to each other as well as to the longitudinal direction of the rope 1 unbroken throughout the length of the rope 1. The coating 2 forms the surface of the rope 1 and extends between adjacent load bearing members 3-6, thereby isolating them from each other both mechanically and electrically. The said conductive load bearing members 3-6 may be made of non-metal material. The said conductive load bearing members 3-6 may be made of composite material comprising electrically conducting reinforcing fibers in polymer matrix, said reinforcing fibers preferably being carbon fibers. The rope 1 of a hoisting apparatus according to the present invention may e.g. be a hoisting rope 1, a suspension rope 1 or a compensation rope 1.

[0029] In a preferred embodiment, the rope according to the present invention comprises protrusions and/or grooves for guiding the rope. Furthermore, in a preferred embodiment, the rope is provided with a cogged surface in order to produce a positive contact with a drive sheave. Furthermore, in a preferred embodiment, the rope is symmetrical in its thickness direction.

[0030] The arrangement for condition monitoring of a rope of a hoisting apparatus according to the present invention comprises an at least one condition monitoring device 9 for monitoring the condition of the rope 1. The arrangement for condition monitoring of a rope of a hoisting apparatus according to the present invention also comprises an at least one connection interface 10-13. The arrangement for condition monitoring of a rope of a hoisting apparatus according to the embodiment of the present invention presented in Figure 1 comprises a condition monitoring device 9 of said at least one condition monitoring device 9 and a first connection interface 10, a second connection interface 11, a third connection interface 12 and a fourth connection interface 13 of said at least one connection interface 10-13.

[0031] In the arrangement for condition monitoring of a rope of a hoisting apparatus according to the embodiment of the present invention an electrical pulse or an electromagnetic signal is inserted into said conductive load bearing members 3-6 to propagate from the first end 7 to the second end 8 of the rope 1 or from the second end 8 to the first end 7 of the rope 1. Thereafter, in the arrangement for condition monitoring of a rope of a hoisting apparatus according to the embodiment of the present invention the condition monitoring device 9 receives an electrical pulse or an electromagnetic signal propagating in said conductive load bearing members 3-6 through said at least one connection interface 10-13. By analyzing and monitoring said received electrical pulse or said received electromagnetic signal said condition monitoring device 9 may determine the condition of the rope 1.

[0032] Figure 2 illustrates a preferred inner structure of the load bearing member according to the present invention. In Figure 2 the width direction w and the thickness direction t of a load bearing member 3 is shown. In Figure 2 the cross section of the load bearing member 3 as viewed in the longitudinal direction l of the load bearing member 3 is shown in particular. The rope could alternatively have some other number of load bearing members 3, either more or less than what is disclosed in the Figures.

[0033] The load bearing members 3-6 are made of composite material comprising reinforcing fibers F embedded in polymer matrix m. The reinforcing fibers F are more specifically distributed in polymer matrix m and bound together by the polymer matrix, particularly such that an elongated rod-like piece is formed. Thus, each load bearing member 3-6 is one solid elongated rod-like piece. The reinforcing fibers F are distributed preferably substantially evenly in the polymer matrix m. Thereby a load bearing member with homogeneous properties and structure is achieved throughout its cross section. In this way, it can be also ensured that each of the fibers can be in contact and bonded with the matrix m. Said reinforcing fibers F are most preferably carbon fibers as they are electrically conducting and have excellent properties in terms of load bearing capacity, weight and tensile stiffness, which makes them particularly well suitable for use in elevator hoisting ropes. Alternatively, said reinforcing fibers F can be of any other fiber material which is electrically conducting. The matrix m comprises preferably of epoxy, but alternative materials could be used depending on the preferred properties. Preferably, substantially all the reinforcing fibers F of each load bearing member 3-6 are parallel with the longitudinal direction of the load

bearing member 3-6. Thereby the fibers are also parallel with the longitudinal direction of the rope 1 as each load bearing member is oriented parallel with the longitudinal direction of the rope 1. Thereby, the fibers in the final rope 1 will be aligned with the force when the rope 1 is pulled, which ensures that the structure provides high tensile stiffness. This is also advantageous for achieving unproblematic behavior of the internal structure, particularly internal movement, when the rope 1 is bent.

[0034] The fibers F used in the preferred embodiments are substantially untwisted in relation to each other, which provides them said orientation parallel with the longitudinal direction of the rope 1. This is in contrast to the conventionally twisted elevator ropes, where the wires or fibers are strongly twisted and have normally a twisting angle from 15 up to 30 degrees, the fiber/wire bundles of these conventionally twisted elevator ropes thereby having the potential for transforming towards a straighter configuration under tension, which provides these ropes a high elongation under tension as well as leads to an unintegral structure.

[0035] The reinforcing fibers F are preferably long continuous fibers in the longitudinal direction of the load bearing member, the fibers F preferably continuing for the whole length of the load bearing member 3-6 as well as the rope 1. Thus, the load bearing ability, good conductivity as well as manufacturing of the load bearing member 3-6 are facilitated. The fibers F being oriented parallel with longitudinal direction of the rope 1, as far as possible, the cross section of the load bearing member 3-6 can be made to continue substantially the same in terms of its cross-section for the whole length of the rope 1. Thus, no substantial relative movement can occur inside the load bearing member 3-6 when it is bent.

[0036] As mentioned, the reinforcing fibers F are preferably distributed in the aforementioned load bearing member 3-6 substantially evenly, in particular as evenly as possible, so that the load bearing member 3-6 would be as homogeneous as possible in the transverse direction thereof. An advantage of the structure presented is that the matrix m surrounding the reinforcing fibers F keeps the interpositioning of the reinforcing fibers F substantially unchanged. It equalizes with its slight elasticity the distribution of a force exerted on the fibers, reduces fiber-fiber contacts and internal wear of the hoisting rope, thus improving the service life of the rope 1. The composite matrix m, into which the individual fibers F are distributed as evenly as possible, is most preferably made of epoxy, which has good adhesion to the reinforcement fibers F and which is known to behave advantageously with carbon fiber. Alternatively, e.g. polyester or vinyl ester can be used, but alternatively any other suitable alternative materials can be used. Figure 2 presents inside the circle a partial cross-section of the load bearing member 3-6 close to the surface thereof as viewed in the longitudinal direction of the rope 1. The reinforcing fibers F of the load bearing member 3-6 are preferably organized in the polymer matrix m according to this cross-section. The rest (parts not showed) of the load bearing member 3-6 have a similar structure.

[0037] Figure 3 illustrates a three dimensional view of a section of the load bearing member according to the present invention. From the presented Figure 2 and Figure 3 it can also be seen how the individual reinforcing fibers F of a load bearing member 3 are substantially evenly distributed in the polymer matrix m, which surrounds the reinforcing fibers F. The polymer matrix m fills the areas between individual reinforcing fibers F and binds substantially all the reinforcing fibers F that are inside the matrix m to each other as a uniform solid substance. A chemical bond exists between, the individual reinforcing fibers F (preferably each of them) and the matrix m, one advantage of which is uniformity of the structure. To improve the chemical adhesion of the reinforcing fiber to the matrix m, in particular to strengthen the chemical bond between the reinforcing fiber F and the matrix m, each fiber can have a thin coating, e.g. a primer (not presented) on the actual fiber structure between the reinforcing fiber structure and the polymer matrix m. However, this kind of thin coating is not necessary. The properties of the polymer matrix m can also be optimized as it is common in polymer technology. For example, the matrix m can comprise a base polymer material (e.g. epoxy) as well as additives, which fine-tune the properties of the base polymer such that the properties of the matrix are optimized. The polymer matrix m is preferably of a hard non-elastomer as in this case a risk of buckling can be reduced for instance. However, the polymer matrix need not be non-elastomer necessarily, e.g. if the downsides of this kind of material are deemed acceptable or irrelevant for the intended use. In that case, the polymer matrix m can be made of elastomer material such as polyurethane or rubber for instance. The reinforcing fibers F being in the polymer matrix means here that the individual reinforcing fibers F are bound to each other with a polymer matrix m, e.g. in the manufacturing phase by immersing them together in the fluid material of the polymer matrix which is thereafter solidified. In this case the gaps of individual reinforcing fibers bound to each other with the polymer matrix comprise the polymer of the matrix. In this way a great number of reinforcing fibers bound to each other in the longitudinal direction of the rope are distributed in the polymer matrix. As mentioned, the reinforcing fibers are preferably distributed substantially evenly in the polymer matrix m, whereby the load bearing member is as homogeneous as possible when viewed in the direction of the cross-section of the rope. In other words, the fiber density in the cross-section of the load bearing member 3-6 does not therefore vary substantially. The individual reinforcing fibers of the load bearing member 3-6 are mainly surrounded with polymer matrix m, but random fiber-fiber contacts can occur because controlling the position of the fibers in relation to each other in their simultaneous impregnation with polymer is difficult, and on the other hand, perfect elimination of random fiber-fiber contacts is not necessary from the

viewpoint of the functioning of the solution. If, however, it is desired to reduce their random occurrence, the individual reinforcing fibers F can be pre-coated with material of the matrix m such that a coating of polymer material of said matrix is around each of them already before they are brought and bound together with the matrix material, e.g. before they are immersed in the fluid matrix material.

[0038] As above mentioned, the matrix m of the load bearing member 3-6 is most preferably hard in its material properties. A hard matrix m helps to support the reinforcing fibers F, especially when the rope bends, preventing buckling of the reinforcing fibers F of the bent rope, because the hard material supports the fibers F efficiently. To reduce the buckling and to facilitate a small bending radius of the load bearing member 3-6, among other things, it is therefore preferred that the polymer matrix m is hard, and in particular non-elastomeric. The most preferred materials for the matrix are epoxy resin, polyester, phenolic plastic or vinyl ester. The polymer matrix m is preferably so hard that its module of elasticity E is over 2 GPa, most preferably over 2.5 GPa. In this case the module of elasticity E is preferably in the range 2.5-10 GPa, most preferably in the range 2.5-3.5 GPa. There are commercially available various material alternatives for the matrix m which can provide these material properties.

[0039] Preferably over 50% of the surface area of the cross-section of the load bearing member 3-6 is of the aforementioned electrically conducting reinforcing fiber. Thereby, good conductivity can be ensured. Fibers F will be in contact with each other randomly along their length whereby electromagnetic wave signal inserted into the load bearing member will propagate within substantially the whole cross section of the load bearing member. To be more precise preferably 50%-80% of the surface area of the cross-section of the load bearing member 3-6 is of the aforementioned reinforcing fiber, most preferably such that 55%-70% is of the aforementioned reinforcing fiber, and substantially all the remaining surface area is of polymer matrix. In this way conductivity and longitudinal stiffness of the load bearing member 3-6 are facilitated yet there is enough matrix material to bind the fibers F effectively to each other. Most preferably, this is carried out such that approx. 60% of the surface area is of reinforcing fiber and approx. 40% is of matrix material.

[0040] Figure 4 illustrates an arrangement for condition monitoring of a rope of a hoisting apparatus according to another embodiment of the present invention having a defect in the rope of the hoisting apparatus. The arrangement for condition monitoring of a rope of a hoisting apparatus presented in Figure 4 is similar to that of presented in Figure 1 with the exception of that there is a defect 14 in the first parallel conductor transmission line 14 of the defected rope 1 of Figure 4. The defected rope 1 is partially broken from a defect 14 in the middle part of the defected rope 1.

[0041] In the arrangement for condition monitoring of a rope of a hoisting apparatus according to the presented another embodiment of the present invention having defect 14 in the rope an electrical pulse or an electromagnetic signal is inserted into said conductive load bearing members 3-6 to propagate from the first end 7 to the second end 8 of the rope 1 or from the second end 8 to the first end 7 of the rope 1. Thereafter, in the arrangement for condition monitoring of a rope of a hoisting apparatus according to the presented another embodiment of the present invention having defect 14 in the rope the condition monitoring device 9 receives an electrical pulse or an electromagnetic signal propagating in said conductive load bearing members 3-6 through said at least one connection interface 10-13. By analyzing and monitoring said received electrical pulse or said received electromagnetic signal said condition monitoring device 9 may substantiate the defect 14 and type of the damage and determine the condition of the rope 1.

[0042] Figure 5 illustrates a side view of a wedge element of a terminating arrangement for a rope of a hoisting apparatus according to one embodiment of the present invention. The wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 16, a bottom wedge component 17 and a hinge portion 18. The wedge element 15 of a said terminating arrangement for a rope according to the presented embodiment has a hinge portion 18 placed between the end of said top wedge component 16 and the end of said bottom wedge component 17. Said hinge portion 18 may e.g. be an elastic hinge portion 18. The wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the present invention is made of electrically resistive (non-conducting) material, such as non-metal material, said non-metal material e.g. being fibre-reinforced plastic or fibre-reinforced plastic or plastic, such as Acrylonitrile Butadiene Styrene (ABS), Polyoxymethylene (POM), Polycarbonate (PC) or Polycaprolactam (PA6).

[0043] Figure 6 illustrates a side view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to one embodiment of the present invention. The wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 16, a bottom wedge component 17 and a hinge portion 18. Said top wedge component 16 and said a bottom wedge component 17 of said wedge element 15 are turned towards each other at the point of said hinge portion 18 and a rope 1 is placed between said top wedge component 16 and said a bottom wedge component 17. The rope 1 of a hoisting apparatus according to the present invention may e.g. be a hoisting rope 1, a suspension rope 1 or a compensation rope 1.

[0044] Said top wedge component 16 and said bottom wedge component 17 are clamped together on both sides of said rope 1 so that said top wedge component 16 and said bottom wedge component 17 enable forming of an electrical connection between the conductive load bear-

ing members 3-6 of said rope 1 and at least one connection interface 10-13 leading to a condition monitoring device 9.

[0045] Said top wedge component 16 and said bottom wedge component 17 of the wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment may also comprise at least one fixing bolt and at least one nut arranged to hold said top wedge component 16 and said bottom wedge component 17 of the wedge element 15 of a terminating arrangement for a rope together. Alternatively, said top wedge component 16 and said bottom wedge component 17 may comprise at least one fixing bolt, said at least one fixing bolt arranged to hold said top wedge component 16 and said bottom wedge component 17 together.

[0046] Figure 7 illustrates an end view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to one embodiment of the present invention. The wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 16, a bottom wedge component 17 and a hinge portion 18. Said top wedge component 16 and said a bottom wedge component 17 of said wedge element 15 are turned towards each other at the point of said hinge portion 18 and a rope 1 is placed between said top wedge component 16 and said a bottom wedge component 17. The rope 1 of a hoisting apparatus according to the present invention may e.g. be a hoisting rope 1, a suspension rope 1 or a compensation rope 1.

[0047] Said top wedge component 16 and said bottom wedge component 17 are clamped together on both sides of said rope 1 so that said top wedge component 16 and said bottom wedge component 17 enable forming of an electrical connection between the conductive load bearing members 3-6 of said rope 1 and at least one connection interface 10-13 leading to a condition monitoring device 9.

[0048] Figure 8 illustrates an end view of a wedge element of a terminating arrangement for a rope of a hoisting apparatus according to another embodiment of the present invention. The wedge element 19 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 20, a bottom wedge component 21 and a hinge portion 22. The wedge element 19 of a said terminating arrangement for a rope according to the presented embodiment has a hinge portion 22 placed between the side of said top wedge component 20 and the side of said bottom wedge component 21. Said hinge portion 22 may e.g. be an elastic hinge portion 22. The wedge element 19 of a terminating arrangement for a rope of a hoisting apparatus according to the present invention is made of electrically resistive (non-conducting) material, such as non-metal material, said non-metal material e.g. being fibre-reinforced plastic or fibre-reinforced plastic or plastic, such as Acrylonitrile Butadiene Styrene (ABS), Polyoxymethylene (POM), Polycarbonate (PC) or Polycaprolactam (PA6).

[0049] Figure 9 illustrates a side view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to another embodiment of the present invention. The wedge element 19 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 20, a bottom wedge component 21, a hinge portion and a securing clip 23 for securing said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 to a rope 1. Said top wedge component 20 and said a bottom wedge component 21 of said wedge element 19 are turned towards each other at the point of said hinge portion and a rope 1 is placed between said top wedge component 20 and said a bottom wedge component 21. The rope 1 of a hoisting apparatus according to the present invention may e.g. be a hoisting rope 1, a suspension rope 1 or a compensation rope 1.

[0050] Said top wedge component 20 and said bottom wedge component 21 are clamped together on both sides of said rope 1 so that said top wedge component 20 and said bottom wedge component 21 enable forming of an electrical connection between the conductive load bearing members 3-6 of said rope 1 and at least one connection interface 10-13 leading to a condition monitoring device 9. Said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 are secured to said rope 1 with said securing clip 23.

[0051] Said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment may also comprise at least one fixing bolt and at least one nut arranged to hold said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 of a terminating arrangement for a rope together.

[0052] Figure 10 illustrates an end view of a wedge element of a terminating arrangement connected to a rope of a hoisting apparatus according to another embodiment of the present invention. The wedge element 19 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 20, a bottom wedge component 21, a hinge portion and a securing clip 23 for securing said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 to a rope 1. Said top wedge component 20 and said a bottom wedge component 21 of said wedge element 19 are turned towards each other at the point of said hinge portion and a rope 1 is placed between said top wedge component 20 and said a bottom wedge component 21. The rope 1 of a hoisting apparatus according to the present invention may e.g. be a hoisting rope 1, a suspension rope 1 or a compensation rope 1.

[0053] Said top wedge component 20 and said bottom wedge component 21 are clamped together on both sides

of said rope 1 so that said top wedge component 20 and said bottom wedge component 21 enable forming of an electrical connection between the conductive load bearing members 3-6 of said rope 1 and at least one connection interface 10-13 leading to a condition monitoring device 9. Said top wedge component 20 and said bottom wedge component 21 of the wedge element 19 are secured to said rope 1 with said securing clip 23.

[0054] Figure 11 illustrates a cross-sectional view of a terminating arrangement for a rope of a hoisting apparatus according to one embodiment of the present invention. The wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment comprises a top wedge component 16, a bottom wedge component 17 and a hinge portion 18. The wedge element 15 of a said terminating arrangement for a rope according to the presented embodiment has a hinge portion 18 placed in the end of said top wedge component 16 and in the end of said bottom wedge component 17. Said hinge portion 18 may e.g. be an elastic hinge portion 18. Said top wedge component 16 and said a bottom wedge component 17 of said wedge element 15 are turned towards each other at the point of said hinge portion 18 and a rope 1 is placed between said top wedge component 16 and said a bottom wedge component 17. Said top wedge component 16 and said bottom wedge component 17 are clamped together on both sides of said rope 1 so that said top wedge component 16 and said bottom wedge component 17 enable forming of an electrical connection between the conductive load bearing members 3-6 of said rope 1 and at least one connection interface 10-13 leading to a condition monitoring device 9.

[0055] Said top wedge component 16 and said bottom wedge component 17 of the wedge element 15 of a terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment may also comprise at least one fixing bolt and at least one nut arranged to hold said top wedge component 16 and said bottom wedge component 17 of the wedge element 15 of a terminating arrangement for a rope together.

[0056] The terminating arrangement for a rope of a hoisting apparatus according to the presented embodiment also comprises a wedge housing 24. In the presented terminating arrangement said terminated rope 1 with said top wedge component 16 and said bottom wedge component 17 secured on both sides of said rope 1 are placed inside said wedge housing 24.

[0057] The terminating arrangement for a rope can now be connected to a condition monitoring device 9. The terminating arrangement for a rope may forward information for quantifying the severity of the defect 14 such as e.g. fiber damage to said condition monitoring device 9.

[0058] In the illustrated embodiments, the load bearing members 3-6 are substantially rectangular. However, this is not necessary as alternative shapes could be used. Said composite members 3-6 can be manufactured for example in any known way, such as in the manner presented in WO2009090299A1.

[0059] In the illustrated embodiments, the rope 1 comprises four load bearing members 3-6. Of course, alternative configurations are possible, where the arrangement is implemented with a rope provided with some other number of load bearing members 3-6.

[0060] When referring to conductivity, in this application it is meant electrical conductivity.

[0061] With the help of the terminating arrangement for a rope according to the present invention a connection of good quality between load bearing members 3-6 of the rope and the condition monitoring device 9 can be secured. With the help of the good quality connection the condition monitoring device 9 can monitor the condition of the rope and notice if there is an indication of damage or an indication that the rope is going to break.

[0062] With the help of the terminating arrangement according to the present invention the on-site installation of the electrical connection is easier and faster than with the prior art solutions. Furthermore, the wedge element of the terminating arrangement according to the present invention does not jam due to rust and provides a more even tension distribution to the non-conducting coating of the rope this increasing the load bearing capacity as well as the rupture lifetime of the terminal. Furthermore, the terminating arrangement according to the present invention reduces the manufacturing costs and is more reliable and withstands excess temperatures and temperature changes considerably better than the prior art solutions.

[0063] It is to be understood that the above description and the accompanying Figures are only intended to teach the best way known to the inventors to make and use the invention. It will be apparent to a person skilled in the art that the inventive concept can be implemented in various ways. The above-described embodiments of the invention may thus be modified or varied, without departing from the invention, as appreciated by those skilled in the art in light of the above teachings. It is therefore to be understood that the invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims and their equivalents.

Claims

1. A terminating arrangement for a rope (1) of a hoisting apparatus, which rope (1) comprises a non-conductive coating (2), and a plurality of adjacent conductive load bearing members (3-6) for bearing the load exerted on the rope (1) in longitudinal direction thereof embedded in the coating (2) and extending parallel to each other and to the longitudinal direction of the rope (1), the coating (2) forming the surface of the rope (1) and extending between adjacent load bearing members (3-6) thereby isolating them from each other, which terminating arrangement comprises:

- an electrically resistive wedge element (15), (19), said wedge element (15), (19) comprising a top wedge component (16), (20) and a bottom wedge component (17), (21) for clamping said wedge element (15), (19) to both sides of said rope (1), and
- at least one connection interface (10-13); so that:

  - upon clamping said top wedge component (16), (20) and said bottom wedge component (17), (21) together, said top wedge component (16), (20) and said bottom wedge component (17), (21) enable forming of an electrical connection between said conductive load bearing members (3-6) of said rope (1) and said at least one connection interface (10-13).

2. A terminating arrangement according to claim 1, wherein said at least one connection interface (10-13) leads to a condition monitoring device.

3. A terminating arrangement according to claim 1 or to claim 2, wherein said wedge element (15), (19) also comprises:

  - a hinge portion (18), (22), said hinge portion (18), (22) allowing the turning of said top wedge component (16), (20) and the turning of said bottom wedge component (17), (21).

4. A terminating arrangement according to claim 3, wherein said hinge portion (18), (22) is an elastic hinge portion (18), (22).

5. A terminating arrangement according to claim 3 or to claim 4, wherein said hinge portion (18) is placed between the end of said top wedge component (16) and the end of said bottom wedge component (17).

6. A terminating arrangement according to claim 3 or to claim 4, wherein said hinge portion (22) is placed between the side of said top wedge component (20) and the side of said bottom wedge component (21).

7. A terminating arrangement according to any of the preceding claims 1-6, wherein said wedge element (15), (19) is made of non-metal material, said non-metal material preferably being fibre-reinforced plastic or plastic.

8. A terminating arrangement according to any of the preceding claims 1-7, wherein said conductive load bearing members (3-6) are made of non-metal material.

9. A terminating arrangement according to any of the preceding claims 1-7, wherein said conductive load bearing members (3-6) are made of composite material comprising electrically conducting reinforcing fibers (F) in polymer matrix (m), said reinforcing fibers (F) preferably being carbon fibers.

10. A terminating arrangement according to any of the preceding claims 1-9, wherein said rope (1) is belt-shaped, i.e. larger in width direction than thickness direction.

11. A terminating arrangement according to any of the preceding claims 1-10, wherein said top wedge component (16), (20) and said bottom wedge component (17), (21) of said wedge element (15), (19) also comprise at least one fixing bolt and at least one nut, said at least one fixing bolt and at least one nut arranged to hold said top wedge component (16), (20) and said bottom wedge component (17), (21) together.

12. A terminating arrangement according to any of the preceding claims 1-11, wherein said top wedge component (20) and said bottom wedge component (21) of said wedge element (19) also comprise one or more securing clips (23) for securing said top wedge component (20) and said bottom wedge component (21) to said rope (1).

13. A terminating arrangement according to any of the preceding claims 1-12, wherein terminating arrangement comprises a wedge housing (24) so that said top wedge component (16), (20) and said bottom wedge component (17), (21) of said wedge element (15), (19) clamped on both sides of said rope (1) are placed inside said wedge housing (24).

14. A terminating arrangement (15) according to any of the preceding claims 1-13, wherein said terminating arrangement is connected to a condition monitoring device (9).

15. A terminating arrangement (15) according to any of the preceding claims 1-14, wherein said terminating arrangement forwards information for quantifying the severity of the defect (14) such as e.g. fiber damage to a condition monitoring device (9).

16. Use of a terminating arrangement according to any of the preceding claims 1-15 in an arrangement for condition monitoring of a rope (1) of a hoisting apparatus.

17. An elevator for transporting passengers and/or goods, wherein said elevator comprises a terminating arrangement according to any of the preceding claims 1-15.

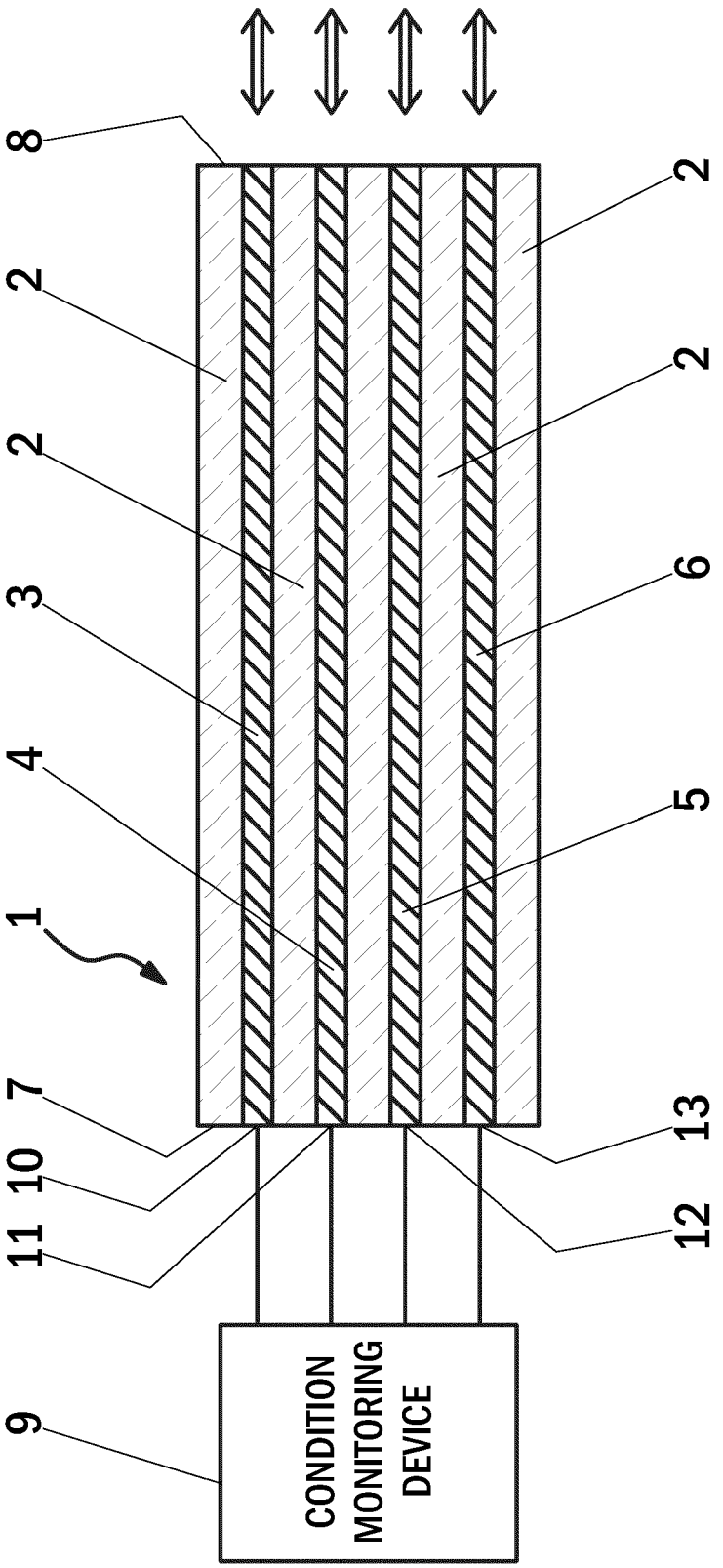

Fig. 1

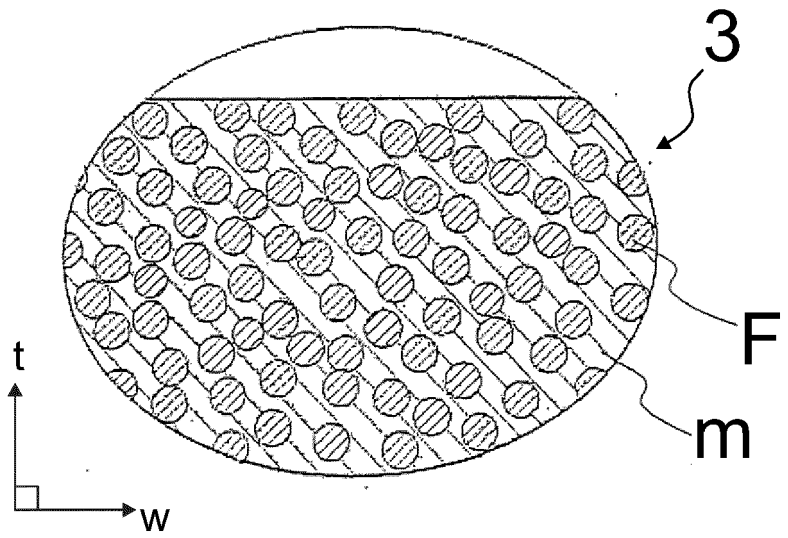

Fig. 2

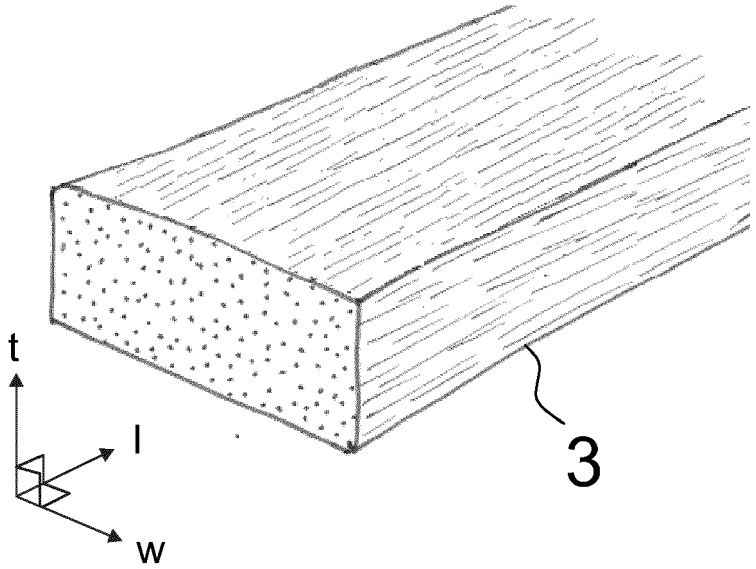

Fig. 3

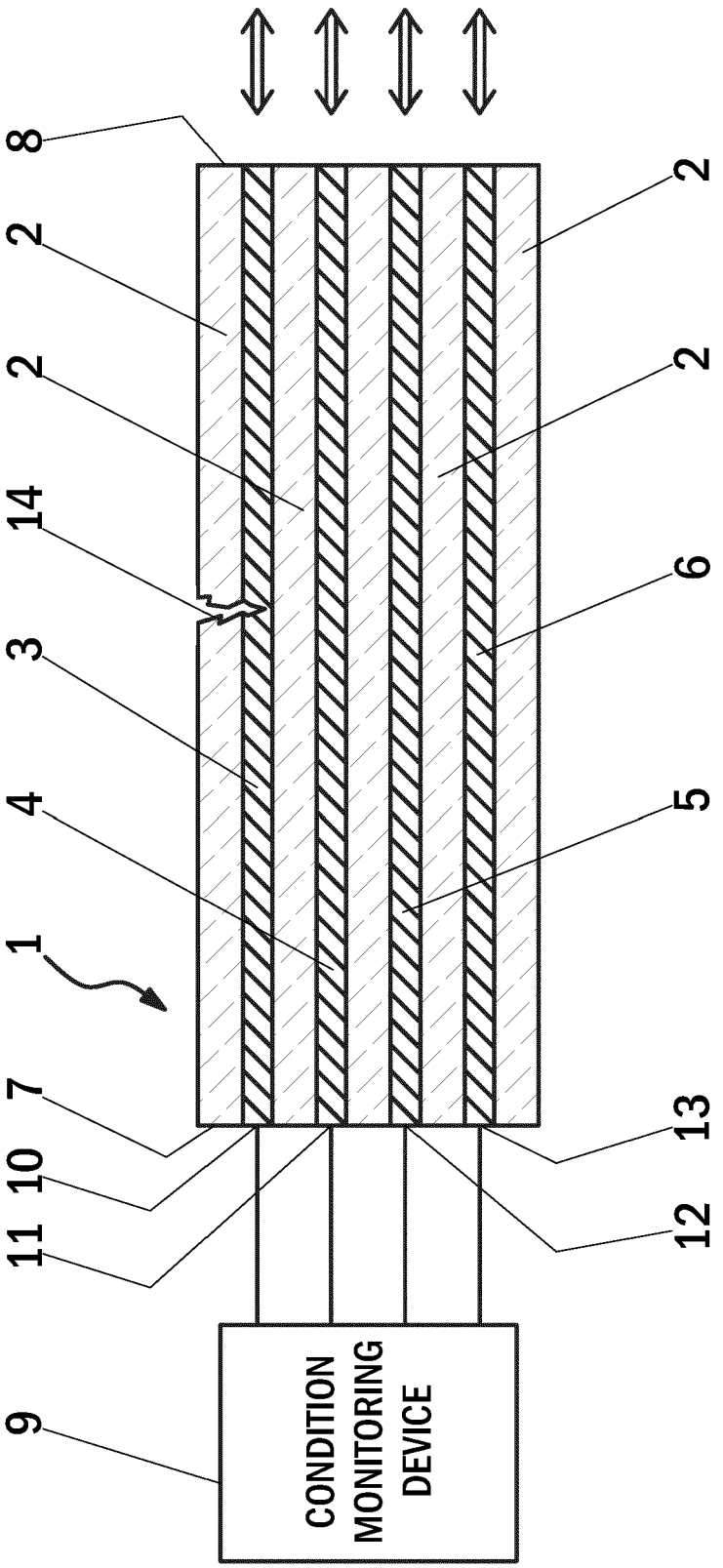

Fig. 4

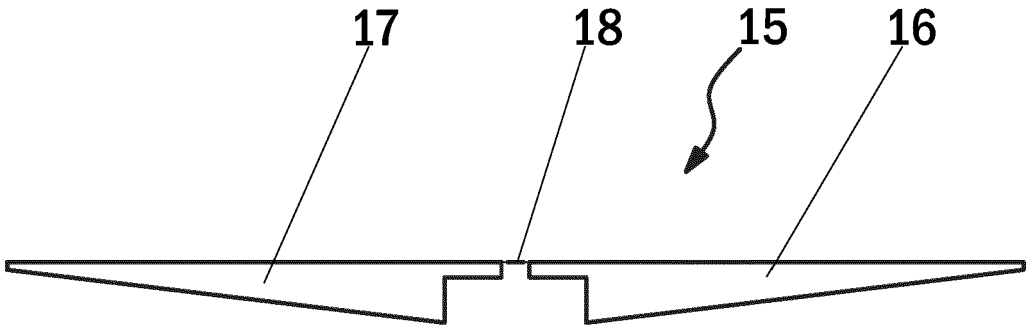

Fig. 5

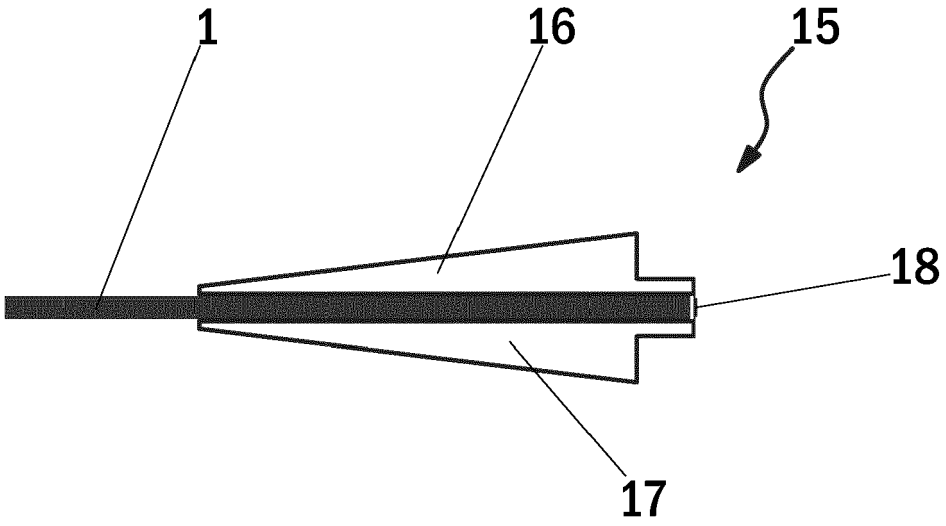

Fig. 6

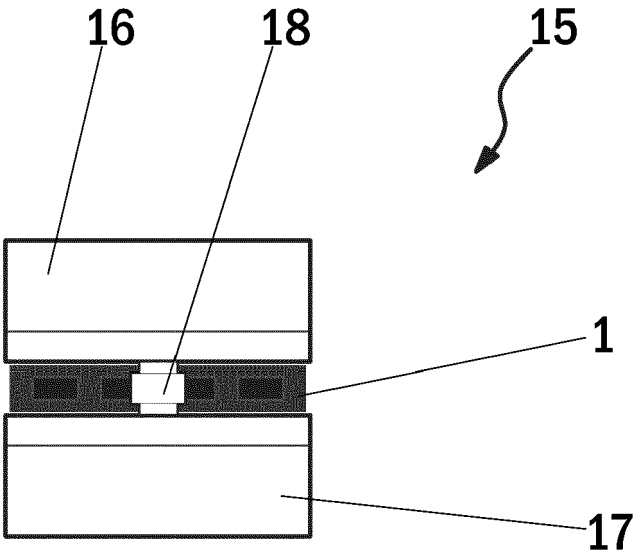

Fig. 7

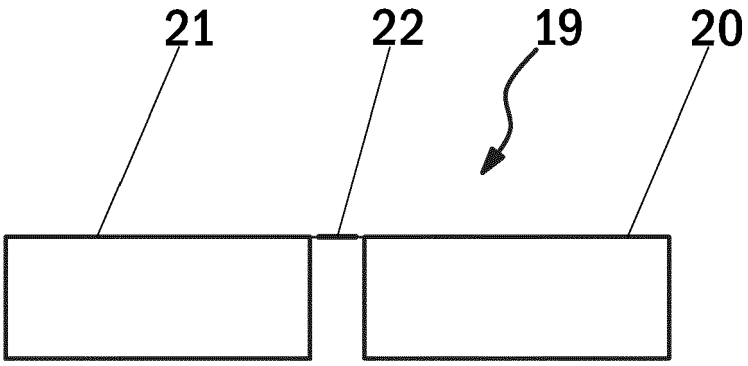

Fig. 8

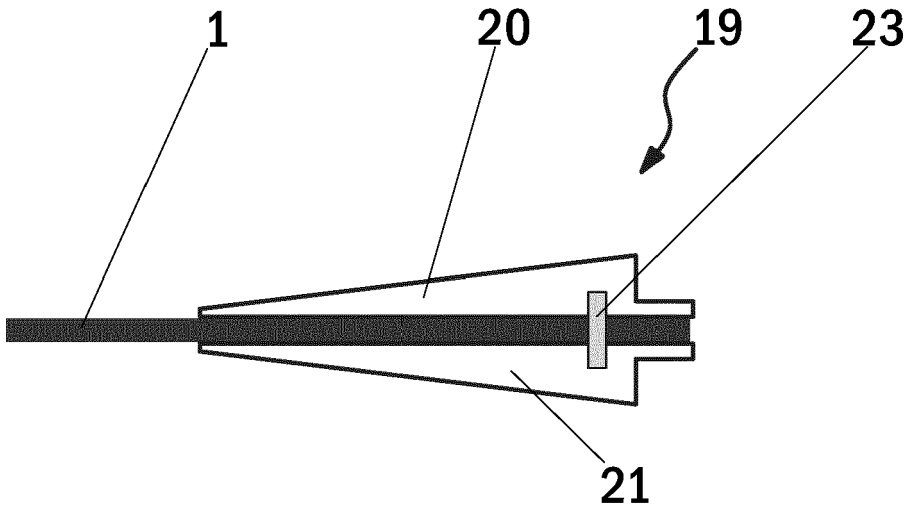

Fig. 9

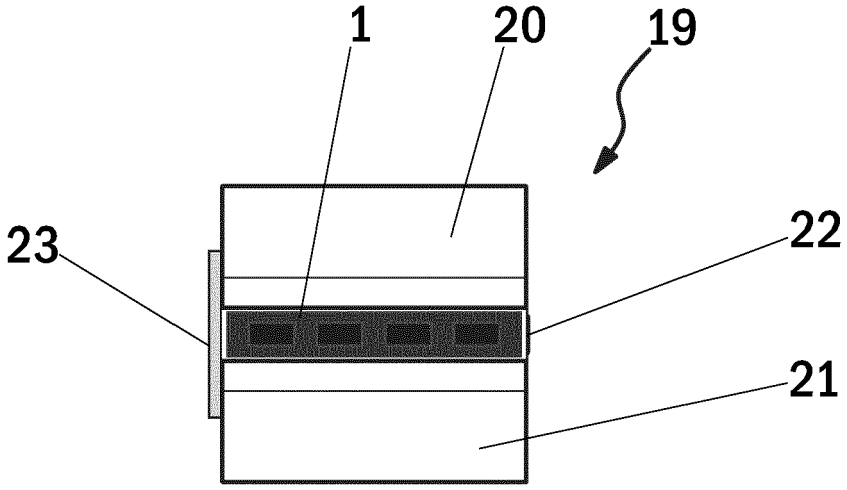

Fig. 10

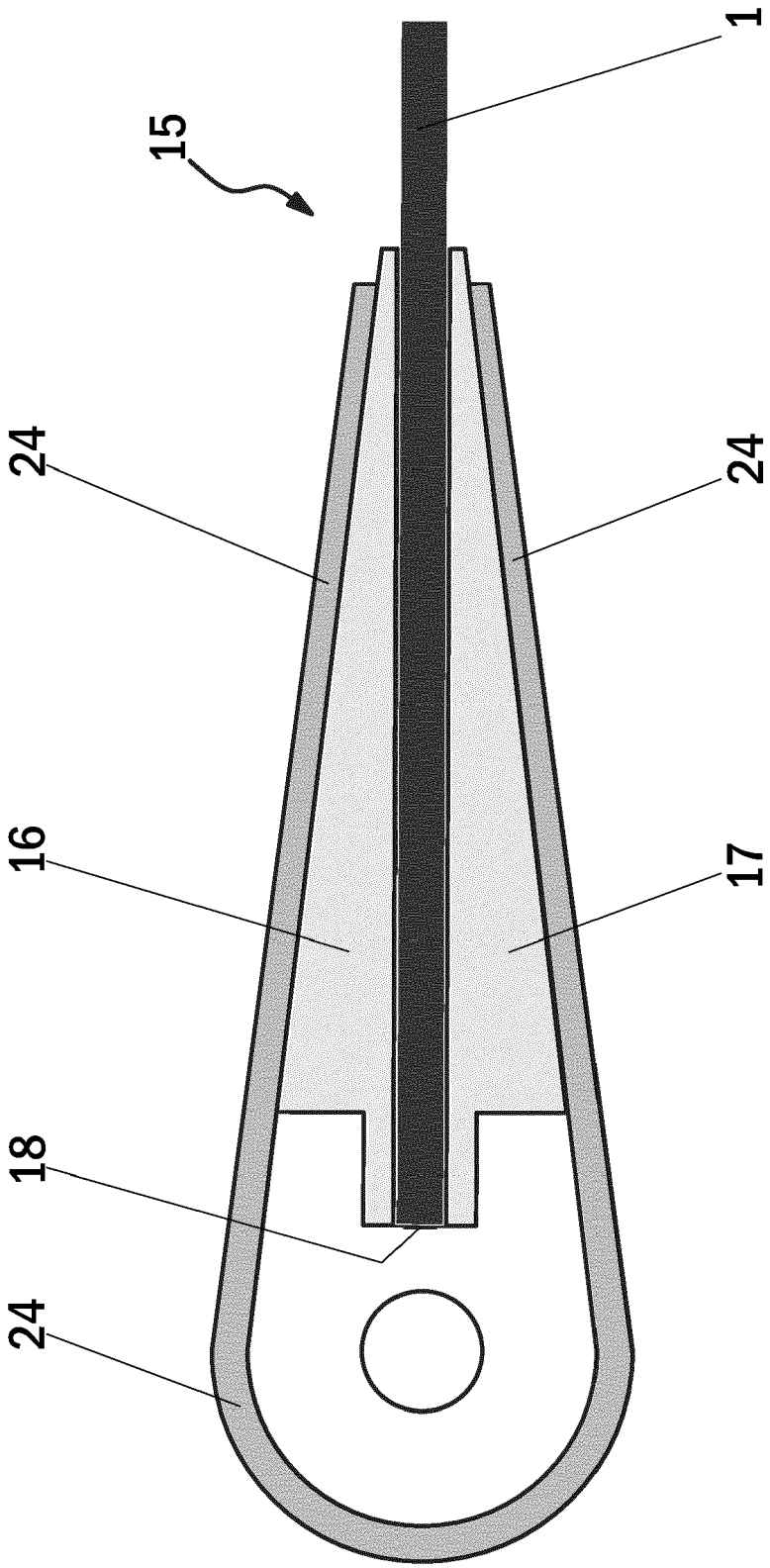

Fig. 11

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1188

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 749 520 A2 (KONE CORP [FI]) 2 July 2014 (2014-07-02) * paragraphs [0035], [0036]; claim 13; figures 2,3 *	1-17	INV. B66B7/08 B66B7/12
A	US 2016/221796 A1 (PURANEN MIKKO [FI] ET AL) 4 August 2016 (2016-08-04) * the whole document *	1-17	
A	US 2016/152445 A1 (LEHTINEN HANNU [FI] ET AL) 2 June 2016 (2016-06-02) * the whole document *	1-17	

TECHNICAL FIELDS SEARCHED (IPC)

B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 June 2017	Lenoir, Xavier

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 1188

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

13-06-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2749520 A2	02-07-2014	AU 2013273614 A1	17-07-2014
		BR 102013032986 A2	04-11-2014
		CN 103912632 A	09-07-2014
		EP 2749520 A2	02-07-2014
		EP 2933218 A1	21-10-2015
		ES 2543955 T3	26-08-2015
		ES 2615905 T3	08-06-2017
		FI 124543 B	15-10-2014
		HK 1199086 A1	19-06-2015
		JP 5572756 B2	13-08-2014
		JP 2014129182 A	10-07-2014
		SG 2013093786 A	30-07-2014
		US 2014182975 A1	03-07-2014
US 2016221796 A1	04-08-2016	CN 105836576 A	10-08-2016
		EP 3053867 A1	10-08-2016
		US 2016221796 A1	04-08-2016
US 2016152445 A1	02-06-2016	CN 105645205 A	08-06-2016
		EP 3028979 A1	08-06-2016
		HK 1221448 A1	02-06-2017
		US 2016152445 A1	02-06-2016

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2009090299 A1 **[0058]**