



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.06.2017 Bulletin 2017/23

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

(21) Application number: **15197705.5**

(22) Date of filing: **03.12.2015**

(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) Inventor: **Valjus, Petteri**
00330 Helsinki (FI)

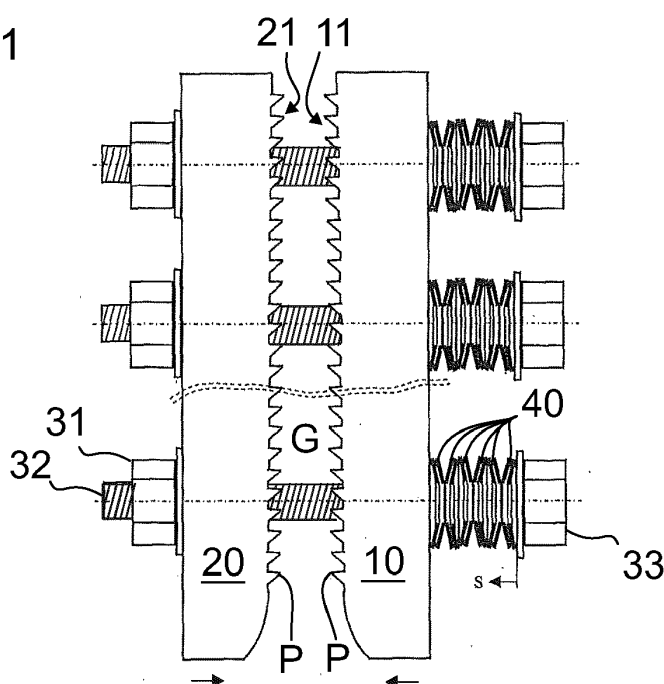
(74) Representative: **Kolster Oy Ab**
Salmisaarenaukio 1
00180 Helsinki (FI)

(54) **ROPE TERMINAL DEVICE, ROPE TERMINAL ARRANGEMENT AND ELEVATOR**

(57) The invention relates to a rope terminal device (1) for a coated rope (R), comprising a first compression member (10) having a first compression face (11) and a second compression member (20) a second compression face (21) wherein the first and second compression face (11,21) delimit between them a rope gap (G) for receiving a rope (R); and a tightening means (31,32,33,40) tightenable to force the compression members (10, 20) towards each other so as to produce compression on the rope (R). The tightening means (31,32,33,40) comprise a tightening member (33) on the

backside of at least one (10) of the compression members (10,20) for exerting a tightening force on the backside of said one (10) of the compression members (10,20) when the tightening means (31,32,33,40) are tightened; and one or more springs (40) mounted between the tightening member (33) and the compression member (10) for transmitting tightening force between the tightening member (33) and the compression member (10). The invention further relates to a rope terminal arrangement and an elevator implementing the rope terminal device (1).

Fig. 1



Description

FIELD OF THE INVENTION

[0001] The invention relates to a rope terminal device of an elevator, a rope terminal arrangement of an elevator and an elevator. Said elevator is preferably an elevator for vertically transporting passengers and/or goods.

BACKGROUND OF THE INVENTION

[0002] In elevators, one or more ropes are used as the means by which the load to be hoisted is suspended. Each rope end needs to be fixed to a fixing base, which is typically either the load to be lifted or a stationary structure, depending on the type of suspension chosen for the elevator. The rope ends can be fixed directly to the load, such as the car or counterweight, which is the case when these are to be suspended with 1:1 ratio. Alternatively, the rope ends can be fixed to a stationary structure of the building, which is the case when the car and counterweight are to be suspended with 2:1 ratio, for instance.

[0003] Ropes of an elevator ropes are normally either belt-shaped or round in cross section. Each elevator rope typically includes one or more load bearing members that are elongated in the longitudinal direction of the rope, each 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, 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 a coating, which cannot transmit tension in the above described way. The coating can be utilized for protection of the load bearing members and/or facilitating contact with rope wheels and/or for positioning adjacent load bearing members relative to each other, for example. Belt-shaped ropes can have only one but often include several of said load bearing members adjacent in width direction of the rope positioned by the coating.

[0004] In prior art, elevator ropes have been fixed to the fixing base with a rope terminal arrangement. The rope structure limits the way in which it can be engaged. Uncoated ropes containing metallic load bearing members can typically be fixed relatively freely without risk of severe rope damage. Ropes that have load bearing members made of brittle material and/or a coating, however, cannot be fixed as freely. Load bearing members may be sensitive to bending, and the material of the coating and/or the material of the load bearing members cannot withstand great local compression. Such rope terminal arrangements have been proposed, for example in US2014/0182975A1, wherein the rope end is compressed in a gap defined by two compression members.

Reliability of this sort of arrangement relies largely on the grip produced by the compression between the rope surface and the compression member. The rope end should be firmly gripped such that it is not able to slide out of the compression gap, because this would mean that the suspension of the particular rope would be lost. Therefore, for facilitating safety, it is advantageous to ensure good grip.

[0005] Firmness of the grip with a coated rope depends on the state of the rope, and in particular on the state of the coating forming the interface for the gripping. It may occur, that the coating is damaged for some reason. Should the coating be made of polymer material, which is sensitive to high temperature, such as thermoplastic polymer materials, it can melt and/or burn if subjected to high temperature, such as in case of fire. Also, the load bearing members may be damaged in this way if they are made of material sensitive to high temperature, such as fiber reinforced composite comprising a matrix material sensitive to high temperature. If the coating and/or the load bearing members melt or burn at least partially, the rope volume is changed, in particular such that its thickness is reduced, whereby the compression members are required to compress closer together so as to maintain firm engagement. A drawback of the known solutions has been that they either cannot adapt at all to changes of rope volume between the compression members, or their ability to adapt to these changes can be easily disturbed. One proposed type of tightening means comprises wedging means that produce the tightening force by wedging. In this type of solution, the rope volume changes can be well adapted to, but this function can be disturbed for example if the melted coating gets stucked such that efficient the large wedge components producing the tightening force is blocked from moving properly. In such case, there is a risk that the rope might slip out of the rope terminal.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The object of the invention is to introduce rope terminal device of an elevator, a rope terminal arrangement of an elevator and an elevator which are improved in terms of their ability to adapt to changes in the condition of the rope being fixed. An object is to introduce a solution by which one or more of the above defined problems of prior art and/or problems discussed or implied elsewhere in the description can be solved. An object is particularly to introduce a solution able to adapt well to situations where the coating of the rope and/or the load bearing members are damaged such that the rope volume is changed, in particular such that its thickness is reduced, whereby the compression members are required to compress closer together so as to maintain firm engagement. Embodiments are presented, inter alia, where one or more of the above objects are realized with simple overall structure and good reliability. Embodiments are presented, inter alia, which are suitable for ropes containing

members that cannot be sharply bent.

[0007] It is brought forward a new rope terminal device for a coated rope, comprising a first compression member having a first compression face to be placed against a first side of the rope, in particular against a first side of the rope facing in thickness direction of the rope; and a second compression member comprising a second compression face to be placed against a second side of the rope, in particular a second side of the rope facing in thickness direction of the rope. The first and second compression face delimit between them a rope gap for receiving a rope. The compression members are movable towards each other, by moving one or both of them, to compress via said compression faces the rope placed in the rope gap for blocking movement of the rope in its longitudinal direction relative to the compression members. The rope terminal device further comprises a tightening means tightenable to force the compression members towards each other so as to produce compression on the rope. The tightening means comprise a tightening member on the backside of at least one of the compression members for exerting a tightening force on the backside of said one of the compression members when the tightening means are tightened, wherein the backside is the opposite side than the aforementioned rope gap, and the tightening member is movable relative to the compression member in thickness direction of the gap. The tightening means further comprises one or more springs mounted between the tightening member and the compression member for transmitting tightening force between the tightening member and the compression member. With this solution one or more of the above mentioned objects are achieved. In particular, a reliable engagement between a coated elevator rope and the compression members can be achieved. A solution is achieved where the compression members compress closer together so that a firm engagement can be maintained with the rope even if the thickness thereof is reduced, e.g. due to burning or melting of nonmetallic parts of the rope. Preferable further details are introduced in the following, which further details can be combined with the device individually or in any combination.

[0008] In a preferred embodiment, the tightening member is tightenable against the one or more springs such that each said spring is brought under tension for exerting a tightening force on the backside of said one of the compression members via the one or more tensioned springs.

[0009] In a preferred embodiment, the tightening means are screw-type tightening means. The tightening member is then preferably tightenable by screwing the screw-type tightening means against the one or more springs such that each said spring is brought under tension for exerting a tightening force on the backside of said one of the compression members via the one or more tensioned springs. With the screw-type tightening means a simple overall structure is achieved. Screw-type tightening means being normally difficult to adapt into changes, in this context the springs that are tensionable

and form part of the tightening function are advantageous, especially due to their ability to maintain compression despite changes in rope thickness.

[0010] It is also brought forward a new rope terminal arrangement comprising an end of a coated rope, and a first compression member having a first compression face placed against a first side of the end of the rope, in particular against a first side of the end of the rope facing in thickness direction of the rope, and a second compression member having a second compression face placed against a second side of the rope, in particular against a second side of the end of the rope facing in thickness direction of the rope. The first and second compression face delimit between them a rope gap wherein the rope is placed, and the compression members are movable towards each other, by moving one or both of them, and arranged to compress via said compression faces the rope placed in the rope gap for blocking movement of the rope in its longitudinal direction relative to the compression members. The rope terminal arrangement further comprises a tightening means tightened to force the compression members towards each other so as to produce compression on the rope. The tightening means comprise a tightening member on the backside of at least one of the compression members for exerting a tightening force on the backside of said one of the compression members, wherein the backside is the opposite side than the aforementioned rope gap, and the tightening member is movable relative to the compression member in thickness direction of the gap. The tightening means further comprises one or more springs in particular a spring or a plurality of springs mounted between the tightening member and the compression member transmitting tightening force between the tightening member and the compression member. With this solution one or more of the above mentioned objects are achieved. In particular, a reliable engagement between a coated elevator rope and the compression members can be achieved. A solution is achieved where the compression members compress closer together so that a firm engagement can be maintained with the rope even if the thickness thereof is reduced, e.g. due to burning or melting of nonmetallic parts of the rope. Preferable further details are introduced in the following, which further details can be combined with the arrangement individually or in any combination.

[0011] In a preferred embodiment, the tightening member is tightened against the one or more springs such that each said spring is brought under tension and a tightening force is exerted on the backside of said one of the compression members via the one or more tensioned springs.

[0012] In a preferred embodiment, the tightening means are screw-type tightening means. The tightening member is then preferably tightened by screwing the screw-type tightening means against the one or more springs such that each said spring is brought under tension and a tightening force is exerted on the backside of said one of the compression members via the one or

more springs. With the screw-type tightening means a simple overall structure is achieved. Screw-type tightening means being normally difficult to adapt into changes, in this context the springs that are tensionable and form part of the tightening function are advantageous, especially due to their ability to maintain compression despite changes in rope thickness.

[0013] In a preferred embodiment, the screw-type tightening means comprises a threaded rod and said tightening member is a bolt head fixedly mounted on the threaded rod or a nut mounted on threads of the threaded rod.

[0014] In a preferred embodiment, the screw-type tightening means comprises a threaded rod having said tightening member on one end for exerting a tightening force on the backside of said one of the compression members via the one or more springs and a further tightening member on the other end for exerting a tightening force on the backside of the other of the compression members, at least one of them having threads via which it engages the threads of the threaded rod (preferably being a nut) and is movable by screwing towards the other of said tightening members by rotation relative to the threaded rod thereby forcing the compression members towards each other.

[0015] In a preferred embodiment, said one or more springs form together a pack of springs arranged in series in tightening direction of the tightening means.

[0016] In a preferred embodiment, said one or more springs comprises plurality of springs piled in thickness direction of the gap such that they are each elastically deformable in thickness direction of the gap. The combined stroke length s of the one or more springs is preferably at least the thickness of coating covering a load bearing member in thickness direction of the rope.

[0017] In a preferred embodiment, one or both of the first and second compression face is provided with uneven surface pattern for facilitating grip between the compression face in question and the side of the rope against which it is to be compressed. Preferably, the uneven surface pattern is a knurling pattern. Then, it is preferable that the uneven surface pattern comprises protrusions protruding into the surface material of the rope when the compression face in question is compressed against the rope. Preferably, majority of the contact area formed between the compression face provided with the uneven surface pattern and a side of the rope section is established via the uneven surface pattern. Preferably, said uneven surface pattern covers at least majority (more than 50%, preferably 80-100%) of the surface of the compression face. (thereby majority of the contact area formed between each compression face and the side of the rope section against which it is set, is established via a uneven surface pattern). In a preferred embodiment, said uneven surface pattern comprises plurality of protrusions protruding into the coating of the rope and plurality of grooves between the protrusions. Preferably, the protrusions are arranged to force the surface shape of

the rope to deform such that recesses are formed into the coating of the rope at the points of the protrusions when the compression face in question is compressed against the rope. Preferably, said grooves are between said protrusions in longitudinal direction of the rope. Preferably, height of said protrusions is less than 2.0 mm, most preferably within range 0.5 mm - 1.5 mm. The aforementioned knurling pattern may be a diamond knurling pattern or a straight knurling pattern, for instance.

[0018] In a preferred embodiment, the first compression member and the second compression member are supported on a fixing base. Thus, the compression members are arranged to transmit tension of the rope to the fixing base. The fixing base is preferably one of the elevator units of an elevator, such as a counterweight or an elevator car, or a stationary structure of a building where-in the elevator is installed.

[0019] In a preferred embodiment, said one or more springs are spring washers, preferably conical spring washers.

[0020] In a preferred embodiment, said one or more springs are made of metal. Thereby they withstand high temperatures.

[0021] In a preferred embodiment, the compression faces of the compression members are parallel and straight such that the rope compressed by them is not bent into a curved form. This provides that the rope can be fixed without bending it, which would be disadvantageous if the rope has rigid and/or brittle elements, such as load bearing members made of composite material.

[0022] In a preferred embodiment, the rope is a belt-shaped rope.

[0023] In a preferred embodiment, the rope is larger in its width direction than in its thickness direction.

[0024] In a preferred embodiment, the rope comprises one or more elongated load bearing members extending parallel with the longitudinal direction of the rope unbroken throughout the length of the rope. Thus, they are able to transmit tension with good tensile stiffness.

[0025] In a preferred embodiment, the one or more elongated load bearing members are embedded in a coating forming the outer surface of the rope.

[0026] In a preferred embodiment, the load bearing members are made of composite material comprising reinforcing fibers embedded in polymer matrix, said reinforcing fibers preferably being carbon fibers.

[0027] In a preferred embodiment, the coating is made of polymer material, such as polyurethane, rubber or silicon, for example. In this context, the tensioning of rope terminal device/rope terminal arrangement is advantageous, because of its improved reliability in high temperature conditions.

[0028] In a preferred embodiment, the coating is made of thermoplastic material, such as thermoplastic polymer material, polyurethane for example. In this context, the tensioning of rope terminal device/ arrangement is particularly preferable, because of its improved reliability in high temperature conditions.

[0029] In a preferred embodiment, the rope is connected to an elevator car.

[0030] In a preferred embodiment, the rope is a suspension rope of an elevator.

[0031] In a preferred embodiment, the reinforcing fibers are distributed at least substantially evenly in polymer matrix m and bound to each other by the polymer matrix.

[0032] In a preferred embodiment, preferably, over 50% of the cross-sectional square area of the load bearing member consists of said reinforcing fibers. Thereby, a high tensile stiffness can be facilitated. Preferably, the load bearing members cover together at least a 25-75% proportion of the cross-section of the rope, most preferably over 50% proportion of the cross-section of the rope.

[0033] In a preferred embodiment, the reinforcing fibers are not twisted together. Instead, it is preferable that the reinforcing fibers of each load bearing member are parallel with the longitudinal direction of the load bearing member. Thereby the fibers are also parallel with the longitudinal direction of the rope as each load bearing member is oriented parallel with the longitudinal direction of the rope. This facilitates further the longitudinal stiffness of the rope.

[0034] In a preferred embodiment, the width/thickness ratio of the rope is more than two, preferably more than 4.

[0035] In a preferred embodiment, the rope is belt-shaped and the compression faces are planar, albeit they can comprise an uneven surface pattern. Owing to the planar construction of the compression faces, a wide contact area and thereby a gentle gripping can be established between the rope and the compression members. Planar construction is particularly advantageous due to the rope being coated and unable to withstand great point loads, but also if the load bearing members are brittle and thereby sensitive to point loads as well.

[0036] It is also brought forward a new elevator, which comprises a rope terminal arrangement as defined anywhere above and fixing an end of a coated rope of the elevator to a fixing base. With this solution one or more of the above mentioned objects are achieved. In particular, a reliable engagement between a coated elevator rope and the compression members can be achieved. A solution is achieved where the compression members compress closer together so that a firm engagement can be maintained with the rope even if the thickness thereof is reduced, e.g. due to burning or melting. Preferable further details have been introduced above and in the following, which further details can be combined with the elevator individually or in any combination. Preferably, the elevator further comprises a hoistway and one or more elevator units vertically movable in the hoistway, including at least an elevator car. Preferably, the rope is arranged to suspend one or more of said elevator units, including at least an elevator car. Said fixing base is preferably one of the elevator units or a stationary structure of the building wherein the elevator is installed.

[0037] The elevator is preferably such that the car thereof is arranged to serve two or more landings. The

elevator preferably controls movement of the car in response to signals from user interfaces located at landing(s) and/or inside the car so as to serve persons on the landing(s) and/or inside the elevator car. Preferably, the car has an interior space suitable for receiving a passenger or passengers, and the car can be provided with a door for forming a closed interior space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] 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 embodiment of a rope terminal device for a coated rope.

Figure 2 illustrates an embodiment of a rope terminal arrangement according to the invention implementing the rope terminal device of Figure 1.

Figure 3 illustrates a first embodiment of an elevator implementing the rope terminal device and the rope terminal arrangement according to the invention.

Figure 4 illustrates a second embodiment of an elevator implementing the rope terminal device and the rope terminal arrangement according to the invention.

Figure 5 illustrates a preferred cross section of the rope.

Figures 6 and 7 illustrate preferred details of the load bearing member of the rope.

[0039] The foregoing aspects, features and advantages of the invention will be apparent from the drawings and the detailed description related thereto.

DETAILED DESCRIPTION

[0040] Figure 1 illustrates an embodiment of a rope terminal device 1 for a coated rope R of an elevator. The rope R comprises one or more elongated load bearing members 2. The one or more elongated load bearing members 2 are embedded in a coating 3 forming the outer surface of the rope R and extend parallel to the longitudinal direction 1 of the rope R unbroken throughout the length of the rope R. Thus, they are able to transmit tension with good tensile stiffness. The rope R is in the presented case belt-shaped. The rope terminal device 1 comprises a first compression member 10 having a first compression face 11 to be placed against a first side S1 of the rope R, which first side is here one of two wide sides of the rope, i.e. a face facing in thickness direction of the rope R. The rope terminal device 1 further comprises a second compression member 20 having a second compression face 21 to be placed against a second side S2 of the rope R, which second side S2 is here the other of the two wide sides of the rope, i.e. a face facing in thickness direction of the rope R. The first and second compression face 11,21 delimit between them a rope gap

G for receiving a rope R, the compression members being 10,20 movable towards each other, by moving one or both of them, to compress via said compression faces 11,21 the rope R placed in the rope gap G for blocking movement of the rope R in its longitudinal direction relative to the compression members 10,20. The rope terminal device 1 further comprises a tightening means 31,32,33,40 tightenable to force, in particular to pull, the compression members 10, 20 towards each other so as to produce compression on the rope R. The tightening means 31,32,33,40 comprise a tightening member 33 on the backside of one of the compression members 10,20, which is in the presented case the first compression member 10, for exerting a tightening force on the backside of said one 10 of the compression members 10,20 when the tightening means 31,32,33,40 are tightened, wherein the backside is the opposite side than the gap G. The tightening member 33 and the compression member 10 are relatively movable in thickness direction of the gap G. The tightening means 31,32,33,40 further comprise one or more springs 40 in particular a spring or a plurality of springs mounted between the tightening member 33 and the compression member 10 for transmitting tightening force between the tightening member 33 and the compression member 10. The compression can thus be ensured in all circumstances. Owing to a suitable pretension created by the tightening means and maintained by the springs, the compression faces approach each other in case volume of rope between them is reduced. The rope terminal arrangement is thereby able to adapt to the changed rope volume caused by melting or burning of the material of the coating and/or the load bearing members. This also makes it possible to use tightening means, which normally would not be able to adapt to changes of the rope volume between the compression faces, such as screw-type tightening means. As illustrated in Figures, the rope terminal device 1 comprises plurality of said tightening means 31,32,33,40 so as to even out the tightening effect and to provide redundancy. This is however not necessary, as only one set of the tightening means would be adequate.

[0041] In the presented case, there are plurality of said springs piled in thickness direction of the gap G such that they are each elastically deformable in thickness direction of the gap G. Said one or more springs 40 thereby form together a pack of springs arranged in series in tightening direction of the tightening means. The combined stroke length s of the one or more springs 40 is preferably at least the thickness of coating covering a load bearing member in thickness direction t of the rope R. More preferably, the combined stroke length s of the one or more springs 40 is preferably at least the thickness of coating covering a load bearing member in thickness direction t of the rope R on the first side of a load bearing member plus the thickness of coating covering a load bearing member in thickness direction t of the rope R on the second side of the load bearing member. Thus, the combined stroke length of said spring(s) is sufficient to compensate

melting away of the coating from both opposite sides of a load bearing member.

[0042] The tightening member 33 is tightenable against the one or more springs 40 such that each said spring 40 is brought under tension for exerting a tightening force on the backside of said one 10 of the compression members 10,20 via the one or more tensioned springs 40.

[0043] In the presented preferred embodiment, the tightening means 31,32,33,40 are screw-type tightening means. This is not, however, not necessary as the tightening means could alternatively be designed to have some other construction for producing a tightening force. In the preferred embodiment, the tightening member 33 is tightenable, by screwing the screw-type tightening means 31,32,33,40, against the one or more springs 40 such that each said spring 40 is brought under tension and a tightening force produced by said screwing is exerted on the backside of said one 10 of the compression members 10,20 via the one or more tensioned springs 40. In the following, the rope terminal arrangement utilizing the rope terminal device 1 is described. Preferred further features of the rope terminal device 1 are described in this context.

[0044] Figure 2 illustrates an embodiment of a rope terminal arrangement A for a coated rope R of an elevator. The rope terminal arrangement comprises an end E of a rope R to be fixed. The rope R is in the presented case belt-shaped. The rope terminal arrangement A comprises a first compression member 10 having a first compression face 11 placed against a first side S1 of the rope R, which first side is here one of two wide sides of the rope, i.e. a face facing in thickness direction of the rope R. The rope terminal arrangement A further comprises a second compression member 20 having a second compression face 21 placed against a second side S2 of the rope R, which second side S2 is here the other of the two wide sides of the rope, i.e. a face facing in thickness direction of the rope R. The first and second compression face 11,21 delimit between them a rope gap G wherein the R is placed, the compression members being 10,20 movable towards each other, by moving one or both of them, and arranged to compress via said compression faces 11,21 the rope R placed in the rope gap G blocking movement of the rope R in its longitudinal direction relative to the compression members 10,20. The rope terminal arrangement A further comprises a tightening means 31,32,33,40 tightened to force, in particular to pull, the compression members 10, 20 towards each other so that compression is produced on the rope R. The tension of the rope R is arranged to be transmitted via the compression members 10 and 20 to the fixing base 50,60,70. For this end, in the rope terminal arrangement A, the first compression member 10 and the second compression member 20 are supported on fixing base 50,60,70, which is preferably one of the elevator units of an elevator, or a stationary structure of a building wherein the elevator is installed.

[0045] The tightening means 31,32,33,40 comprise a tightening member 33 on the backside of one of the compression members 10,20, which is in the presented case the first compression member 10, exerting a tightening force on the backside of said one 10 of the compression members 10,20. The tightening member 33 and the compression member 10 are relatively movable in thickness direction of the gap G. The tightening means 31,32,33,40 further comprise one or more springs 40, in particular a spring or a plurality of springs, mounted between the tightening member 33 and the compression member 10 transmitting said tightening force between the tightening member 33 and the compression member 10. In the presented case, there are plurality of said springs piled in thickness direction of the gap G such that they are each elastically deformed in thickness direction of the gap G by tightening of the tightening means. Said one or more springs 40 thereby form together a pack of springs arranged in series in tightening direction of the tightening means. The combined stroke length s of the one or more springs 40 is preferably at least the thickness of coating covering a load bearing member in thickness direction t of the rope R. More preferably, the combined stroke length s of the one or more springs 40 is preferably at least the thickness of coating covering a load bearing member in thickness direction t of the rope R on the first side of a load bearing member plus the thickness of coating covering a load bearing member in thickness direction t of the rope R on the second side of the load bearing member. Thus, the combined stroke length of said one or more springs is sufficient to compensate melting away of the coating from both opposite sides of a load bearing member.

[0046] The tightening member 33 is tightened against the one or more springs 40 such that each said spring 40 is brought under tension and a tightening force is exerted on the backside of said one 10 of the compression members 10,20 via the one or more tensioned springs 40.

[0047] In the presented preferred embodiment, the tightening means 31,32,33,40 are screw-type tightening means. This is not, however, not necessary as the tightening means could alternatively be designed to have some other construction for producing a tightening force. In the preferred embodiment, the tightening member 33 is tightened, by screwing the screw-type tightening means 31,32,33,40, against the one or more springs 40 such that each said spring 40 is brought under tension and a tightening force produced by said screwing is exerted on the backside of said one 10 of the compression members 10,20 via the one or more tensioned springs 40. Preferred further optional features are described hereinafter.

[0048] In the preferred embodiment, the screw-type tightening means 31,32,33,40 comprises a threaded rod 32 having said tightening member 33 on one end for exerting a tightening force on the backside of said one 10 of the compression members 10,20 via the one or more springs 40 and a further tightening member 31 on the

other end for exerting a tightening force on the backside of the other 20 of the compression members 10,20. The threaded rod passes through the central hole of each said spring that is in the form of a spring washer. At least one of the tightening members 31,33 (in the presented case the tightening member 31) has threads via which it engages the threads of the threaded rod 32, and is movable by screwing towards the other 33 of said tightening members 31,33 by rotation relative to the threaded rod thereby being able to force the compression members 10, 20 towards each other. In the preferred embodiment, the tightening member 31 is a nut, and the tightening member 33 is a bolt head fixedly mounted on the threaded rod, whereby these together form a bolt. The screw-type tightening means 31,32,33,40 could be implemented also differently than disclosed in the Figures, namely such that both of the tightening members 31,33 are nuts having threads via which they engage the threads of the threaded rod 32, or such that the aforementioned bolt engages directly with threads formed in the second compression member 10.

[0049] In the preferred embodiment, the first and second compression face are each provided with uneven surface pattern for facilitating grip between the compression face in question and the side of the rope against which it is placed/to be placed. The uneven surface pattern preferably comprises protrusions and grooves between the protrusions. Preferably, the protrusions are arranged to force the surface shape of the rope to deform such that recesses are formed into the coating material of the rope at the points of the protrusions when the compression face in question is compressed against the rope. Preferably, said grooves are between said protrusions in longitudinal direction of the rope, whereby particularly slipping in the direction of rope tension will be reduced. Preferably, the uneven surface pattern is a knurling pattern. As illustrated, it is preferable, that the uneven surface pattern P comprises protrusions for protruding into the coating of the rope R when the compression face is compressed against the rope R. The height of said protrusions is preferably less than thickness of the coating covering a load bearing member in thickness direction t of the rope R. The height is particularly preferably less than 2.0 mm, most preferably within range 0.5 mm - 1.5 mm. Thus, they can engage to the coating without damaging the load bearing members. The aforementioned knurling pattern may be a diamond knurling pattern or a straight knurling pattern, for instance.

[0050] In the preferred embodiment, said one or more springs 40 are spring washers, more specifically conical spring washers. The springs 40 can thus be in the form of Belleville springs. Said one or more springs 40 are preferably made of metal, whereby they withstand high temperatures.

[0051] The compression members 10,20 are preferably shaped to minimize bending of the rope R. For this purpose, the compression faces 11,21 of the compression members 10,20 are parallel and straight such that

the rope R compressed by them is not bent into a curved form. Thus, the rope terminal arrangement is particularly suitable for fixing a rope that comprises rigid and/or brittle load bearing members, such as load bearing members made of fiber reinforced composite, and needs to be fixed by a rope terminal arrangement without bending.

[0052] The rope being belt-shaped, the compression faces are in this case preferably planar, albeit they can comprise an uneven surface pattern. Owing to the planar construction of the compression faces, a wide contact area and thereby a gentle gripping can be established between the rope and the compression members. The belt is thus also maintained straight. Planar construction is particularly advantageous due to the rope being coated and unable to withstand great point loads, but also if the load bearing members are brittle and thereby sensitive to point loads as well.

[0053] Figures 3 and 4 illustrate preferred embodiments of the elevator utilizing the rope terminal device 1 and the rope terminal arrangement A described above. The elevator comprises a hoistway H and elevator units 50,60 vertically movable in the hoistway H. The elevator units 50,60 include in this case an elevator car 50 and a counterweight 60. In both embodiments, the elevator further comprises one or more coated ropes R, each being connected with said elevator units 50, 60 and having two ends, each end being fixed to a fixing base 50,60,70. Each said rope R suspends the elevator units 50,60 whereto it is connected. Accordingly, the rope R is in this case a suspension rope R of the elevator. Each of said rope ends are fixed with a rope terminal arrangement A to its fixing base 50,60,70. The rope terminal arrangement A is as described elsewhere in the application. The illustrated elevators differ from each other in terms of their suspension ratios, i.e. how the ropes R have been connected with the elevator units 50,60. In the embodiment of Figure 3, the fixing base is for one end of the rope R the elevator unit 50, and for the other end the elevator unit 60. In the embodiment of Figure 4, on the other hand, the fixing base is for both ends of the rope R a stationary structure 70 of the building wherein the elevator is installed.

[0054] The elevators illustrated in Figures 3 and 4 are more specifically such that each of them comprises one or more upper rope wheels 80,81 mounted higher than the car 50 and the counterweight 60, in this case particularly in proximity of the upper end of the hoistway H. In this case there are two of said rope wheels 80,81 but the elevator could be implemented also with some other number of rope wheels. Each of said one or more ropes R pass around said one or more rope wheels 80,81 mounted in proximity of the upper end of the hoistway H. In this case the one or more rope wheels 80,81 are mounted inside the upper end of the hoistway H, but alternatively they could be mounted inside a space beside or above the upper end of the hoistway H. Said one or more rope wheels 80,81 comprise a drive wheel 80 engaging said one or more hoisting ropes R, and the elevator com-

prises a motor M for rotating the drive wheel 80. The elevator car 50 can be moved by rotating the drive wheel 80 engaging each of said ropes R. The elevator further comprises an elevator control unit 100 for automatically controlling rotation of the motor M, whereby the movement of the car 50 is also made automatically controllable. Each of said one or more ropes R is preferably belt-shaped and passes around the one or more rope wheels 80,81 turning around an axis extending in width direction w of the rope R, the wide side thereof, i.e. the side facing in thickness direction t of the rope R, resting against the one or more rope wheels 80,81.

[0055] Figure 5 illustrates a preferred structure of the rope R. The rope R is belt-shaped, whereby it is substantially larger in its width direction w than in its thickness direction t. The rope has two opposite wide sides S1,S2 facing in thickness direction t of the rope R. These wide sides S1,S2 can be engaged firmly with compression members 10,20. This provides that the rope R can be fixed firmly also without bending it, which would be disadvantageous if the rope has rigid and/or brittle elements. The width/thickness ratio of the rope R is preferably at least 2 more preferably at least 4, or even more. In this way a large cross-sectional area for the rope R is achieved, the bending capacity around the width-directional axis being favorable also with rigid materials of the load bearing member, such as composite material. Owing to the wide shape, the rope R suits very well to be used in hoisting appliances, in particular in elevators, wherein the rope R needs to be guided around rope wheels. As above mentioned, the rope R comprises one or more elongated load bearing members 2, which are embedded in a coating 3 forming the outer surface of the rope R and extend parallel to the longitudinal direction 1 of the rope R unbroken throughout the length of the rope R. It is preferable that each load bearing member 2 is shaped wide, as illustrated. Accordingly, each of said one or more load bearing members 2 is preferably larger in its width direction w than in its thickness direction t of the rope 2. Particularly, the width/thickness ratio of each of said one or more load bearing members is then preferably more than 2. Thereby, the bending resistance of the rope R is small but the load bearing total cross sectional area is vast with minimal non-bearing areas.

[0056] The coating 3 is preferably made of polymer material. With the coating 3, the rope R is provided with a surface via which the rope R can effectively engage frictionally with a drive wheel of an elevator, for instance. Also, hereby the friction properties and/or other surface properties of the rope are adjustable, independently of the load bearing function, such that the rope performs well in the intended use, for instance in terms of traction for transmitting force in longitudinal direction of the rope so as to move the rope with a drive wheel. Furthermore, the load bearing members 2 embedded therein are thus provided with protection. The coating 3 is preferably elastic. Elastic polymer material, for example polyurethane provides the rope R the desired frictional properties sim-

ply, good wear resistance as well as efficient protection for the load bearing members 2. Polyurethane is in general well suitable for elevator use, but also materials such as rubber or silicon or equivalent elastic materials are suitable for the material of the coating 3. In the embodiment illustrated in Figure 5, there are plurality of the load bearing members 2, which are adjacent each other in width direction w of the rope R. In the present case, there are particularly four of said load bearing members 2 embedded adjacently in said coating 3, but the rope 1 could alternatively any other number of load bearing members 2, such any other number of adjacent load bearing members 2, e.g. from 2 to 10. The rope 1 could also be made to have only one load bearing member 2. Said one or more load bearing members 2 is/are preferably, but not necessarily, made of composite material comprising reinforcing fibers f embedded in polymer matrix m, said reinforcing fibers preferably being carbon fibers. With this kind of structure, the rope R has especially advantageous properties in elevator use, such as light weight and good tensile stiffness in longitudinal direction. The load bearing members of this kind are being relatively brittle, e.g. when compared to steel, and require gentle fixing. For this reason, the rope terminal device 1 as presented in particularly advantageous in fixing of the rope R. Also, owing the tightening means that can adapt to high temperature, the coating 3 can be safely made of thermoplastic material, such as thermoplastic polyurethane.

[0057] Figure 6 illustrates a preferred inner structure for said load bearing member 2, showing inside the circle an enlarged view of the cross section of the load bearing member 2 close to the surface thereof, as viewed in the longitudinal direction 1 of the load bearing member 2. The parts of the load bearing member 2 not showed in Figure 6 have a similar structure. Figure 7 illustrates the load bearing member 2 three dimensionally. The load bearing member 2 is made of composite material comprising reinforcing fibers f embedded in polymer matrix m. The reinforcing fibers f are more specifically distributed at least substantially evenly in polymer matrix m and bound to each other by the polymer matrix. This has been done e.g. in the manufacturing phase by immersing them together in the fluid material of the polymer matrix which is thereafter solidified. The load bearing member 2 formed is a solid elongated rod-like one-piece structure. Said reinforcing fibers f are most preferably carbon fibers, but alternatively they can be glass fibers, or possibly some other fibers. Preferably, the reinforcing fibers f of each load bearing member 2 are parallel with the longitudinal direction of the load bearing member 2. Thereby, the fibers f are also parallel with the longitudinal direction of the rope R as each load bearing member 2 is oriented parallel with the longitudinal direction of the rope R. This is advantageous for the rigidity as well as behavior in bending. Owing to the parallel structure, the fibers in the rope R will be aligned with the force when the rope R is pulled, which ensures that the structure provides high tensile stiffness. The fibers f used in the preferred em-

bodiments are accordingly substantially untwisted in relation to each other, which provides them said orientation parallel with the longitudinal direction of the rope R. 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 40 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. The reinforcing fibers f are preferably long continuous fibers in the longitudinal direction of the load bearing member 2, preferably continuing for the whole length of the load bearing member 2.

[0058] All the reinforcing fibers f are preferably distributed in the aforementioned load bearing member 2 at least substantially evenly. The fibers f are then arranged so that the load bearing member 2 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 force exerted on the fibers, reduces fiber-fiber contacts and internal wear of the rope, thus improving the service life of the rope R. Owing to the even distribution, the fiber density in the cross-section of the load bearing member 2 is substantially constant. The composite matrix m, into which the individual fibers f are distributed, is most preferably made of epoxy, which has good adhesiveness to the reinforcement fibers f and which is known to behave advantageously with reinforcing fibers such as carbon fiber particularly. Alternatively, e.g. polyester or vinyl ester can be used, but any other suitable alternative materials can be used.

[0059] The matrix m has been applied on the fibers f such that a chemical bond exists between each individual reinforcing fiber f and the matrix m. Thereby a uniform structure is achieved. 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, such as said epoxy, 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.

[0060] As above mentioned, the matrix m of the load bearing member 2 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 2, 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 2.5-4.5 GPa. There are commercially available various material alternatives for the matrix m which can provide these material properties. Preferably over 50% proportion of the surface area of the cross-section of the load bearing member 2 is of the aforementioned reinforcing fiber, preferably such that 50%-80% proportion is of the aforementioned reinforcing fiber, more preferably such that 55%-70% proportion is of the aforementioned reinforcing fiber, and substantially all the remaining surface area is of polymer matrix m. 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 (preferably epoxy material). In this way a good longitudinal stiffness for the load bearing member 2 is achieved. As mentioned carbon fiber is the most preferred fiber to be used as said reinforcing fiber due to its excellent properties in hoisting appliances, particularly in elevators. However, this is not necessary as alternative fibers could be used, such as glass fiber, which has been found to be suitable for the hoisting ropes as well. The load bearing members 2 are preferably each completely non-metallic, i.e. made not to comprise metal.

[0061] In the illustrated embodiments, the load bearing members 2 are substantially rectangular and larger in width direction than thickness direction. However, this is not necessary as alternative shapes could be used. Likewise, it is not necessary that the number of the load bearing members is four which is used for the purpose of the example. The number of the load bearing members 2 can be greater or smaller. The number can be one, two or three for instance, in which cases it may be preferably to shape it/them wider than what is shown in Figures. The rope R could also be made to have plurality of load bearing members 2 stacked in thickness direction t, for instance

[0062] The rope R is furthermore such that the aforementioned load bearing member 2 comprised in the rope or the plurality of load bearing members 2 comprised in the rope R together, cover majority, preferably 70% or over, more preferably 75% or over, most preferably 80% or over, most preferably 85% or over, of the width of the

cross-section of the rope R for essentially the whole length of the rope R. Thus the supporting capacity of the rope R with respect to its total lateral dimensions is good, and the rope R does not need to be formed to be thick.

[0063] As mentioned, in the presented preferred embodiment, the tightening means 31,32,33,40 are screw-type tightening means. This is, however, not necessary as the tightening means could alternatively be designed to have some other construction for producing a tightening force, such as to work by wedging principle. In an alternative construction the tightening means can be wedging means, and the tightening member 33 is instead of the bolt head presented in Figures 1 and 3 a wedge member wedgeable between a tapered frame wall comprised in the rope terminal device and the one or more springs 40.

[0064] In the preferred embodiments, an advantageous structure for the rope R has been disclosed. However, the invention can be utilized with also other kind of ropes such as with other kinds of belt-shaped ropes having different materials. Also, the outer shape of the rope R could be contoured otherwise than disclosed. In the illustrated examples, the rope is smooth and shaped without uneven surface pattern. However, this is not necessary as the rope could alternatively be provided with an uneven surface pattern on one or both of its wide sides. If the rope has an uneven surface pattern on its wide side, it is preferable that the compression face placed against it is provided with an uneven surface pattern forming a counterpart for the uneven surface pattern of the rope. The uneven surface pattern of the rope could comprise protrusions and/or recesses for guiding the rope laterally, e.g. when it turns along a rope wheel comprising a surface pattern forming a counterpart for the uneven surface pattern of the rope. The uneven surface pattern of the rope could be a polyvee pattern or a tooth pattern, for instance.

[0065] 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.

Claims

1. A rope terminal device (1) for a coated rope (R), comprising a first compression member (10) having a first compression face (11) and a second compression member (20) having a second compression face (21), wherein the first and second compression face

- (11,21) delimit between them a rope gap (G) for receiving a rope (R); and a tightening means (31,32,33,40) tightenable to force the compression members (10, 20) towards each other so as to produce compression on the rope (R), **characterized in that** the tightening means (31,32,33,40) comprise a tightening member (33) on the backside of at least one (10) of the compression members (10,20) for exerting a tightening force on the backside of said one (10) of the compression members (10,20) when the tightening means (31,32,33,40) are tightened; and one or more springs (40) mounted between the tightening member (33) and the compression member (10) for transmitting tightening force between the tightening member (33) and the compression member (10).
2. A rope terminal device (1) according to claim 1, wherein the tightening means (31,32,33) are screw-type tightening means.
 3. A rope terminal device (1) according to any of the preceding claims, wherein the tightening member (33) is tightenable against the one or more springs (40) such that each said spring is brought under tension for exerting a tightening force on the backside of said one (10) of the compression members (10,20) via the one or more tensioned springs (40).
 4. A rope terminal arrangement (A) comprising an end (E) of a coated rope (R); and a first compression member (10) having a first compression face (11) placed against a first side (S1) of the rope (R) and a second compression member (20) having a second compression face (21) placed against a second side (S2) of the rope (R), wherein the first and second compression face (11,21) delimit between them a rope gap (G) wherein the end (E) of the rope (R) is placed; and a tightening means (31,32,33,40) tightened to force the compression members (10, 20) towards each other so as to produce compression on the rope (R), **characterized in that** the tightening means (31,32,33,40) comprise a tightening member (33) on the backside of at least one (10) of the compression members (10,20) for exerting a tightening force on the backside of said one (10) of the compression members (10,20); and one or more springs (40) mounted between the tightening member (33) and the compression member (10) transmitting tightening force between the tightening member (33) and the compression member (10).
 5. A rope terminal arrangement (A) according to claim 4, wherein the tightening means (31,32,33,40) are screw-type tightening means.
 6. A rope terminal arrangement (A) according to any of the preceding claims 4-5, wherein the tightening member (33) is tightened against the one or more springs (40) such that each said spring is brought under tension and a tightening force is exerted on the backside of said one (10) of the compression members (10,20) via the one or more springs (40).
 7. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein said one or more springs (40) comprises plurality of springs (40) piled in thickness direction of the gap (G).
 8. A rope terminal arrangement or a rope terminal device (1) according to any of the preceding claims, wherein one or both of the first and second compression face (11,21) is provided with uneven surface pattern (P) for facilitating grip between the compression face (11,21) in question and the side (S1,S2) of the rope (R) against which it is placed.
 9. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein said one or more springs (40) are spring washers.
 10. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein the compression faces (11,21) of the compression members (10,20) are straight and parallel such that the rope (R) compressed by them is not bent into a curved form.
 11. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein the rope is belt-shaped.
 12. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein, the rope (R) comprises one or more elongated load bearing members (2) embedded in a coating (3) forming the outer surface of the rope (R) and extending parallel with the longitudinal direction (1) of the rope (R) unbroken throughout the length of the rope (R).
 13. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein the load bearing members (2) are made of composite material comprising reinforcing fibers (f) embedded in polymer matrix (m), said reinforcing fibers (f) preferably being carbon fibers.
 14. A rope terminal arrangement (A) or a rope terminal device (1) according to any of the preceding claims, wherein the coating (3) is made of polymer material, such as polyurethane, rubber or silicon.
 15. An elevator, which comprises a rope terminal ar-

rangement (A) as defined in any of the preceding claims 4-14 fixing an end (E) of a coated rope (R) of the elevator to a fixing base (50,60,70).

5

10

15

20

25

30

35

40

45

50

55

Fig. 1

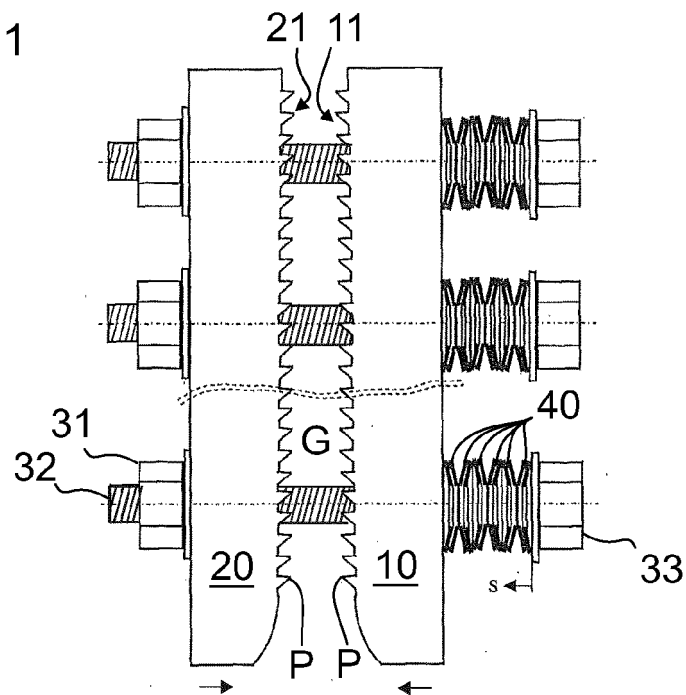


Fig. 2

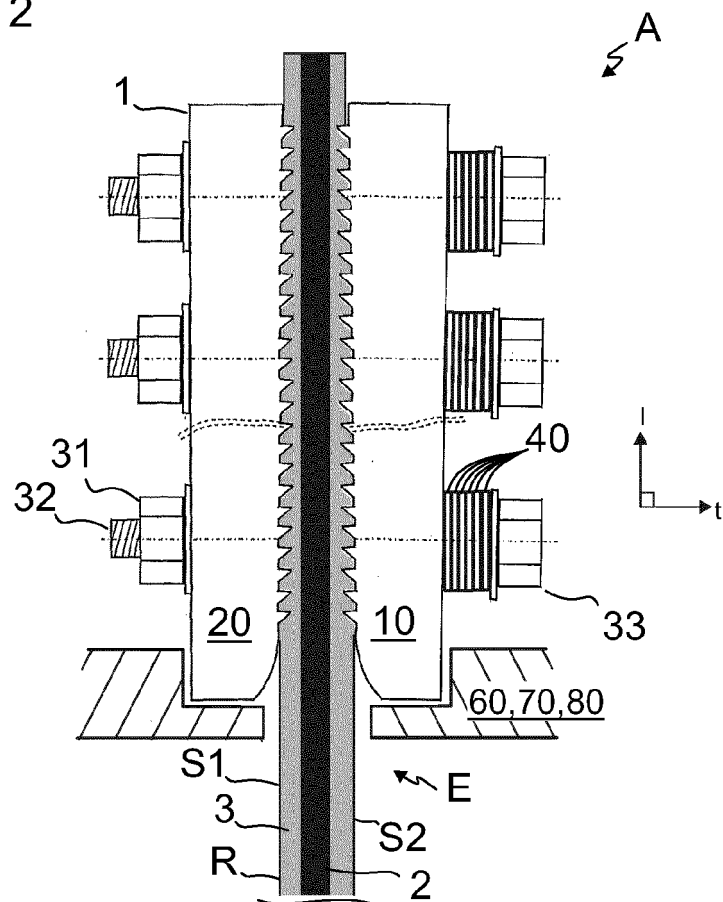


Fig. 3

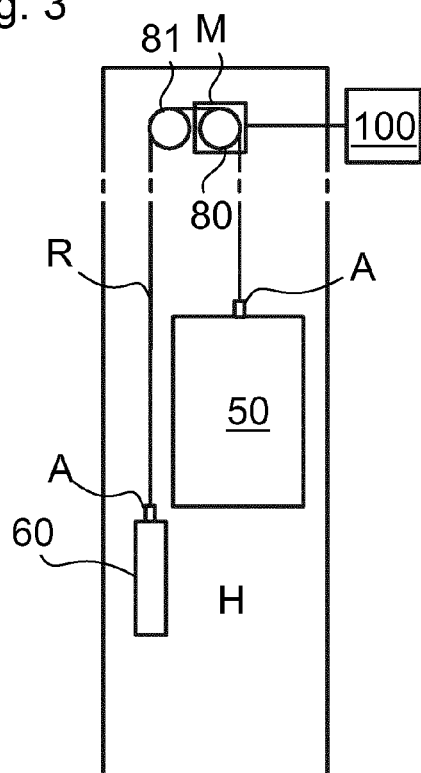


Fig. 4

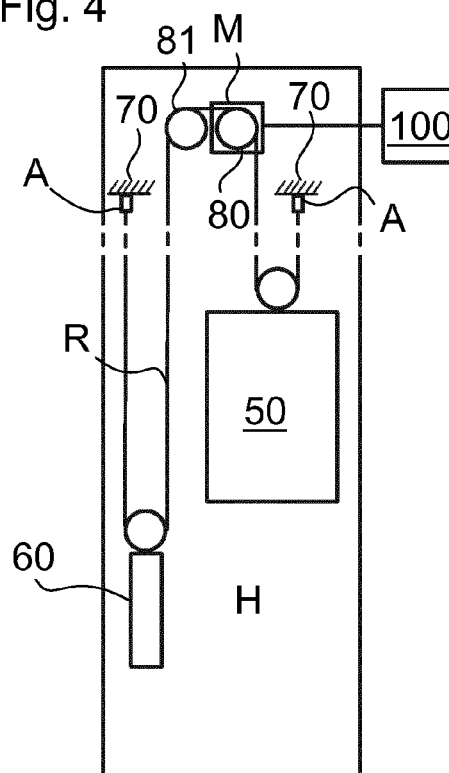


Fig. 5

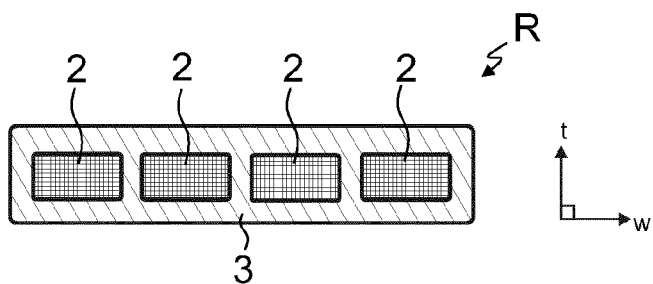


Fig. 6

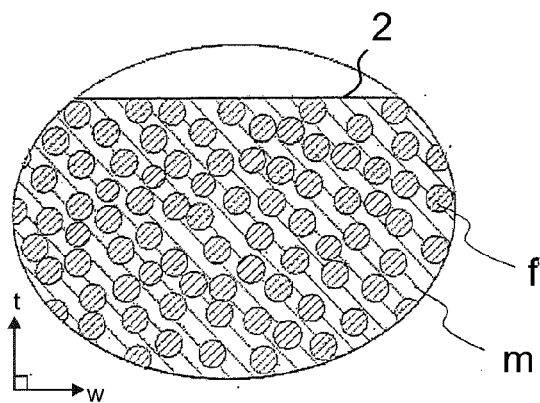
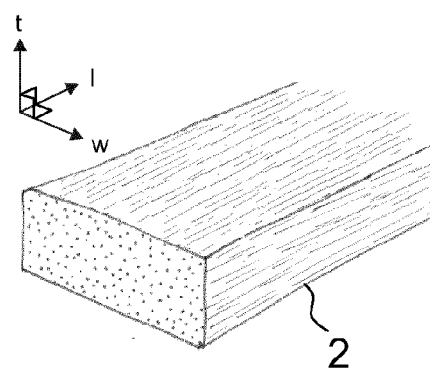


Fig. 7





EUROPEAN SEARCH REPORT

Application Number
EP 15 19 7705

5

10

15

20

25

30

35

40

45

50

55

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 1 028 911 A1 (OTIS ELEVATOR CO [US]) 23 August 2000 (2000-08-23)	1-7, 9-11,15	INV. B66B7/08
Y	* paragraph [0025]; figures 2,9-13 *	8,12-14	
Y	EP 2 910 509 A1 (KONE CORP [FI]) 26 August 2015 (2015-08-26) * paragraphs [0045] - [0047], [0049]; figures 9,10 *	8,12-14	
Y	WO 2009/090299 A1 (KONE CORP [FI]; PELTO-HUIKKO RAIMO [FI]; VALJUS PETTERI [FI]; HONKANEN) 23 July 2009 (2009-07-23) * page 24, line 29 - page 25, line 37; figure 8 *	8,12-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 May 2016	Examiner Miklos, Zoltan
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			

 1
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 15 19 7705

5

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.

30-05-2016

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 1028911	A1	23-08-2000	DE	69933107 T2	05-04-2007
			EP	1028911 A1	23-08-2000
			ES	2267249 T3	01-03-2007
			WO	9943591 A1	02-09-1999

EP 2910509	A1	26-08-2015	CN	104843558 A	19-08-2015
			EP	2910509 A1	26-08-2015
			HK	1210130 A1	15-04-2016
			SG	10201500200U A	29-09-2015
			US	2015232302 A1	20-08-2015

WO 2009090299	A1	23-07-2009	AU	2009204744 A1	23-07-2009
			CA	2711074 A1	23-07-2009
			CA	2914023 A1	23-07-2009
			CN	101977834 A	16-02-2011
			DE	102009005093 A1	24-09-2009
			EA	201001018 A1	28-02-2011
			EP	2240395 A1	20-10-2010
			GB	2458001 A	09-09-2009
			HK	1135441 A1	18-02-2011
			JP	5713682 B2	07-05-2015
			JP	2011509899 A	31-03-2011
			JP	2015038005 A	26-02-2015
			KR	20100102169 A	20-09-2010
			KR	20150038722 A	08-04-2015
			US	2011000746 A1	06-01-2011
			US	2011266097 A1	03-11-2011
			WO	2009090299 A1	23-07-2009

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

- US 20140182975 A1 [0004]