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(54) ELEVATOR SYSTEMS

(57) Elevator systems are disclosed. The elevator systems comprise an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path, a pair of taut cables arranged laterally from the cabin, one or more cable guides attached to the cabin and one or more wirefixes coupled around the taut cables, attached to the elevator path and configured to pass through the cable guides during vertical motion of the cabin. The elevator systems further comprise an upper or lower damping element provided around a portion of the taut cables at or near one of the top and bottom of the elevator path such that vibrations of the taut cables are absorbed by the upper or lower damping element. Methods for retrofitting an elevator system are also disclosed.

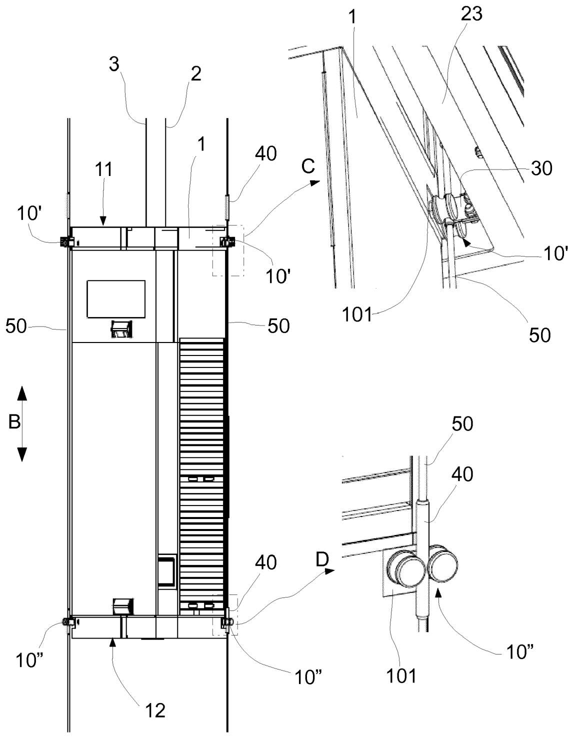

FIG. 2

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Description

[0001] The present disclosure relates to elevator systems, particularly service elevator systems configured for use in wind turbine towers. The present disclosure further relates to wind turbines comprising such elevator systems and to methods for retrofitting existing elevator systems arranged, for example, in wind turbines towers.

BACKGROUND

[0002] Modern wind turbines are commonly used to supply electricity into the electrical grid. Wind turbines generally comprise a rotor mounted on top of a wind turbine tower. The rotor has a rotor hub and a plurality of blades. The rotor is set into rotation under the influence of the wind on the blades. The operation of the generator produces the electricity to be supplied into the electrical grid.

[0003] When maintenance works are required inside wind turbines, hoists are often used in the form of elevator-like structures where a lift platform or a cabin for the transportation of people and/or equipment is hoisted up and down within the wind turbine tower. Wind turbines are often provided with working platforms arranged at various altitudes along the height of the tower with the purpose of allowing workers to leave the cabin and inspect or repair equipment where intended or needed. These sorts of elevator systems are also known in other applications, such as e.g. factories, construction sites, and all sorts of towers.

[0004] Elevator systems in general include an elevator car or cabin that is suspended within a hoistway or elevator path by wire ropes. The term wire rope is herein used to denote a relatively thick cable. But in the art, the terms cables and wire ropes are often used interchangeably. In some systems, e.g. for some electric elevators, a counterweight may be provided, depending *inter alia* on the available space. Other systems such as hydraulic elevators normally do not comprise a counterweight.

[0005] Different ways of driving elevator systems are known. Examples of driving systems may use one or more traction wire ropes in combination with a traction sheave driven by e.g. a motor. Alternatively, the driving system may be defined by a rack and pinion engagement. In these cases, the rack is usually provided along the elevator path and the pinion is usually arranged in the elevator cabin and a motor for driving the pinion may be mounted in or on the elevator cabin.

[0006] Wind turbines are high slender structures that are usually supported by a closed tower. Wind turbine elevator systems are thus protected from outside atmospheric conditions. Nevertheless, due to wind forces, the high and slender tower may oscillate significantly. And wind forces may further be increased by rotor rotation. To reduce oscillations of the cabin, it is known to provide a system for stabilizing the vertical motion of the cabin. Such systems may comprise a substantially rigid guide and a guide component attached to the cabin. In addition the rigid guide may comprise a fastening element (e.g. a wirefix) coupled to the rigid guide and that is configured to traverse (pass through) the guide component as the cabin moves vertically inside the tower. Document WO2010056766 describes such stabilization devices.

[0007] Examples of known stabilization devices involve e.g. a pair of taut lines or cables running laterally from the elevator cabin and extending all the way from the top to the bottom of the elevator path (inside of the wind turbine tower). In these examples, the taut lines are under tension thus defining relatively rigid guiding means for the cabin. This way the elevator cabin runs in a substantially controlled manner guided by the taut lines.

[0008] In offshore wind turbines, to the wind forces, forces exerted by waves, currents and tides have to be added. Particularly, the taut lines guiding the elevator cabin may also begin to move and sway within the elevator path of offshore wind turbine towers. This may result in the taut lines repeatedly touching their guide components and/or fastening elements. Such a repetitive contact between the taut lines and their fixations may lead to wear of the guide components and/or fastening elements and also, in circumstances, wear of the taut lines themselves. This is most prominent in higher and more powerful wind turbines, e.g. MW class.

[0009] There is thus a need for safe, reliable and effective elevator systems which can easily extend the life of taut lines guiding the elevator cabin including their fixations that are arranged in offshore wind turbine towers and that are also cost-effective and simple to retrofit *in-situ* without dismantling the taut lines thereby reducing maintenance time.

[0010] Even though the present disclosure particularly relates to wind turbines, examples of the methods and systems disclosed herein may also be applied in other relatively high structures.

SUMMARY

[0011] In accordance with a first aspect, an elevator system is provided. The elevator system comprises an elevator cabin configured to run along an elevator path and an uppermost position close to a top of the elevator path. The elevator system further comprises a pair of taut cables arranged laterally from the cabin. The taut cables extend from the top to the bottom of the elevator path for guiding vertical motion of the cabin. The elevator system also comprises one or more cable guides attached to the cabin. The cable guide comprises a through-channel configured such that the taut cables can pass through it. And the elevator system further comprises a sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near one of the lowermost position and uppermost position such that vibrations of the taut cables are absorbed by the sleeve when the elevator cabin is at or near either the lowermost position or the uppermost position.

[0012] According to this aspect, the sleeve made of damping material (i.e. damping sleeve) absorbs/attenuates, at least in part, vibrations and/or oscillations produced in the taut cable that guides the elevator cabin, e.g. inside an offshore wind turbine tower. Particularly in offshore wind turbines these vibrations may occur e.g. when wind forces acting on the blades (supported on top of the tower) are further increased with forces exerted by waves, currents and/or tides. By reducing vibrations and/or oscillations of the taut cable, repetitive contact (and premature wear) between the taut cable and the cable guides are also reduced thus extending lifetime of cable guides and of the taut cables themselves.

[0013] Furthermore, by providing the damping sleeve either at or near the lowermost position or the uppermost position of the elevator cabin, absorption of taut cable vibrations is done at the most typical resting positions of the elevator cabin along the elevator path. This means, where it is most needed. For example, in offshore wind turbines the lowermost position of the cabin may be the position at which the cabin is normally left when maintenance tasks are completed and personnel leaves the wind turbine. And the uppermost position of the cabin may be such a position at which the cabin is normally left during maintenance tasks inside, e.g. the rotor hub. Alternatively, maintenance personnel may arrive e.g. in helicopter and reach the tower through the nacelle. Therefore, these two positions are the most typical resting positions and may last for various weeks or even months.

[0014] Throughout the present disclosure, an elevator path is to be understood as a space or passage through which the elevator cabin can travel upwards and downwards. In a wind turbine tower, the elevator path is thus defined inside the tower. There may be a closed space inside the tower along which the cabin travels. Alternatively, the space inside the tower may be open.

[0015] In some examples, the damping sleeve may be provided around the portion of the taut cables that is arranged within the cable guide when the cabin is only at one of the lowermost position and uppermost position such that vibrations of the taut cables are absorbed by the damping sleeve when the elevator cabin is at either the lowermost position or the uppermost position.

[0016] In some examples, the elevator system may comprise a bottom sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the lowermost position and a top sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the uppermost position such that vibrations of the taut cables when the elevator cabin is at or near the uppermost and lowermost positions are absorbed by the damping sleeves. This way, two well-defined dampening areas are provided along the elevator path, which substantially correspond to the most common resting positions for the elevator cabin.

[0017] In some of these cases, the bottom and top damping sleeves may be provided around the portion of the taut cables that is arranged within the cable guide when the cabin is only at the lowermost and uppermost positions. In another aspect, an elevator system is provided, which comprises an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path. The elevator system further comprises a pair of taut cables arranged laterally from the cabin. The taut cables extend from the top to the bottom of the elevator path for guiding vertical motion of the cabin. The elevator system also comprises one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path. The wirefixes are configured to pass through cable guides of the elevator cabin during vertical motion of the cabin. One or more wirefixes is a wirefix damper comprising an inner bushing made of damping material (i.e. damping bushing) and provided in contact with the taut cables to dampen vibrations of the taut cables. The wirefix damper is attached to the taut cables at or near one of the bottom of the elevator path and the top of the elevator path such that vibrations of the taut cables are absorbed by the damping bushing when the elevator cabin is at or near either the lowermost position or the uppermost position.

[0018] According to this aspect, in a similar manner as explained in connection with the elevator system of the first aspect, the provision of at least one wirefix damper having an inner damping bushing arranged in contact with the taut cables provides attenuation/absorption of vibrations of the taut cables. This reduces wear of the taut cables and of the cable guides through which the taut cables may be guided. Furthermore, by providing the wirefix damper (including an inner damping bushing) at or near one of the top and bottom of the elevator path, absorption of taut cable vibrations is done at positions along the elevator path that usually involve straight portions of the elevator path thus they allow for some play (provided by the damping bushing) to absorb vibration (and reduce wear). Other portions of the elevator path may involve steepness or turnings so less play can be permitted at such positions.

[0019] In some examples, the wirefix damper may be attached to the taut cables only at one of the top or bottom of the elevator path such that vibrations of the taut cables are absorbed by the damping bushing when the elevator cabin is at either the lowermost position or the uppermost position.

[0020] In some examples, the elevator system may further comprise a further wirefix damper attached to the taut cables at or near the other of the bottom of the elevator path or the top of the elevator path such that vibrations of the taut cables are absorbed by the damping bushings of the wirefix dampers when the elevator cabin is at or near the uppermost and lowermost positions. By providing a further wirefix damper at or near another portion of the taut cables, two well-defined dampening areas are provided along the elevator path. Particularly, these two well-defined areas substantially correspond to the most common resting positions of the elevator cabin.

[0021] In some examples, the wirefixes and/or the wirefix dampers may be made up from two halves. Wirefix dampers made up from two halves may further comprise inner bushings made of damping material and made up from two halves. These types of wirefixes and/or wirefix dampers are easy (simple and fast) to retrofit in existing elevator systems without dismantling the taut cables guiding the elevator cabin. The fact that the taut cables do not need to be dismantled simplifies retrofitting tasks while lifetime of the taut cables is extended by the vibration attenuation promoted by the dampers.

[0022] In a further aspect, a wirefix for damping vibrations of a taut cable is provided. The wirefix is configured to be coupled around the taut cable and to be attached to a fixed structure delimiting an elevator path. The wirefix comprises an inner bushing made of damping material and configured to contact the taut cable when the wirefix is coupled around the taut cable. The wirefix is made up from two halves and the inner damping bushing is made up from two halves. An aspect of providing wirefixes and/or wirefix dampers made up from two halves it that they can be easily (simple and fast) mounted around an already installed taut cable guiding the elevator cabin. This means that they are simple, fast and cost-effective to retrofit in existing elevator systems so as to provide vibration/oscillation absorption without dismantling the taut cables.

[0023] In yet a further aspect, a method for retrofitting an elevator system is provided. The elevator system comprises an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path and a pair of taut cables arranged laterally from the cabin. The taut cables extend from the top to the bottom of the elevator path for guiding vertical motion of the cabin. The elevator system further comprises one or more cable guides attached to the cabin. The cable guide comprises a through-channel configured such that the taut cable can pass through it. The method comprises selecting a portion of the taut cables that is arranged within the cable guide when the cabin is at a rest position, placing a mold around the selected portion of the taut cables, injecting a damping material in fluid state into the mold; and opening the mold when the damping material is cooled so as to obtain a damping sleeve around the selected portion of the taut cables.

[0024] According to this method, existing elevator systems wherein the elevator cabin is guided, e.g. by a pair of taut cables arranged laterally from the elevator cabin, may be retrofitted in a relatively simple, fast and cost effective manner without dismantling the taut cables. This way, the retrofitted elevator systems are provided with the additional functionality substantially as herein disclosed, i.e. vibration/oscillation absorption thereby reducing repetitive contact between taut cables guiding the cabin and the cable guides through which the taut cables are guided.

[0025] In yet a further aspect, a method for retrofitting an elevator system is provided. The elevator system comprises an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path and a pair of taut cables arranged laterally from the cabin. The taut cables extend from the top to the bottom of the elevator path for guiding vertical motion of the cabin. The elevator system further comprises one or more wirefixes coupled around the taut cables and fixed to the elevator path. The wirefixes are configured to pass through cable guides of the elevator cabin during vertical motion of the cabin. The method comprises selecting one of an uppermost and lowermost wirefix arranged around a portion of the taut cables, removing the selected wirefix, providing a wirefix made from two halves with an inner damping bushing also made from two halves, and putting together two halves of the wirefix and the inner damping bushing around the selected portion of the taut cables.

[0026] According to this method, other way of retrofitting existing elevator systems wherein the elevator cabin is guided, e.g. by a pair of taut cables arranged laterally from the elevator cabin, may be provided. This method is also relatively simple, fast and cost effective to retrofit without dismantling the taut cables. And again with this method, the retrofitted elevator systems are provided with the additional functionality substantially as herein disclosed, i.e. vibration/oscillation absorption thereby reducing repetitive contact between taut cables guiding the cabin and the wirefixes supporting the taut cables as well as repetitive contact between the taut cables and cable guides through which the taut cables (with wirefixes or not) are guided.

[0027] In a still further aspect, an elevator system is provided. The elevator system comprises an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path and a pair of taut cables arranged laterally from the cabin. The taut cables extend from the top to the bottom of the elevator path for guiding vertical motion of the cabin. The elevator system also comprises one or more cable guides attached to the cabin. The cable guide comprises a through-channel configured such that the taut cables can pass through it. The elevator system comprises one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path. The wirefixes are configured to pass through the cable guides during vertical motion of the cabin. And the elevator system further comprises an upper or lower damping element provided around a portion of the taut cables at or near one of the top and the bottom of the elevator path such that vibrations of the taut cables are absorbed by the upper or lower damping element when the elevator cabin is at or near either the uppermost position or the lowermost position.

[0028] Throughout the present description and claims, a damping element is an accessory capable of absorbing energy that when provided at least in part surrounding a substantially rigid element (e.g. a taut cable or taut wire), absorbs/dampens/attenuates vibrations and/or oscillations of the rigid element. Examples of damping elements may be made from damping materials or shock absorbing materials such as elastomers, natural rubber and/or shock absorbing gels. Particularly, elastomeric sleeves and elastomeric bushings made of self-levelling silicone potting agent (e.g. commercially available from Sika Schweiz AG as Sikasil® AS-787 SL) may be foreseen. Other examples may comprise nitrile based rubber, chloroprene rubber, ethylene propylene rubber (e.g. EPDM/M-class rubber, EPM), butyl rubber, fluoro rubber, silicon rubber, high-strength silicon rubber, low-elasticity rubber (e.g. commercially available from Naigai Rubber Industry Co., Ltd as Hanenaito®) and/or urethane-based synthetic rubber.

[0029] In some examples, the upper or lower damping element may be provided around the portion of the taut cables only at one of the top or bottom of the elevator path such that vibrations of the taut cables are absorbed by the upper or lower damping element when the elevator cabin is only at either the uppermost or lowermost positions.

[0030] Furthermore, as explained above, damping elements substantially as hereinbefore described may be easily retrofitted onto existing elevator systems as long as they have a cabin guided by a pair of taut cables or wires. Moreover, these damping elements may be fitted in relatively small areas surrounding the taut cables thus not hindering vertical motion of the elevator cabin.

[0031] In still a further aspect, a wind turbine comprising any of the elevator systems substantially as herein described is provided. The elevator system is arranged within a wind turbine tower. In some examples, the wind turbine may be an offshore wind turbine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] Non-limiting examples of the present disclosure will be described in the following, with reference to the appended drawings, in which:

Figure 1 shows an offshore wind turbine tower comprising an elevator system;

Figure 2 shows a partial front view of an elevator system according to an example;

Figure 3 shows some steps of a method for retrofitting an elevator system according to the example of figure 1; and

Figure 4 shows a wirefix damper according to an example.

DETAILED DESCRIPTION OF EXAMPLES

[0033] In these figures the same reference signs have been used to designate matching elements.

[0034] Figure 1 schematically shows an offshore wind turbine tower comprising an elevator system. The elevator system comprises a car or cabin 1 configured to run along an elevator path 20 between a lowermost position L at or near a bottom 21 of the elevator path 20 and an uppermost position U at or near a top 22 of the elevator path 20. The uppermost U and lowermost L positions are the two most common resting positions of the cabin 1 along the elevator path 20. The lowermost position L is the position at which maintenance personnel enters and leaves the cabin 1 and the uppermost position U is the position at which the cabin 1 reaches e.g. a nacelle of the wind turbine. An enlarged detail A of figure 1 further shows the cabin 1 being stopped (resting) at the uppermost position U, e.g. during maintenance tasks inside the nacelle or a rotor hub.

[0035] In examples, various working platforms (or other intermediate stopping positions) may be provided along the elevator path. In circumstances, the elevator system may stop at any of the working platforms.

[0036] Figure 2 shows a partial front view of an elevator system according to an example. The elevator system comprises a cabin 1 configured to move up and down (arrow B) along the elevator path (see figure 1) driven e.g. by a traction wire rope 2. In alternative examples, more than one traction wire ropes may be provided. In the example of figure 2, a safety wire rope 3 is also provided. In alternative examples, other driving systems may be foreseen, e.g. a rack and pinion engagement.

[0037] According to this example, the elevator cabin 1 is guided by a pair of taut cables 50 arranged laterally from the elevator cabin 1. The taut cables 50 extend from the top to the bottom of the elevator path (see figure 1) and are under tension. Due to this tension they become relatively rigid thereby being suitable as a cabin guiding means.

[0038] Further in this example, the elevator cabin 1 is provided with cable guiding means arranged at each side of the elevator cabin 1 for guiding the cabin 1 along a length of the taut cables 50. In this example, an upper pair of rollers 10' is provided closer to a top 11 of the cabin 1 and a lower pair of rollers 10" is provided closer to a bottom 12 of the cabin. Alternatively, other number of cable guiding means may be provided at each side of the elevator cabin or even a single one as a function of the size of the elevator cabin and as long as there are guiding elements at both sides of the elevator cabin for guiding the cabin along the pair of taut cables.

[0039] In alternative examples, one or more pairs of rollers may be replaced by any other known cable guiding means, for example, selected from the group consisting of a tubular part, a ring, an eyelet or a substantially C-shaped profile, as long as they comprise a through-channel configured such that the taut cables can pass through it during vertical motion of the cabin. The pairs of rollers may be fixed to the cabin with a prescribed clearance or gap between the rollers to define the through-channel allowing the taut cable to pass there through.

[0040] The enlarged detail C of figure 2 shows that the upper pairs of rollers 10' are rotatably mounted on a flange 101 of the cabin, e.g. mounted on bearings via a ball joint, the pairs of rollers being mounted with a clearance or gap between the rollers to allow the taut cable 50 to pass there through. A portion of the taut cable is thus arranged within the clearance or gap provided between the rollers. The flange 101 is attached to a side of the cabin 1, e.g. by screws. A wirefix 30 is coupled around the taut cables 50 and fixed to a working platform 23 of the elevator path. The clearance or gap between the pair of rollers 10' is also configured such that the wirefix 30 passes through it during vertical motion of the cabin.

[0041] In general, wirefixes may be coupled around the taut cables and attached to a structure delimiting the elevator path or to working platforms provided therewith. The pairs of rollers are thus also configured such that the wirefixes pass through them during vertical motion of the cabin.

[0042] The enlarged detail D of figure 2 shows a similar assembly lower pair of roller-wirefix as the enlarged detail C. And, an elastomeric sleeve 40 is shown. In this example, the elastomeric sleeve 40 is provided around a portion of the taut cable 50 that is arranged within the lower pair of rollers 10'' when the cabin 1 is at one of the lowermost position and uppermost position explained in connection with figure 1. This way, vibrations of the taut cables when the elevator cabin is at either the lowermost position or the uppermost position are absorbed by the elastomeric sleeve. This reduces wear caused by repetitive contact between the rollers and the taut cables when the cabin is maintained in the same position for a substantially long period that may last from various hours to various weeks or even months.

[0043] In some examples, an elastomeric sleeve may be provided around another portion of the taut cable that is arranged within e.g. the upper pair of rollers when the cabin is at the lowermost or uppermost position substantially as explained in connection with enlarged detail D of figure 2.

[0044] In more alternatives, elastomeric sleeves may be provided around other portions of the taut cables that pass through any of upper and/or lower pairs of rollers when the cabin is at the other of the lowermost and uppermost position.

[0045] In a particular example, the elastomeric sleeve(s) may be provided in a position such that when the cabin is at any of the resting positions substantially as hereinbefore explained, i.e. lowermost position and/or uppermost position, the elastomeric sleeve(s) is right in the clearance or gap provided in between the rollers of the pairs of rollers. This means that the elastomeric sleeve is provided right in between the rollers (or any other through-channel of other type of cable guiding means that may be foreseen) and the taut cables. This way, repetitive contact between the cable guiding means and the taut cable is avoided or at least reduced in the positions that are most critical, i.e. the positions where the elevator cabin may spend most time.

[0046] In further examples, a plurality of wirefixes coupled around the taut cables, along a length of the taut cables and attached to working platforms provided along the elevator path may be foreseen.

[0047] In all examples, the sleeve may be provided by injection of an elastomer in a two-part mold. This way, injection can be done *in situ* and without dismantling the taut cables. And e.g. existing offshore wind turbines can thus be easily retrofitted to extend lifetime or their taut cables guiding the elevator cabin.

[0048] Figure 3 shows some steps of a method for retrofitting an elevator system substantially as hereinbefore described. Particularly the steps of: placing a mold around the selected portion of the taut cables and opening the mold when the elastomeric material is cooled so as to obtain an elastomeric sleeve are shown.

[0049] In the example of figure 3, the mold 60 is made in two parts screwed to each other around the taut cable 50. In this example, the mold 60 comprises two positioning pins 61. And the mold may further comprise one or more injection ports for injection of the damping material in fluid state into the mold. In some examples, the method may further comprise heating the selected portion of the taut cables, e.g. up to around 10°C before placing the mold around it.

[0050] It has been found that elastomeric sleeves made from a self-levelling silicone potting agent, commercially available from Sika Schweiz AG as Sikasil® AS-787 SL perform particularly good to absorb low frequency vibrations. Curing time for these examples of elastomers was found to be around 15 minutes.

[0051] Figure 4 shows a wirefix damper 70 according to an example. The wirefix damper 70 comprises an outer wirefix component 71 and an inner elastomeric bushing 72 provided in contact with the taut cables 50 so as to damper vibrations of the taut cables 50. The wirefix component 71 is mounted on (or integrally formed in further examples) with a bracket 73 for further attachment of the wirefix damper 70 to a working platform or another structure delimiting the elevator path. And the wirefix component is also configured to pass through cable guiding means attached to the cabin during vertical motion of the cabin as explained in connection with figure 2. This way, wirefix dampers have two functions, holding the taut cable and dampening their vibrations.

[0052] In the example of figure 4, the wirefix damper 70 is made up from two halves of wirefix component 71 and two halves of inner elastomeric bushing 72. This way, they can be easily retrofitted in existing elevator systems without dismantling the taut cables by, e.g. replacing an existing wirefix with a wirefix damper substantially as hereinbefore described. For example, existing offshore wind turbines can thus be easily retrofitted with wirefix dampers substantially as hereinbefore described to extend lifetime of the taut cables guiding the elevator cabin.

[0053] Particularly, wirefix dampers as hereinbefore described may be provided at one or more of the most common resting positions of the cabin along the elevator path as shown in connection with figure 1.

[0054] Furthermore, elevator systems may be retrofitted with combinations of elastomeric sleeves as explained in connection with figure 2 and wirefix dampers as explained in connection with figure 4.

[0055] In all examples, the elevator system may further comprise a travelling cable for supplying e.g. energy and/or signals to the cabin. The travelling cable may usually be connected to a power supply at one end that may be provided at some fixed point along the elevator path and to the elevator cabin at the other end. For example in wind turbine towers, the fixed point may be a point of attachment to the wind turbine tower or to a platform arranged within the tower.

[0056] For reasons of completeness, various aspects of the invention are set out in the following numbered clauses:

Clause 1. An elevator system comprising:

an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;

a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin; and

one or more cable guides attached to the cabin, the cable guide comprising a through-channel configured such that the taut cables can pass through it;

wherein the elevator system further comprises

a sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near one of the lowermost position and uppermost position such that vibrations of the taut cables are absorbed by the sleeve when the elevator cabin is at or near either the lowermost position or the uppermost position.

Clause 2. The elevator system of clause 1, comprising a bottom sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the lowermost position and a top sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the uppermost position such that vibrations of the taut cables when the elevator cabin is at or near the uppermost and lowermost positions are absorbed by the sleeves.

Clause 3. The elevator system of any of clauses 1 or 2, wherein the cable guide is selected from the group consisting of a pair of rollers, an eyelet, a tubular part or a substantially C-shaped profile.

Clause 4. The elevator system of any of clauses 1 - 3, comprising an upper cable guide provided at or near a top part of the cabin and a lower cable guide provided at or near a bottom part of the cabin.

Clause 5. The elevator system of any of clauses 1 - 4, further comprising one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path, the wirefixes being configured to pass through the cable guides during vertical motion of the cabin.

Clause 6. The elevator system of clause 5, wherein the wirefixes are attached to working platforms arranged along the elevator path.

Clause 7. The elevator system of any of clauses 5 or 6, wherein one or more wirefixes is a wirefix damper comprising an inner bushing made of damping material and provided in contact with the taut cables to damper vibrations of the taut cables.

Clause 8. The elevator system of clause 7, wherein the wirefixes and/or the wirefix dampers are made up from two halves, the wirefix dampers made up from two halves comprising inner bushings made of damping material and made up from two halves.

Clause 9. The elevator system of any of clauses 1 - 8, wherein the damping material is an elastomer.

Clause 10. A wind turbine comprising an elevator system according to any of clauses 1 - 9 arranged within a wind turbine tower.

Clause 11. An offshore wind turbine comprising an elevator system according to any of clauses 1 - 9 arranged within a wind turbine tower.

Clause 12. An elevator system comprising:

an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;

a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin; and
one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path, the wirefixes being configured to pass through cable guides of the elevator cabin during vertical motion of the cabin; wherein one or more wirefixes is a wirefix damper comprising an inner bushing made of damping material and provided in contact with the taut cables to dampen vibrations of the taut cables, the wirefix damper being attached to the taut cables at or near one of the bottom of the elevator path and the top of the elevator path such that vibrations of the taut cables are absorbed by the bushing.

Clause 13. The elevator system of clause 12, further comprising a further wirefix damper attached to the taut cables at or near the other of the bottom of the elevator path or the top of the elevator path such that vibrations of the taut cables are absorbed by the bushings of the wirefix dampers.

Clause 14. The elevator system of any of clauses 12 or 13, wherein the wirefixes are attached to working platforms arranged along the elevator path.

Clause 15. The elevator system of any of clauses 12 - 14, wherein the wirefixes and/or the wirefix dampers are made up from two halves, the wirefix dampers made up from two halves comprising inner bushings made of damping material and made up from two halves.

Clause 16. The elevator system of any of clauses 12 - 15, wherein the cable guides comprise a through-channel configured such that the taut cables and/or the wirefixes passes through it during vertical motion of the cabin.

Clause 17. The elevator system of clause 16, further comprising a lower sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the lowermost position such that vibrations of the taut cables are absorbed by the lower sleeve when the elevator cabin is at or near the lowermost position.

Clause 18. The elevator system of any of clauses 16 or 17, further comprising an upper sleeve made of damping material and provided around a portion of the taut cables that is arranged within the cable guide when the cabin is at or near the uppermost position such that vibrations of the taut cables are absorbed by the upper sleeve when the elevator cabin is at or near the uppermost position.

Clause 19. The elevator system of any of clauses 16 - 18, wherein the cable guide is selected from the group consisting of a pair of rollers, an eyelet, a tubular part or a substantially C-shaped profile.

Clause 20. The elevator system of any of clauses 16 - 19, comprising an upper cable guide provided at or near a top of the cabin and a lower cable guide provided at or near a bottom of the cabin.

Clause 21. The elevator system of any of clauses 12 - 20, wherein the damping material is an elastomer.

Clause 22. A wind turbine comprising an elevator system according to any of clauses 12 - 21 arranged within a wind turbine tower.

Clause 23. An offshore wind turbine comprising an elevator system according to any of clauses 12 - 21 arranged within a wind turbine tower.

Clause 24. Wirefix for damping vibrations of a taut cable, the wirefix being configured to be coupled around the taut cable and to be attached to a fixed structure delimiting an elevator path and the wirefix comprising an inner bushing made of damping material and configured to contact the taut cable when the wirefix is coupled around the taut cable, wherein the wirefix is made up from two halves and the inner bushing is made up from two halves

Clause 25. The wirefix of clause 24, wherein the damping material is an elastomer.

Clause 26. A method for retrofitting an elevator system, wherein the elevator system comprises

- an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;
- a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin; and
- one or more cable guides attached to the cabin, the cable guide comprising a through-channel configured such that the taut cable can pass through it;

wherein the method comprises

- selecting a portion of the taut cables that is arranged within the cable guide when the cabin is at a rest position;

- placing a mold around the selected portion of the taut cables;
- injecting a damping material in fluid state into the mold; and
- opening the mold when the damping material is cooled so as to obtain a sleeve.

Clause 27. The method of clause 26, wherein the rest position of the cabin comprises the lowermost position of the elevator path and/or the uppermost position of the elevator path.

Clause 28. The method of any of clauses 26 or 27, further comprising cleaning the selected portion of the taut cables before placing the mold around the cable.

Clause 29. The method of any of clauses 26 - 28, further comprising heating the selected portion of the taut cables up to 10°C before placing the mold around the cable.

Clause 30. The method of any of clauses 26 - 29, further comprising

- selecting one of an uppermost and lowermost wirefix arranged around a portion of the taut cables;
- removing the selected wirefix;
- providing a wirefix made from two halves with an inner bushing made of damping material and also made from two halves,
- putting together two halves of the wirefix and the inner bushing around the selected portion of the taut cables.

Clause 31. The method of any of clauses 26 - 30, wherein the damping material is an elastomer.

Clause 32. A method for retrofitting an elevator system, wherein the elevator system comprises

- an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;
- a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin; and
- one or more wirefixes coupled around the taut cables and fixed to the elevator path, the wirefixes being configured to pass through cable guides of the elevator cabin during vertical motion of the cabin;

wherein the method comprises

- selecting one of an uppermost and lowermost wirefix arranged around a portion of the taut cables;
- removing the selected wirefix;
- providing a wirefix made from two halves with an inner bushing made of damping material and also made from two halves,
- putting together two halves of the wirefix and the inner bushing around the selected portion of the taut cables.

Clause 33. The method of clause 32, wherein the damping material is an elastomer.

Clause 34. An elevator system comprising:

an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;
a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin;
one or more cable guides attached to the cabin, the cable guide comprising a through-channel configured such that the taut cables pass through it; and
one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path, the wirefixes being configured to pass through the cable guides during vertical motion of the cabin;

wherein the elevator system further comprises
an upper or lower damping element provided around a portion of the taut cables at or near one of the top and the bottom of the elevator path such that vibrations of the taut cables are absorbed by the upper or lower damping element.

Clause 35. The elevator system of clause 34, comprising an upper damping element provided around an upper portion of the taut cables at or near the top of the elevator path and a lower damping element provided around at or near the bottom of the elevator path such that vibrations of the taut cables are absorbed by the damping elements.

Clause 36. The elevator system of any of clause 34 or 35, wherein the damping element is a sleeve made of damping material and provided around the portion of the taut cable that is arranged within the cable guide when the cabin is at or near the lowermost position and/or the uppermost position.

Clause 37. The elevator system of any of clause 34

- 36, wherein the damping element is a wirefix damper comprising an inner bushing made of damping material and provided in contact with the taut cables to dampen vibrations of the taut cables.

Clause 38. The elevator system of clause 37, wherein the wirefixes and/or the wirefix dampers are made up from two halves, the wirefix dampers made up from two halves comprising inner bushings made of damping material and made up from two halves.

Clause 39. The elevator system of any of clauses 36 - 38, wherein the damping material is an elastomer.

Clause 40. The elevator system of any of clauses 34 - 39, wherein the cable guide is selected from the group consisting of a pair of rollers, an eyelet, a tubular part or a substantially C-shaped profile.

Clause 41. The elevator system of any of clauses 34 - 40, comprising an upper cable guide provided at or near a top part of the cabin and a lower cable guide provided at or near a bottom part of the cabin.

Clause 42. The elevator system of any of clauses 34 - 41, wherein the wirefixes are attached to working platforms arranged along the elevator path.

Clause 43. A wind turbine comprising an elevator system according to any of clauses 34 - 42 arranged within a wind turbine tower.

Clause 44. An offshore wind turbine comprising an elevator system according to any of clauses 34 - 42 arranged within a wind turbine tower.

Although only a number of examples have been disclosed herein, other alternatives, modifications, uses and/or equivalents thereof are possible. Furthermore, all possible combinations of the described examples are also covered. Thus, the scope of the present disclosure should not be limited by particular examples, but should be determined only by a fair reading of the claims that follow.

Claims

1. An elevator system comprising:

an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;
a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin;
one or more cable guides attached to the cabin, the cable guide comprising a through-channel configured such that the taut cables pass through it; and
one or more wirefixes coupled around the taut cables and fixed to a structure delimiting the elevator path, the wirefixes being configured to pass through the cable guides during vertical motion of the cabin;
wherein the elevator system further comprises an upper or lower damping element provided around a portion of the taut cables at or near one of the top and the bottom of the elevator path such that vibrations of the taut cables are absorbed by the upper or lower damping element.

2. The elevator system of claim 1, comprising an upper damping element provided around an upper portion of the taut cables at or near the top of the elevator path and a lower damping element provided around at or near the bottom of the elevator path such that vibrations of the taut cables are absorbed by the damping elements.

3. The elevator system of any of claims 1 or 2, wherein the damping element is a sleeve made of damping material and provided around the portion of the taut cable that is arranged within the cable guide when the cabin is at or near the lowermost position and/or the uppermost position.

4. The elevator system of any of claims 1 - 3, wherein the damping element is a wirefix damper comprising an inner bushing made of damping material and provided in contact with the taut cables to dampen vibrations of the taut cables.

5. The elevator system of claim 4, wherein the wirefixes and/or the wirefix dampers are made up from two halves, the wirefix dampers made up from two halves comprising inner bushings made of damping material and made up from two halves.

6. The elevator system of any of claims 3 - 5, wherein the damping material is an elastomer.

7. The elevator system of any of claims 1 - 6, wherein the cable guide is selected from the group consisting of a pair of rollers, an eyelet, a tubular part or a substantially C-shaped profile.

8. The elevator system of any of claims 1 - 7, comprising an upper cable guide provided at or near a top part of the cabin and a lower cable guide provided at or near a bottom part of the cabin.

9. A wind turbine comprising an elevator system according to any of claims 1 - 8 arranged within a wind turbine tower.

10. An offshore wind turbine comprising an elevator system according to any of claims 1 - 8 arranged within a wind turbine tower.

11. A method for retrofitting an elevator system, wherein the elevator system comprises

- an elevator cabin configured to run along an elevator path between a lowermost position proximate to a bottom of the elevator path and an uppermost position close to a top of the elevator path;
- a pair of taut cables arranged laterally from the cabin, the taut cables extending from the top to the bottom of the elevator path for guiding vertical motion of the cabin; and
- one or more cable guides attached to the cabin, the cable guide comprising a through-channel configured such that the taut cable can pass through it;

wherein the method comprises

• selecting a portion of the taut cables that is arranged within the cable guide when the cabin is at a rest position;
• placing a mold around the selected portion of the taut cables;
• injecting a damping material in fluid state into the mold; and
• opening the mold when the damping material is cooled so as to obtain a sleeve.

12. The method of claim 11, wherein the rest position of the cabin comprises the lowermost position of the elevator path and/or the uppermost position of the elevator path.

13. The method of any of claims 11 or 12, further comprising cleaning the selected portion of the taut cables before placing the mold around the cable.

14. The method of any of claims 11 - 13, further comprising heating the selected portion of the taut cables up to 10°C before placing the mold around the cable.

15. The method of any of claims 11 - 14, further comprising

• selecting one of an uppermost and lowermost wirefix arranged around a portion of the taut cables;
• removing the selected wirefix;
• providing a wirefix made from two halves with an inner bushing made of damping material, the bushings also being made from two halves,
• putting together two halves of the wirefix and the inner bushing around the selected portion of the taut cables.

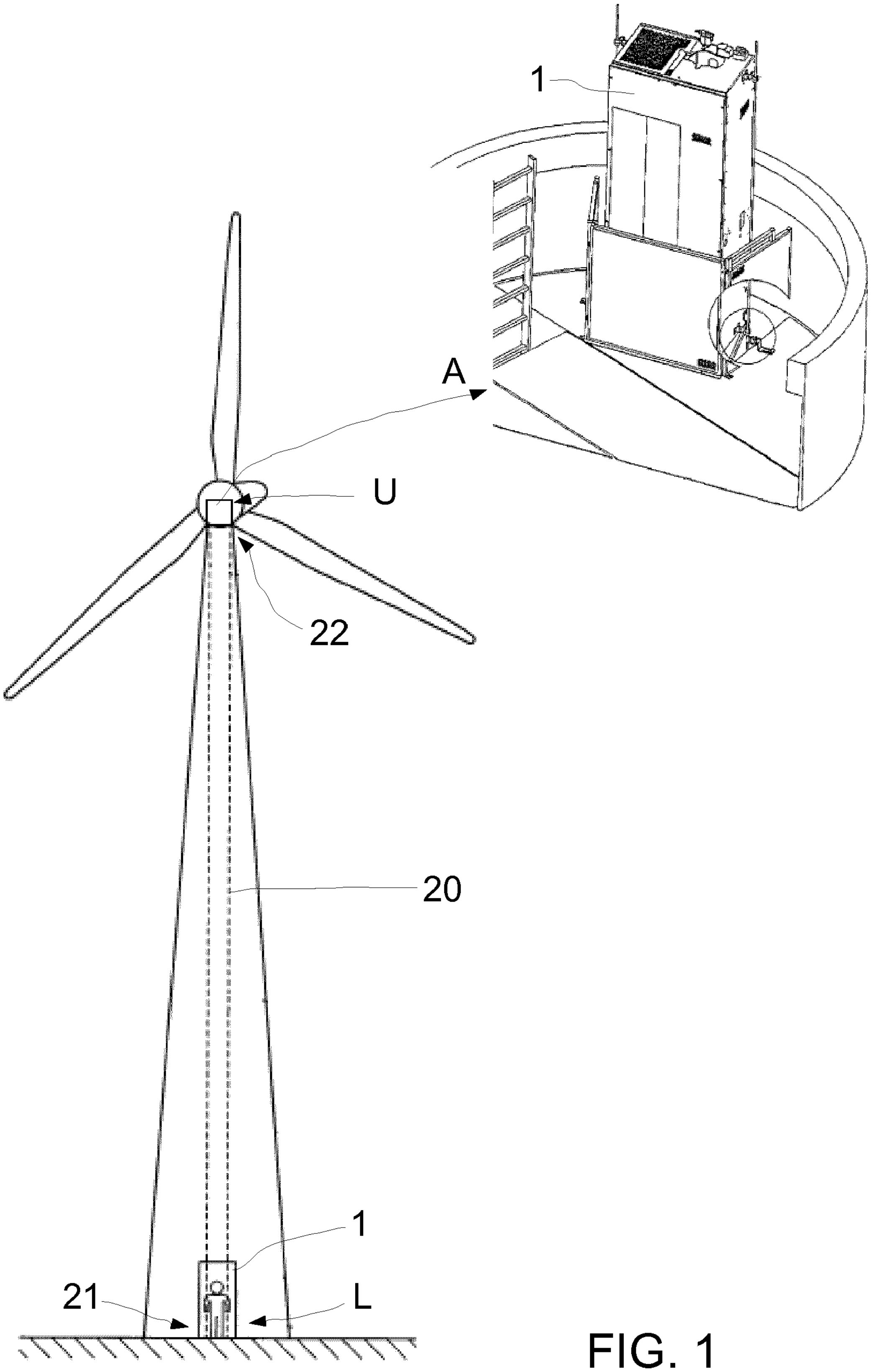

FIG. 1

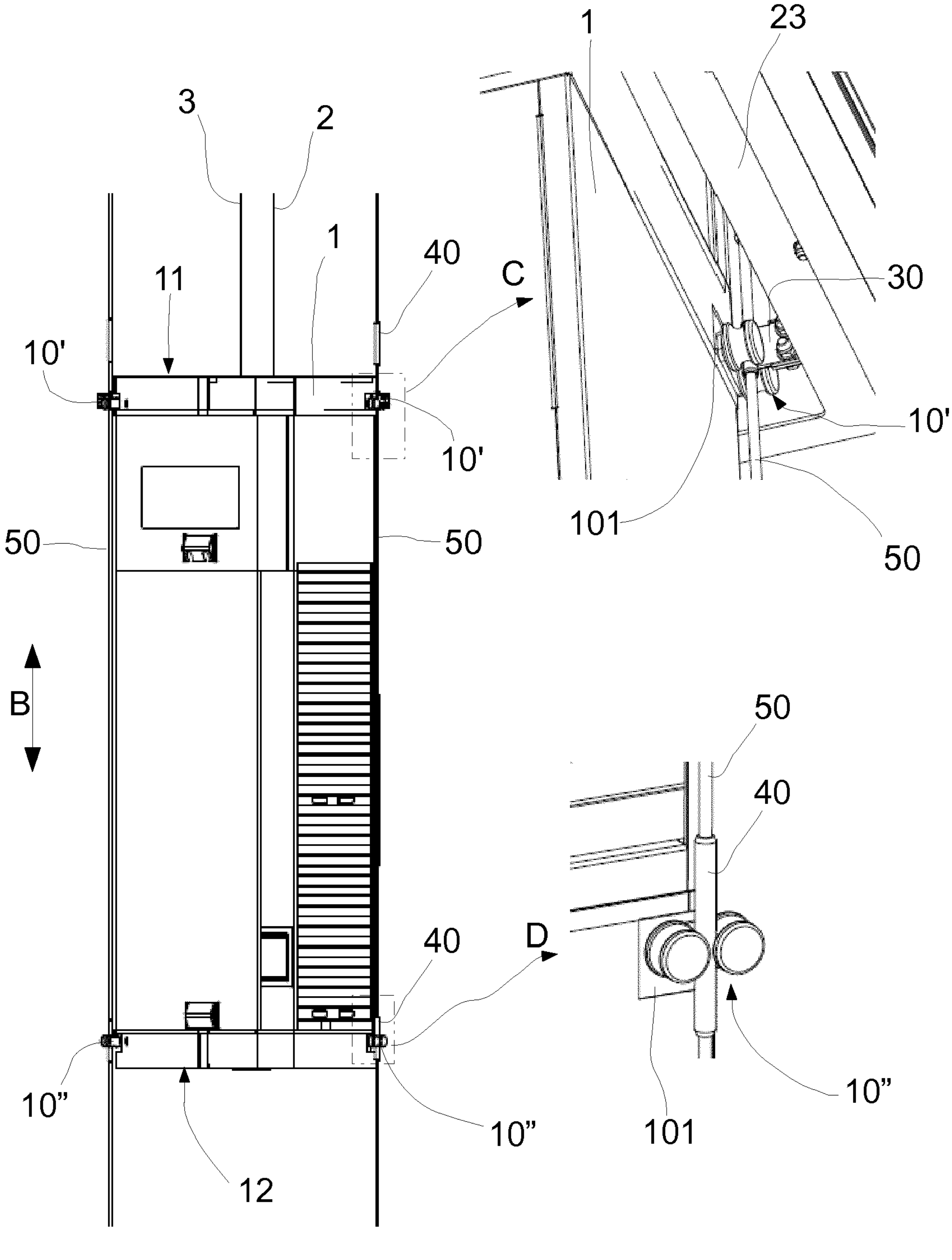

FIG. 2

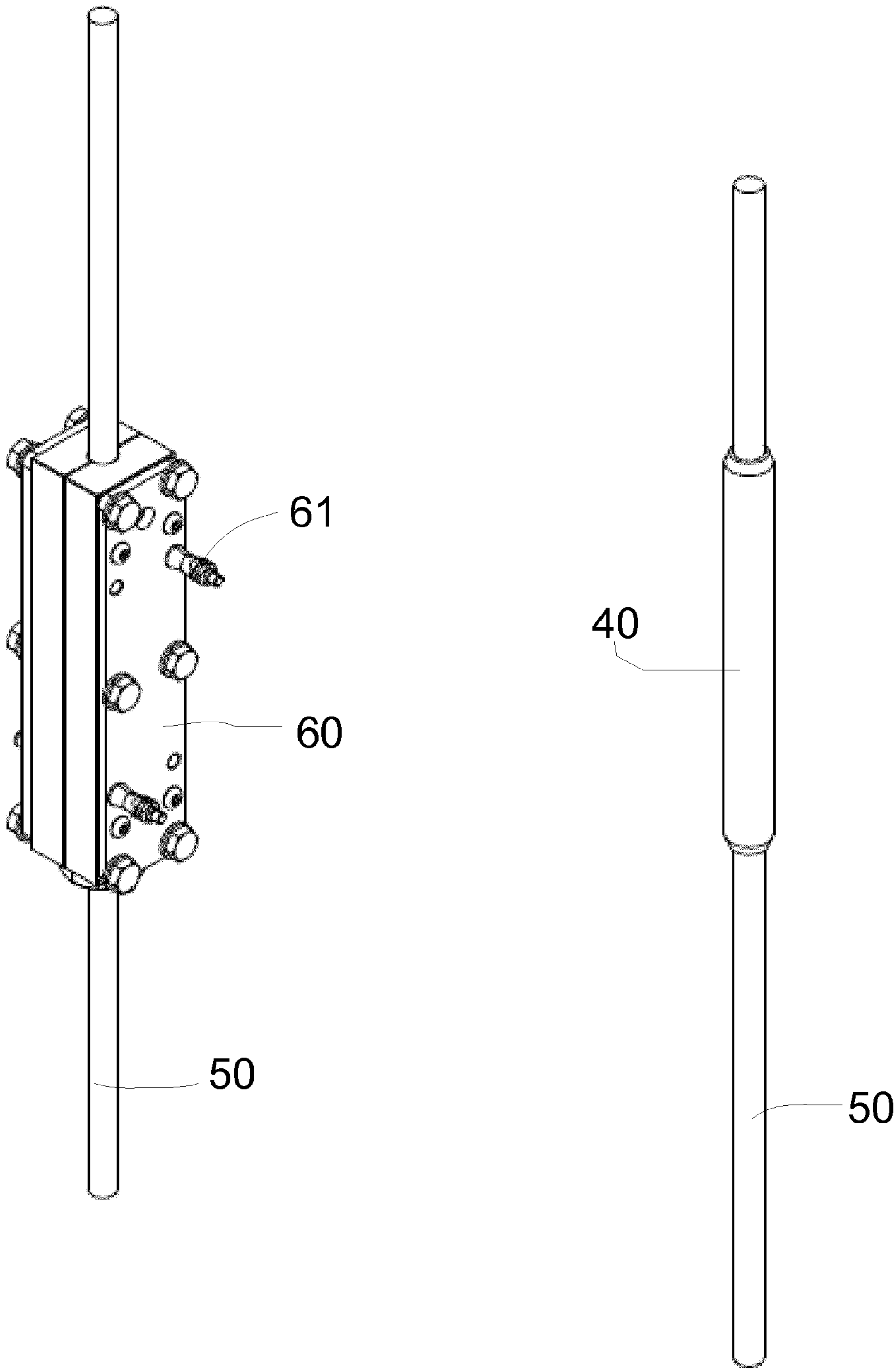

FIG. 3

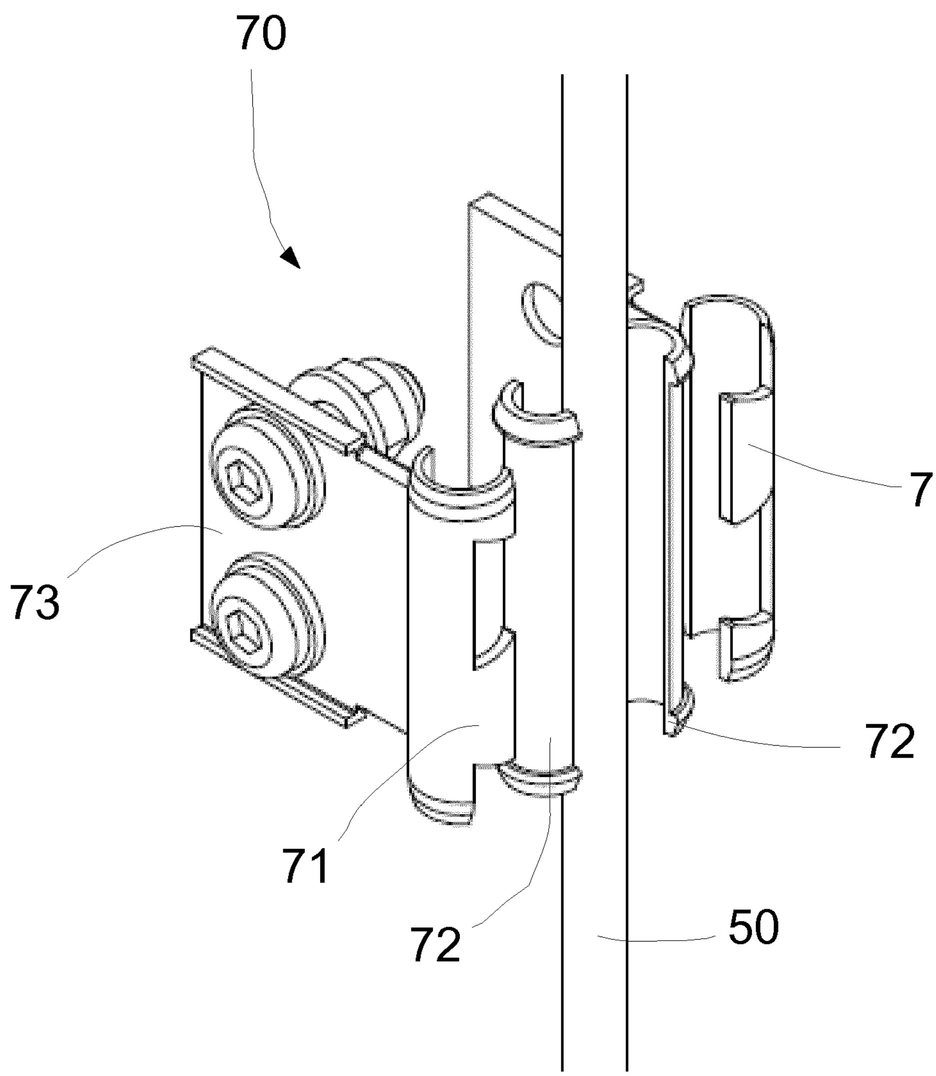

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 38 2166

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y,D A	WO 2010/056766 A1 (SAFE WORKS LLC [US]; BRICKELL CHRISTOPHER GAVIN [US]; HAIGH JOHN JEROM) 20 May 2010 (2010-05-20) * abstract * * paragraph [0019] - paragraph [0040] * * figures 1-9B * -----	1,2,4, 7-10 3,5,6, 11-15	INV. B66B7/02 B66B7/06 B66B19/00 B66B9/187
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TECHNICAL FIELDS SEARCHED (IPC)
B66B
D07B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	8 September 2017	Dijoux, Adrien

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08-09-2017

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

REFERENCES CITED IN THE DESCRIPTION

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