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

(11) EP 3 336 033 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.06.2018 Bulletin 2018/25

(51) Int Cl.:
B66B 5/00 *(2006.01)* ***B66B 7/12*** *(2006.01)*

(21) Application number: **16205065.2**

(22) Date of filing: **19.12.2016**

(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

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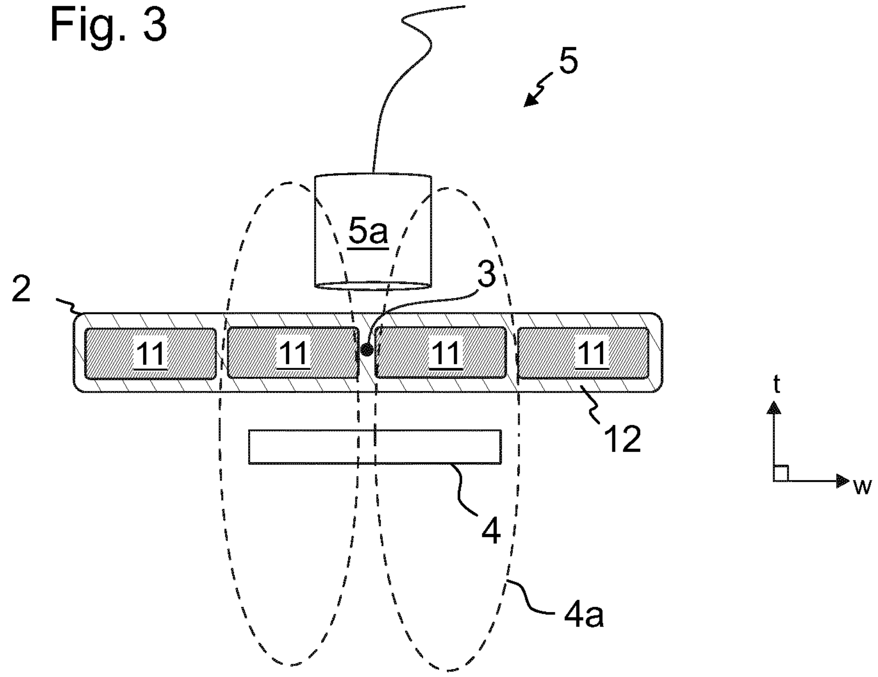
(54) **ARRANGEMENT OF A HOISTING DEVICE**

(57) Arrangement (1,1’) for monitoring position of a rope (2,2’) of a hoisting device, the arrangement comprising a means (4) for generating a magnet field; a rope (2,2’) comprising metal material, the rope (1,1’) being positioned such that metal material (3,3’) of the rope (2,2’) passes through or beside the magnet field generated by said means (4); and a detection means (5) for detecting changes in said magnetic field.

Fig. 3



EP 3 336 033 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to monitoring position of a rope of a hoisting device, such as an elevator for vertically transporting passengers and/or goods.

BACKGROUND OF THE INVENTION

[0002] In hoisting devices such as elevators, one or more hoisting ropes are used as the means by which the load to be hoisted is suspended. Each hoisting rope typically includes one or more 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.

[0003] In hoisting devices, such as elevators, passage of ropes is guided by one or more rope wheels. One of the rope wheels can also be a drive wheel for transmitting drive force from a motor to the ropes. Lateral position of each rope, and most importantly position relative to a rope wheel in the axial direction of the rope wheel, should be maintained such that the rope does not drift in said axial direction away from the circumferential surface area of the rope wheel against which the rope in question is intended to rest.

[0004] Typically, in prior art, position of belt-shaped ropes in the axial direction of rope wheels has been controlled by providing one or more of the rope wheels and the rope engaging the rope wheel with a ribbed or toothed shapes complementary for each other, whereby movement of the rope in said axial direction is blocked by mechanical shape-locking. One alternative way to control position of the belt-shaped ropes in said axial direction is to shape the circumferential surface areas of the drive wheel cambered.

[0005] A drawback of the known elevators has been that moving of a rope laterally outside its intended course has not been noticed and prevented in an adequately simple and efficient manner. This has been difficult especially with belt-shaped ropes and particularly when the displacement has occurred in width direction of the rope. These challenges have been most frequent when said mechanical shape-locking has been inadequately reliable or unavailable for some reason such as due to preference to utilize cambered shape of the drive wheel for rope position control.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The object of the invention is to introduce an improved arrangement for monitoring position of a rope of a hoisting device, such as an elevator. The object of the invention is particularly to solve previously described drawbacks of known solutions and problems discussed or implied later in the description of the invention. Embodiments are presented, inter alia, where running of a rope outside its intended course in transverse direction thereof can be detected. Embodiments are presented, inter alia, in which such a problem situation with regard to rope position can be reacted to appropriately bringing the hoisting device to a safer state. Thus further development of the problem into even more hazardous state can be prevented. Embodiments are presented, inter alia, in which said objects are realized with simple and reliable configuration.

[0007] It is brought forward a new arrangement for monitoring position of a rope of a hoisting device, such as an elevator, the arrangement comprising a means for generating a magnet field; a rope comprising metal material, the rope being positioned such that metal material of the rope passes through or beside the magnet field generated by said means; and a detection means for detecting changes in said magnetic field. With this solution one or more of the above mentioned objects can be achieved. Preferable further details are introduced in the following, which further details can be combined with the arrangement individually or in any combination.

[0008] In a preferred embodiment, the rope comprises a metal member made of metal material, the rope being positioned such that the metal member passes through or beside the magnet field generated by said means.

[0009] In a preferred embodiment, the hoisting device comprises a control means, such as an electronic control system, arranged to perform one or more predefined actions in response to detection of a change, in particular a predefined change, in said magnetic field.

[0010] In a preferred embodiment, the one or more actions include one or more of the following: stopping of movement of the load to be hoisted, sending of a signal such as an alarm signal. Said stopping can comprise braking the movement of the load to be hoisted. Said signal can be sent for example to a remote monitoring center.

[0011] In a preferred embodiment, movement of the rope in transverse direction thereof is arranged to bring the metal member and thereby metal material of the rope to move in transverse direction of the rope relative to the magnetic field, such that a change in the magnetic field, in particular flux thereof, is caused.

[0012] In a preferred embodiment, movement of the rope in transverse direction thereof is arranged to bring the metal member and thereby metal material of the rope to move in transverse direction of the rope into the magnet field, within the magnetic field or out from the magnetic field, such that a change in the magnetic field, in particular flux thereof, is caused.

[0013] In a preferred embodiment, the rope is a belt and substantially larger in width direction than thickness direction thereof, and said transverse direction of the rope is the width direction of the rope.

[0014] In a preferred embodiment, the rope is positioned such that the metal member and thereby metal material passes beside the magnet field in transverse direction of the rope, and movement of the rope in transverse direction thereof is arranged to bring the metal member to move in transverse direction of the rope into the magnet field.

[0015] In a preferred embodiment, the rope is positioned such that the metal member and thereby metal material passes through the magnet field, and movement of the rope in transverse direction thereof is arranged to move the metal member in transverse direction of the rope in the magnet field

[0016] In a preferred embodiment, the metal material covers the whole length of the rope.

[0017] In a preferred embodiment, the metal member is a longitudinal member made of metal and extending parallel with the longitudinal direction of the rope throughout the length of the rope.

[0018] In a preferred embodiment, the metal member is a metal wire.

[0019] In a preferred embodiment, the detection means are configured to detect changes in the magnetic flux of the magnet field.

[0020] In a preferred embodiment, the detection means comprises a sensor for sensing one or more properties of the flux of the magnetic field.

[0021] In a preferred embodiment, the sensor is a hall effect sensor.

[0022] In a preferred embodiment, the means for generating a magnet field comprise at least one magnet, such as a permanent magnet or electromagnet, which is located beside the rope.

[0023] In a preferred embodiment, the rope is connected with a load to be hoisted. The rope can be a suspension rope suspending said load, whereby position thereof is likely to be critical for safety of the hoisting device. In case of an elevator, said load comprises an elevator car.

[0024] In a preferred embodiment, the elevator comprises one or more ropes that pass around one or more rope wheels mounted in proximity of the upper end of the hoistway. In the presented embodiment, the elevator comprises a machinery and said one or more rope wheels includes a drive wheel rotated by a motor comprised in the machinery for thereby moving the elevator car. In addition to said motor, the machinery preferably also comprises a mechanical brake for braking rotation of the drive wheel. The elevator preferably furthermore comprises a control means, such as an electronic control system for controlling the machinery.

[0025] In a preferred embodiment, relative positioning of the sensor and the magnetic field is such that the sensor is at least partially within the magnet field 4a generated.

[0026] In a preferred embodiment, the rope comprises one or more load bearing members, each extending parallel with the longitudinal direction of the rope unbroken throughout the length of the rope.

[0027] In a preferred embodiment, each said load bearing member is embedded in a coating forming the outer surface of a rope.

[0028] In a preferred embodiment, the one or more load bearing members are each non-metallic.

[0029] In a preferred embodiment, the metal member and thereby the metal material is separate from the load bearing members.

[0030] In a preferred embodiment, the metal member and thereby the metal material and the load bearing members and embedded in a coating.

[0031] In a preferred embodiment, the coating isolates the metal member and thereby the metal material from the load bearing members.

[0032] In a preferred embodiment, the load bearing members are each made of composite material comprising reinforcing fibers embedded in polymer matrix. Said reinforcing fibers are preferably carbon fibers or glass fibers.

[0033] In a preferred embodiment, the arrangement for monitoring position of a rope of a hoisting device comprises a first rope wheel and a second rope wheel around which the rope is arranged to pass, and the arrangement is arranged to monitor position of a section of the rope extending between said first and second rope wheel.

[0034] In a preferred embodiment, the aforementioned sensor for sensing one or more properties of the flux of the magnetic field comprises a planar outer surface at a distance from, facing towards and extending parallel with the width directional outer side of the belt-shaped rope, and said flux of the magnetic field is directed to pass through said planar outer surface of the sensor.

[0035] The elevator is preferably such that the car thereof is configured to serve two or more vertically displaced landings. The elevator is preferably configured to control 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

[0036] 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 a preferred embodiment of an arrangement for monitoring position of a rope of a hoisting device.

Figure 2 illustrates a partial and enlarged view of Figure 1.

Figure 3 illustrates preferred details of a first embodiment of an arrangement for monitoring position of a rope of a hoisting device.

Figure 4 illustrates preferred details of a second embodiment of an arrangement for monitoring position of a rope of a hoisting device.

Figures 5 illustrates a block diagram of the arrangement for monitoring position of a rope of a hoisting device.

Figures 6 and 7 illustrate preferred details of the load bearing member of the rope. The foregoing aspects, features and advantages of the invention will be apparent from the drawings and the detailed description related thereto.

DETAILED DESCRIPTION

[0037] Figure 1 illustrates a preferred embodiment of an arrangement 1,1' for monitoring position of a rope 2,2' of a hoisting device. The hoisting device is in this embodiment an elevator comprising a hoistway H and elevator car 7 and a counterweight 8 vertically movable in the hoistway H. The elevator comprises one or more ropes 2,2' that pass around one or more rope wheels 9,9' mounted in proximity of the upper end of the hoistway H. Said one or more rope wheels 9,9' can be mounted inside the upper end of the hoistway H, but alternatively it could be mounted inside a a machine room space beside or above the upper end of the hoistway H, for example. In the presented embodiment, the elevator comprises a machinery 10 and said one or more rope wheels 9,9' includes a drive wheel 9 rotated by a motor comprised in the machinery 10 for thereby moving the elevator car 7. There are of course also other alternative ways to provide the motive force to the car 7. In addition to said motor, the machinery 10 preferably also comprises a mechanical brake for braking rotation of the drive wheel 9. The elevator preferably furthermore comprises a control system 6 for controlling the machinery, and particularly for controlling rotation of the motor thereof and said brakes, whereby the movement of the car 7 is also made controllable.

[0038] Figure 2 illustrates a partial and enlarged view of the arrangement 1,1' for monitoring position of the rope 2,2' of Figure 1. The arrangement 1,1' comprises a means 4 for generating a magnet field 4a; and a rope 2,2'. The rope has been provided to comprise metal material 3,3', and it is positioned such that metal material 3,3' of the rope 2,2' passes through or beside the magnet field 4a generated by said means 4. Said means 4 can be formed by at least one magnet located beside the rope 2, which magnet can be a permanent magnet or an electric magnet, for instance. The arrangement 1,1' further comprises a detection means 5 for detecting changes in said magnet field. The magnet field 4a and the metal material 3,3' has been illustrated in Figures 3 and 4. These Figures illustrate alternative ways to implement the solution of Figures 1 and 2.

[0039] The hoisting device comprises a control system 6, such as an electronic control system, arranged to perform one or more predefined actions in response to detection of a change, in particular a predefined change, in said magnetic field. The control system 6 can be the same control system responsible for controlling the machinery 10 as described earlier above. The one or more actions preferably include stopping of movement of the load 7 to be hoisted, which is in the presented embodiment the car 7. Said stopping preferably comprises braking the movement of the load 7 to be hoisted. The one or more actions preferably additionally or alternatively include sending of a signal such as an alarm signal. By any of these actions, the hoisting device can be brought towards a safer state. Said predefined change in said magnetic field can be any change associated with an unsafe displacement of the rope 2,2'.

[0040] Figures 3 and 4 each present an embodiment, where the rope 2,2' comprises a metal member 3,3' made of metal material 3,3'. Generally, the metal material 3,3' changes the flux of the magnet field 4a, should it move in transverse direction of the rope 2,2' into the magnet field 4a, within the magnetic field 4a or out from the magnetic field 4a. The changes are detectable by a detection means 5 for detecting changes in said magnetic field 4a.

[0041] The metal material 3,3' preferably covers the whole length of the rope 2. In embodiments of Figures 3 and 4, the metal member 3,3' is a longitudinal member 3,3' made of metal and extending parallel with the longitudinal direction of the rope throughout the length of the rope 2,2'. Preferably, the metal member 3,3' is a metal wire.

[0042] In the embodiment of Figure 3, the rope 2 is positioned such that the metal member 3 passes through the magnet field 4a generated by said means 4. Should the rope 2 move in transverse direction w thereof, this would be detected. Changes in position of metal material in the magnet field 4a cause changes in the flux of the magnet field 4a, which are detectable. Particularly, in this embodiment movement of the rope 2 in transverse direction w thereof is arranged to bring the metal member 3, and thereby metal material 3,3' to move in transverse direction w of the rope 2 relative to the magnetic field 4a, in particular within the magnetic field 4a or even out from the magnetic field 4a, which each cause a change in the flux of the magnetic field 4a. In the embodiment of Figure 3, the rope 2 is a belt and substantially larger in width direction w than thickness direction t thereof, and said transverse direction w of the rope 2 is the width direction w of the rope 2. Thus, displacement of the rope 2 in width direction thereof from its intended course can be detected. This direction is a critical direction for a belt shaped rope 2, because drifting excessively sideways could lead to improper guidance and eventually falling of the rope 2 away from the circumference of rope wheels 9,9' guiding the passage thereof.

[0043] The detection means 5 are configured to detect changes in the magnetic flux of the magnet field 4a. The detection means 5 comprises a sensor 5a for sensing one or more properties of the flux of the magnetic field 4a. Preferably, the sensor 5a is a hall effect sensor 5a, which is a transducer that varies its output voltage in response to a magnetic field. The relative positioning of the sensor 5a and the magnetic field 4a is preferably such that the sensor 5a is at least partially within the magnet field 4a generated.

[0044] In the embodiment of Figure 4, the rope comprises two of said metal members 3', and for each said metal member 3'a means 4 for generating a magnet field 4a; and a detection means 5 for detecting changes in said magnetic field 4a. The rope 2 is positioned such that each metal member 3' passes beside the magnet field 4a generated by said means 4. Should the rope 2 move in transverse direction w thereof such that a metal member 3' penetrates a magnet field 4a, this would be detected. This is because penetration of metal material in the magnet field 4a causes changes in the flux of the magnet field 4a, which are detectable.

[0045] There being two means 4 or generating a magnet field 4a, there are two magnet fields 4a. These are displaced in width direction of the rope 2', and the two metal members 3' of the rope 2' are both between the magnet fields 4a of the two means 4. The two metal members 3' of the rope 2' are furthermore positioned on opposite sides of the rope 2' in width direction w of the rope 2' whereby they can pass very close beside the magnetic fields 4a.

[0046] In this embodiment, movement of the rope 2' in transverse direction w thereof is arranged to bring a metal member 3', and thereby metal material to move in transverse direction w of the rope 2' relative to the magnetic field 4a, in particular into the magnet field 4a, such that a change in the flux of the magnetic field 4a is caused.

[0047] In this embodiment, the rope 2' is a belt and substantially larger in width direction w than thickness direction t thereof, and said transverse direction w of the rope 2' is the width direction w of the rope 2'. Thus, displacement of the rope 2' from its intended course in width direction w thereof can be detected. This direction is a critical direction for a belt shaped rope 2', because drifting excessively sideways could lead to improper guidance and eventually falling of the rope 2' away from the circumference of rope wheels 9,9' guiding the passage thereof.

[0048] The detection means 5 are configured to detect changes in the magnetic flux of the magnet field 4a. The detection means 5 comprises a sensor 5a for sensing one or more properties of the flux of the magnetic field 4a. Preferably, the sensor 5a is a hall effect sensor 5a, which is a transducer that varies its output voltage in response to a magnetic field. The relative positioning of the sensor 5a and the magnetic field 4a is preferably such that the sensor 5a is at least partially within the magnet field 4a generated.

[0049] In both of the embodiments of Figures 3 and 4, the rope 2,2' comprises one or more load bearing members 11, each extending parallel with the longitudinal direction 1 of the rope 2,2' unbroken throughout the length of the rope 2,2'. The rope 2,2' furthermore comprises a coating 12 forming the outer surface of the rope 2,2'. In each case, each said metal member 3,3' and thereby the metal material, as well as the load bearing members 11 are embedded in the coating 12. The coating 12 is preferably a polymer coating comprising polymer material such as polyurethane. It is preferably an elastomer coating.

[0050] It is preferred that the metal member 3,3', and thereby the metal material, is separate from the load bearing members 11, as illustrated. This is implemented such that the coating 12 isolates the metal member 3,3' and thereby the metal material from the load bearing members 11. In the embodiment illustrated in Figure 3, the metal member 3 is in width direction w between two load bearing members 11. In the embodiment illustrated in Figure 4, the two metal members 3' are positioned on opposite sides of the rope 2' in width direction w of the rope 2'.

[0051] The one or more load bearing members 11 are preferably each made of non-metallic material. Most preferably they are made of composite material comprising reinforcing fibers f embedded in polymer matrix m. Thus, they are lightweighted yet they have good load bearing abilities. These properties are particularly facilitated if the reinforcing fibers are carbon fibers, but they could alternatively be some other fibers such as glass fibers.

[0052] Figure 6 illustrates a preferred inner structure for said load bearing member 11, showing inside the circle an enlarged view of the cross section of the load bearing member 11 close to the surface thereof, as viewed in the longitudinal direction 1 of the load bearing member 11. The parts of the load bearing member 11 not showed in Figure 6 have a similar structure. Figure 7 illustrates the load bearing member 1 three dimensionally. The load bearing member 11 is made of composite material comprising reinforcing fibers f embedded in polymer matrix m. 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. 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 reinforcing fibers f are distributed substantially evenly in polymer matrix m and bound to each other by the polymer matrix m. The load bearing member 11 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, substantially all the reinforcing fibers f of each load bearing member 11 are parallel with the longitudinal direction of the load bearing member 11. Thereby, the fibers f are also parallel with the longitudinal direction of the rope 2,2' as each load bearing member 11 are to be oriented parallel with the longitudinal direction of the rope 2,2'. This is advantageous for the rigidity as well as behavior in bending. Owing to the parallel structure, the fibers in the rope 2,2' will be aligned with the force when the rope 2,2' is pulled, which ensures that the structure provides high tensile stiffness. The fibers f used in the preferred embodiments are accordingly substantially untwisted in relation to each other, which provides them said orientation parallel with the longitudinal direction of the rope 2,2'. 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 11, preferably continuing for the whole length of the load bearing member 11.

[0053] As mentioned, the reinforcing fibers f are preferably distributed in the aforementioned load bearing member 11 substantially evenly. The fibers f are then arranged so that the load bearing member 11 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 2,2'. Owing to the even distribution, the fiber density in the cross-section of the load bearing member 11 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.

[0054] 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.

[0055] Preferably over 50% proportion of the surface area of the cross-section of the load bearing member 11 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 11 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 member 11 is preferably completely non-metallic, i.e. made not to comprise metal.

[0056] In the preferred embodiments, an advantageous structure for the load bearing member 11 and the rope 2,2' has been disclosed. However, the invention can be utilized with also other kind of the load bearing members and the ropes such as with those having different materials and/or shapes. The number of load bearing members 11 could also be different, such as greater or smaller, than what is illustrated. The positioning of the metal material could also be different. It is, for example not necessary that the metal material is in the form of a continuous metal member, because it is possible that the metal material is formed by a large number of small metal particles embedded in the coating and even though not being as themselves continuous, they together form a continuous array of metal material covering the whole length of the rope.

[0057] In the preferred embodiments, the means 4 for generating a magnet field 4a have been placed on opposite sides of the rope 2,2 as the detection means 5 for detecting changes in said magnetic field 4a. However, this is not necessary because the means 4 for generating a magnet field 4a could alternatively be placed on the same side of the rope 2,2' as the detection means 5 for detecting changes in said magnetic field 4a.

[0058] As mentioned, the control means 6 is preferably arranged to perform one or more predefined actions in response to detection of a predefined change in said magnetic field 4a. The control means 6 then preferably compares a detection with a threshold stored in a memory of the control means 6. The arrangement can work for example such that in normal operation, when rope is in correct position, magnetic field is static and output signal of the detector e.g. a hall effect sensor is a certain DC-voltage (proportional to the magnetic field). The detected exact voltage level then depends on the measurement configuration, such as relative placement of the sensor and the magnet field generating means 4 (e.g. a magnet). If the rope 2,2' moves out of the desired position, sensor output voltage changes; it may increase or decrease depending on the rope movement and measurement configuration. If voltage changes such that a pre-defined threshold is exceeded, the control means 6 is triggered to perform said one or more predefined actions. Generally, the control means 6 can be understood broadly to represent a control means which can be in the form of a control system responsible for a small number or great number of control tasks of the elevator. The control means 6 can physically be of centralized or uncentralized kind.

[0059] 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. An arrangement (1,1') for monitoring position of a rope (2,2') of a hoisting device, the arrangement comprising

a means (4) for generating a magnet field (4a);
a rope (2,2') comprising metal material (3,3'), the rope (1,1') being positioned such that metal material (3,3') of the rope (2,2') passes through or beside the magnet field (4a) generated by said means (4);
a detection means (5) for detecting changes in said magnetic field (4a).

2. An arrangement according to claim 1, wherein the rope (2,2') comprises a metal member (3,3'), which is made of metal material (3,3'), the rope (1,1') being positioned such that the metal member (3,3') passes through or beside the magnet field (4a) generated by said means (4).

3. An arrangement according to any of the preceding claims, wherein the hoisting device comprises a control means (6) arranged to perform one or more predefined actions in response to detection of a change, in particular a predefined change, in said magnetic field (4a).

4. An arrangement according to any of the preceding claims, wherein the one or more actions include one or more of the following: stopping of movement of the load (7) to be hoisted, sending of a signal such as an alarm signal.

5. An arrangement according to any of the preceding claims, wherein movement of the rope (2,2') in transverse direction (w) thereof is arranged to bring metal material (3,3') of the rope (2,2') to move in transverse direction (w) of the rope (2,2') relative to the magnetic field (4a), such that a change in the magnetic field (4a) is caused.

6. An arrangement according to claim 5, wherein movement of the rope (2,2') in transverse direction (w) thereof is arranged to bring metal material (3,3') of the rope (2,2') to move in transverse direction of the rope (2,2') into the magnet field (4a), within the magnetic field (4a) or out from the magnetic field (4a), such that a change in the magnetic field (4a) is caused.

7. An arrangement according to any of the preceding claims, wherein the rope (2,2') is a belt and substantially larger in width direction (w) than thickness direction (t) thereof, and said transverse direction of the rope (2,2') is the width direction (w) of the rope (2,2').

8. An arrangement according to any of the preceding claims 2-7, wherein the metal member (3,3') is a longitudinal member (3,3') made of metal and extending parallel with the longitudinal direction of the rope (2,2') throughout the length of the rope (2,2').

9. An arrangement according to any of the preceding claims, wherein the metal member (3,3') is a metal wire.

10. An arrangement according to any of the preceding claims, wherein the detection means (5) are configured to detect changes in the magnetic flux of the magnet field (4a).

11. An arrangement according to any of the preceding claims, wherein the detection means (5) comprises a sensor (5a) for sensing one or more properties of the flux of the magnetic field (4a).

12. An arrangement according to any of the preceding claims, wherein the sensor (5a) is a hall effect sensor (5a).

13. An arrangement according to any of the preceding claims, wherein the rope (2,2') comprises one or more load bearing members (11), each extending parallel with the longitudinal direction (1) of the rope (2,2') unbroken throughout the length of the rope (2,2').

14. An arrangement according to any of the preceding claims, wherein each said load bearing member (11) is embedded in a coating (12) forming the outer surface of the rope (2,2').

15. An arrangement according to any of the preceding claims, wherein the one or more load bearing members (11) are each non-metallic, the load bearing members (11) preferably being each made of composite material comprising reinforcing fibers (f) embedded in polymer matrix (m), said reinforcing fibers (f) preferably being carbon fibers or glass fibers.

16. An arrangement according to any of the preceding claims, wherein the metal material (3, 3') is separate from the load bearing members (11).

17. An arrangement according to any of the preceding claims, wherein the arrangement (1,1') for monitoring position of a rope (2,2') of a hoisting device comprises a first rope wheel (9') and a second rope wheel (9) around which the rope (2,2') is arranged to pass, and the arrangement is arranged to monitor position of a section of the rope (2,2') extending between said first and second rope wheel (9, 9').

Fig. 1

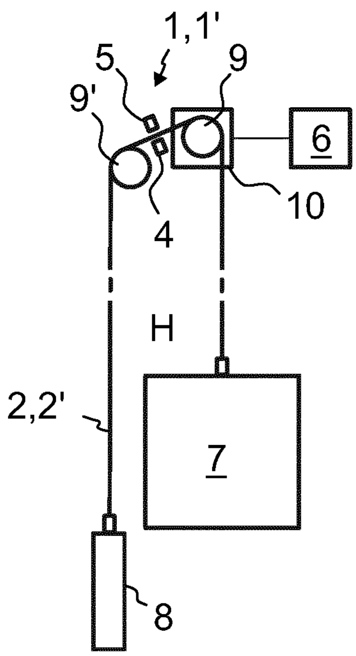


Fig. 2

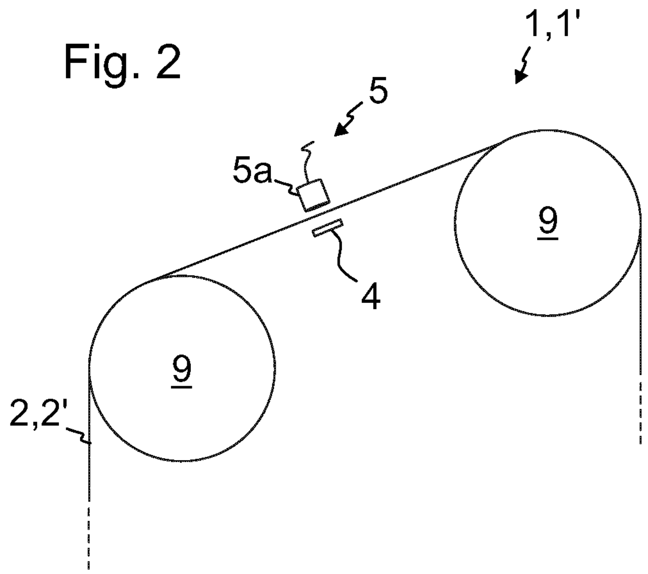


Fig. 3

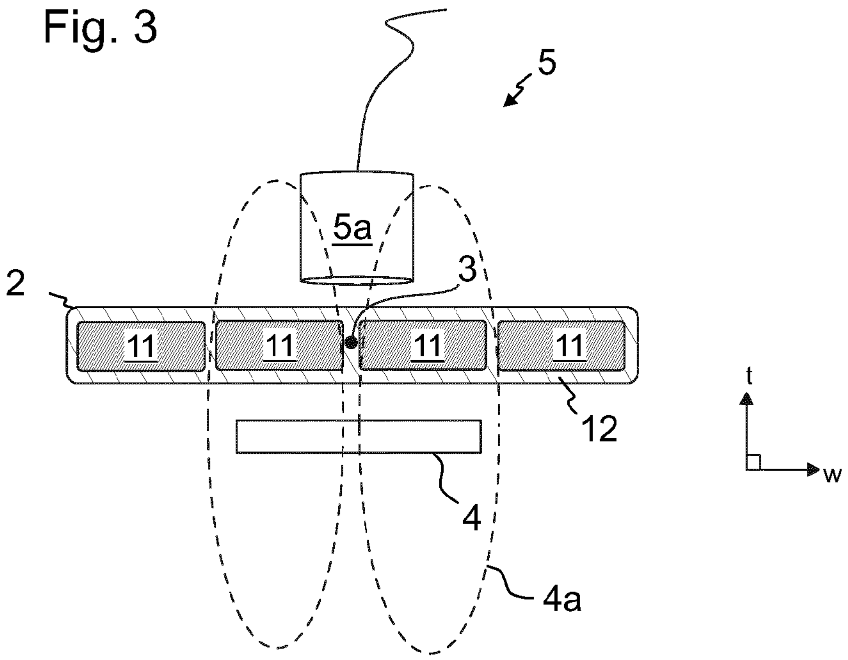


Fig. 4

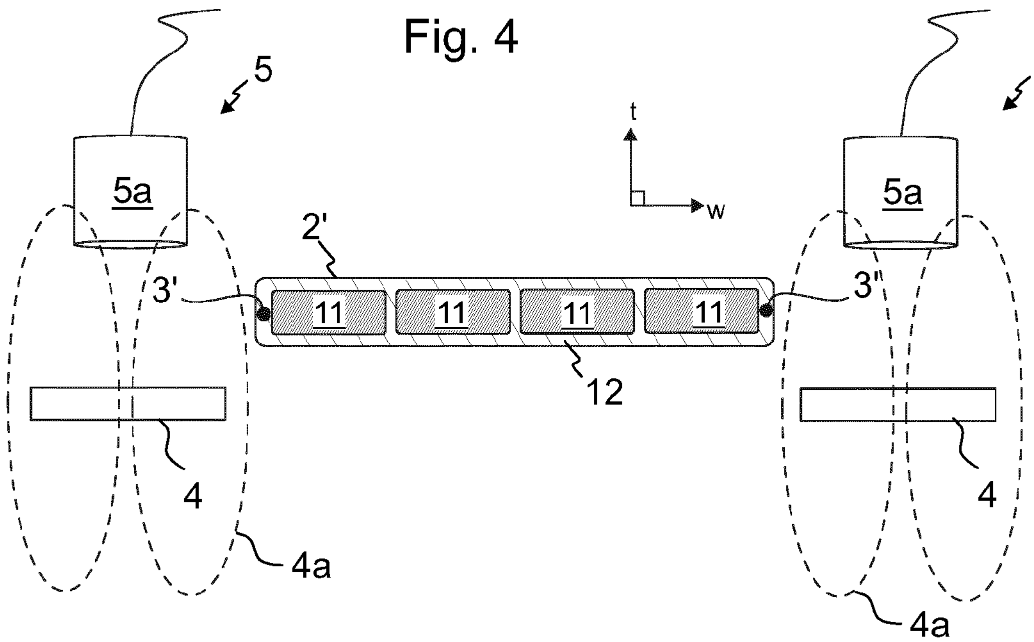


Fig. 5

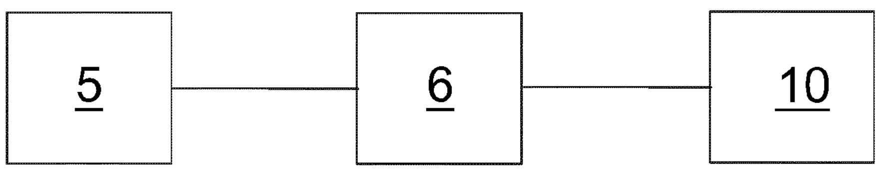


Fig. 6

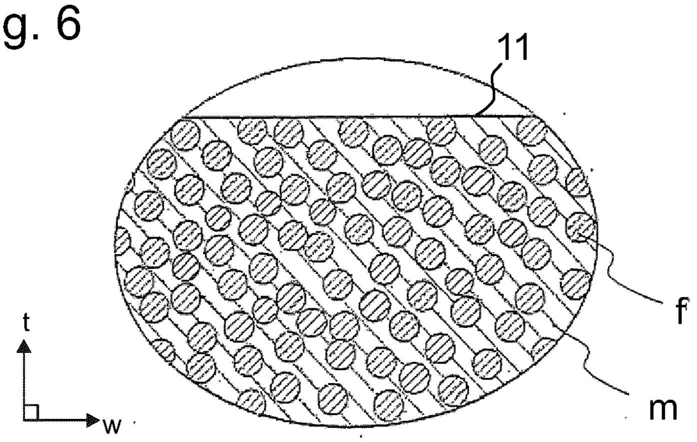
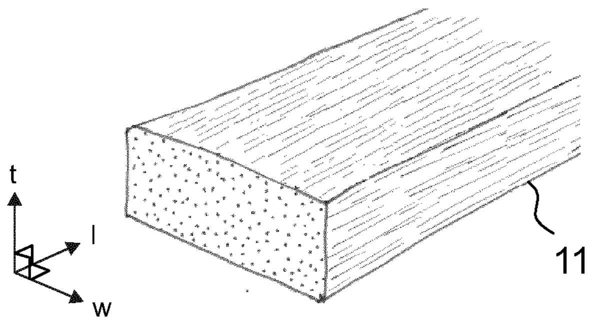


Fig. 7



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Application Number
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Place of search	Date of completion of the search	Examiner
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