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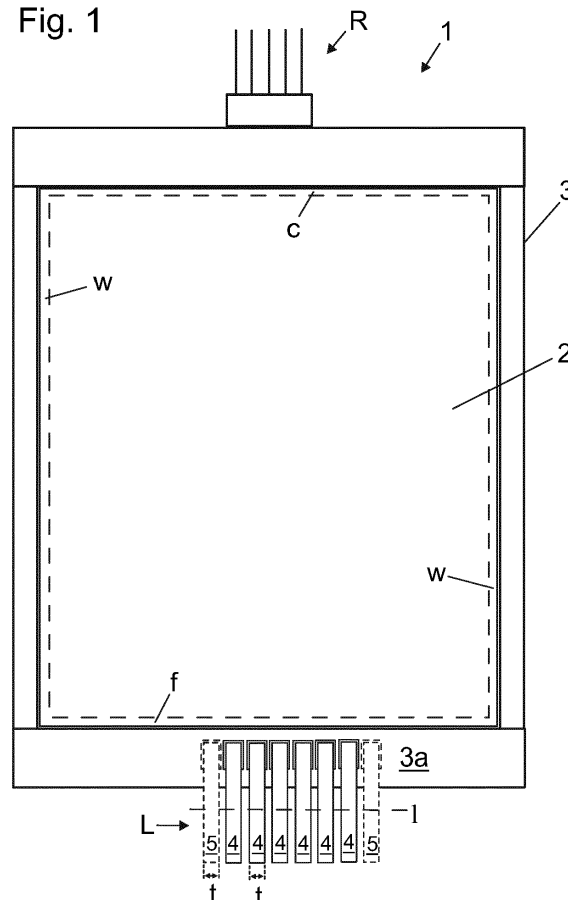
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(54) **ELEVATOR WITH DAMPING ELEMENTS AND METHOD**

(57) The invention relates to an elevator comprising an elevator car (1), the elevator car (1) comprising an interior (2) for receiving a load to be transported; a car frame (3) via which the elevator car (1) is suspended by a roping (R), the car frame (3) comprising at least one horizontally oriented cross beam (3a) extending across the vertical projection of the interior (2); and a plurality of weight elements (4,5) forming a line (L) of weight elements and being suspended by the cross beam (3a). One or more of the weight elements (4,5) are oscillation dampers (4) for dampening vertical oscillation of the car (1). The invention also relates to a method for modifying an existing elevator to be as described above.

Fig. 1



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Description

FIELD OF THE INVENTION

[0001] The invention relates to an elevator and a method for modifying an elevator. The elevator is preferably an elevator for transporting passengers and/or goods.

BACKGROUND OF THE INVENTION

[0002] Most elevators use ropes to suspend the elevator car during travel. The suspension ropes typically pass around one or more rope wheels positioned above the elevator car and therefore need some flexibility. The number and cross-sectional size of the ropes are usually based on the payload of the elevator while also trying to minimize sag for higher travels. For economic and eco-efficiency reasons, the dimensions of these ropes are optimized to reduce cost and weight to such a level that safety and lifetime requirements are fulfilled.

[0003] As the ropes get longer their inherent damping reduces. Furthermore, roller guides are used at higher speeds and travels to compensate for ride comfort, and otherwise wear of sliding guide shoes. This reduction in damping gets noticed particularly in elevators of higher travels. As passengers step in and out of the elevator, it will naturally move slightly according to the increase or reduction in weight. A drawback has been that because of the reduced damping, a noticeable vertical oscillation will be caused, which causes discomfort for the passengers. It has been noticed that the longer the damping time, the more discomfort is experienced by the passengers.

[0004] A further aspect in the background of the invention is that elevator car weight may need to be optimized. This may sometimes mean increasing the weight. Increasing the weight may sometimes be necessary for increasing traction between the suspension ropes and a drive wheel, for instance. The general trend is to reduce weight, which creates traction challenges. To compensate this, dead weights are sometimes added on the car and on the counterweight to provide ballast and thereby increase traction.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The object of the invention is to provide a new elevator improved in terms of comfort of use. An object is particularly to alleviate one or more of the above defined drawbacks of prior art and/or problems discussed or implied elsewhere in the description. Solutions are presented, *inter alia*, by which magnitude and duration of vertical oscillation of the car can be reduced. Solutions are presented, *inter alia*, which can serve as a completely passive system requiring no electrical connection to controller.

[0006] It is brought forward a new elevator comprising an elevator car, the elevator car comprising an interior

for receiving the load to be transported, the interior preferably being delimited by at least walls, a ceiling and a floor; a roping; a car frame via which the car is suspended by the roping, the car frame preferably carrying the walls, ceiling and floor, which car frame comprises at least one horizontally oriented cross beam extending across the vertical projection of the interior, the cross beam preferably being disposed below the interior; and a plurality of weight elements forming a line of weight elements, the plurality of weight elements being suspended by the cross beam, wherein one or more of the weight elements are oscillation dampers for dampening vertical oscillation of the car. With this solution, one or more of the above mentioned advantages and/or objectives are achieved. Particularly, hereby an efficient solution is provided which can facilitate reduction of car oscillation occurring when passengers step into and out of elevator car as well as addition of weight on the car e.g. to increase traction.

[0007] Preferable further features are introduced in the following, which further features can be combined with the elevator individually or in any combination.

[0008] In a preferred embodiment, the oscillation damper comprises a damper body; and one or more weight blocks, which are carried by the damper body and vertically movable relative to the damper body; and one or more deformable members between the one or more weight blocks and the damper body for resisting vertical movement of the one or more weight blocks relative to the damper body. Particularly, vertical movement of the one or more weight blocks relative to the damper body is arranged to cause the one or more deformable members to deform and resist vertical movement of the one or more weight blocks relative to the damper body. With this solution, the original natural frequency becomes changed such that oscillation is reduced.

[0009] In a preferred embodiment, the oscillation damper comprises a damper body engaged with the cross beam, preferably in vertical direction at least substantially immovably; and one or more weight blocks, which are carried by the damper body and vertically movable relative to the damper body; and one or more deformable members between the one or more weight blocks and the damper body for resisting vertical movement of the one or more weight blocks relative to the damper body. Particularly, vertical movement of the one or more weight blocks relative to the damper body is arranged to cause the one or more deformable members to deform and resist vertical movement of the one or more weight blocks relative to the damper body. With this solution, the original natural frequency becomes changed such that oscillation is reduced.

[0010] In a preferred embodiment, said plurality of weight elements form a line of weight elements, wherein the weight elements are disposed successively along a straight line.

[0011] In a preferred embodiment, the weight elements are below the interior within the vertical projection thereof. This is advantageous since in many elevators there

is space below the car where the weight elements can be placed. In this case, the horizontally oriented cross beam preferably extends across the vertical projection of the interior below the interior. Alternatively, the weight elements could be above the interior within the vertical projection thereof. This would be advantageous if the space requirements of the elevator below the car are demanding. In this case, the horizontally oriented cross beam would extend across the vertical projection of the interior above the interior.

[0012] In a preferred embodiment, the horizontally oriented cross beam extends across the vertical projection of the interior below the interior.

[0013] In a preferred embodiment, each of weight elements weighs more than 5 kg.

[0014] In a preferred embodiment, the weight blocks of an individual oscillation damper weigh more than 1 kg altogether, most preferably at least 2 kg.

[0015] In a preferred embodiment, the center of gravity of each said weight element is below the cross beam and within the vertical projection thereof.

[0016] In a preferred embodiment, said one or more deformable members include an elastically deformable member and/or a shock absorber. Hereby, the original natural frequency becomes changed such that oscillation is reduced. When said one or more deformable members include an elastically deformable member (at least one) and a shock absorber (at least one), the original natural frequency of the system splits into more than one frequencies in the most advantageous manner. Said one or more deformable members can together form a so called tuned mass damper.

[0017] In a preferred embodiment, the aforementioned shock absorber is a shock absorber for absorbing energy. It is particularly preferably a shock absorber for absorbing kinetic energy of the one or more weight blocks. It is preferably more precisely a shock absorber for absorbing kinetic energy of the one or more weight blocks and for converting it into heat.

[0018] In a preferred embodiment, said shock absorber is a pneumatic or a hydraulic shock absorber. The shock absorber can be for example a device comprising a piston movable in a hydraulic cylinder or a device comprising a piston movable in a pneumatic cylinder, such as a device where compressed fluid outflow from a chamber end in piston movement caused by movement to weight block(s) is allowed in a restricted manner. As a further advantageous alternative, the shock absorber can be an elastomeric shock absorber. In this case, said elastomeric shock absorber preferably is or at least comprises a shock absorber element made of cellular polymer, such as cellular polyurethane, or cellular rubber, for instance.

[0019] In a preferred embodiment, said shock absorber is in the form of a dashpot.

[0020] In a preferred embodiment, said elastically deformable member is a spring, such as a coil spring.

[0021] In a preferred embodiment, the spring is fixedly

connected with the one or more weight blocks and with the damper body.

[0022] In a preferred embodiment, the shock absorber is fixedly connected with the one or more weight blocks and with the damper body.

[0023] In a preferred embodiment, said one or more deformable members between the one or more weight blocks and the damper body include an elastically deformable member and a shock absorber in parallel configuration.

[0024] In a preferred embodiment, each weight element has thickness width and height, the thickness being substantially smaller than width and height, and the weight elements are disposed such that their thickness directional side faces in longitudinal direction of the line of weight elements.

[0025] In a preferred embodiment, one or more of the weight elements are dead weight elements, in particular not comprising a vertically movable weight element carried by a damper body.

[0026] In a preferred embodiment, the weight elements are substantially plate-shaped.

[0027] In a preferred embodiment, the weight elements are preferably shaped to have a plurality of faces facing in perpendicular direction to their thickness direction which are aligned when viewed in longitudinal direction of the line of weight elements. Such faces preferably include at least faces facing towards opposite lateral sides, as well as downwards facing face of the weight elements.

[0028] In a preferred embodiment, each said dead weight element is made of concrete or at least 50 % of its weight is concrete.

[0029] In a preferred embodiment, the cross beam is made of metal.

[0030] In a preferred embodiment, the elevator comprises a hoistway wherein the elevator car is vertically movable.

[0031] In a preferred embodiment, the elevator comprises a counterweight suspended by the roping, which counterweight is vertically movable in the hoistway.

[0032] In a preferred embodiment, the roping passes around a rope wheel and suspends the elevator car and counterweight on opposite sides of the rope wheel. The rope wheel is preferably a drive wheel, since in this context the weight elements advantageously increase traction. The elevator preferably moreover comprises a motor for driving the drive wheel and an elevator control arranged to automatically control rotation of the motor.

[0033] In a preferred embodiment, the car is provided with a doorway for allowing passengers to access the interior of the elevator car from landings of the elevator.

[0034] It is also brought forward a new method for modifying an existing elevator. The method comprising modifying an existing elevator to be as defined anywhere above. With this solution, one or more of the above mentioned advantages and/or objectives are achieved.

[0035] Particularly, an existing elevator can be modified to be improved in terms of its comfort of use due to

reduced oscillation.

[0036] Preferable further features have been introduced above as well as in the following, which further features can be combined with the method individually or in any combination.

[0037] In a preferred embodiment, in the method the existing elevator comprises an elevator car comprising an interior for receiving the load to be transported, which interior is preferably delimited by walls, ceiling and floor; a car frame via which the car is suspended by a roping, the car frame preferably carrying the walls, ceiling and floor, which car frame comprises at least one horizontally oriented cross beam extending across the vertical projection of the interior, the cross beam preferably being disposed below the interior; and a plurality of weight elements forming a line of weight elements the plurality of weight elements being suspended by the cross beam. The method comprises replacing one or more of the aforementioned weight elements with one or more weight elements, which are oscillation dampers for dampening vertical oscillation of the car. Hereby, an existing elevator can be modified to be improved in terms of its comfort of use due to reduced oscillation simply and cost-effectively, since in the modification only small amount of changes need to be done.

[0038] In a preferred embodiment, the oscillation damper comprises a damper body engaged with the cross beam preferably in vertical direction at least substantially immovably; and one or more weight blocks, which are carried by the damper body and vertically movable relative to the damper body; and one or more deformable members between the one or more weight blocks and the damper body for resisting vertical movement of the one or more weight blocks relative to the damper body. Particularly, vertical movement of the one or more weight blocks relative to the damper body is arranged to cause the one or more deformable members to deform and resist vertical movement of the one or more weight blocks relative to the damper body.

[0039] The elevator is in general preferably such that it comprises a plurality of landings, and the elevator car is vertically movable to and from each of said plurality of landings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] 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 partially an elevator according to a preferred embodiment.

Figure 2 illustrates preferred details of a weight element which is an oscillation damper according to a first embodiment.

Figure 3 illustrates preferred details of a weight element which is a dead weight element.

Figure 4 illustrates further preferred details of an el-

evator according to Figure 1.

Figure 5 illustrates preferred details of an existing elevator to be modified in a method according to an embodiment.

Figure 6 illustrates preferred details of the elevator of Figure 5 after being modified in a method according to an embodiment.

Figure 7 illustrates preferred details of a weight element which is an oscillation damper according to a second embodiment.

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

DETAILED DESCRIPTION

[0041] Figure 1 illustrates an elevator according to a preferred embodiment. The elevator is an elevator for transporting passengers and/or goods. Figure 1 illustrates the elevator partially. In the embodiment of Figure 1, the elevator car 1 comprises walls w, ceiling c and floor f delimiting an interior 2 for receiving the load (such as passengers and/or goods) to be transported, and a car frame 3 via which the car 1 is suspended by a roping R. The frame 3 carries the walls w, ceiling c and floor f and comprises at least one horizontally oriented cross beam 3a, which extends across the vertical projection of the interior 2 below the interior 2. The elevator car 1 moreover comprises a plurality of weight elements 4,5 suspended by the cross beam 3a. Each of weight elements 4,5 is engaged with the cross beam. The plurality of weight elements 4,5 forms a line L of weight elements. Particularly, the weight elements 4,5 are disposed successively along a straight line 1. In the preferred embodiment presented, the weight elements 4,5 are below the interior 2 within the vertical projection thereof.

[0042] One or more of the weight elements 4,5 of the aforementioned plurality of weight elements 4,5 are oscillation dampers 4 for dampening vertical oscillation of the car 1. Forming one or more of the weight elements suitable for the purpose of oscillation dampening provides firstly that they can serve for multiple purposes effectively, but also that the configuration is modifiable depending on needs of the particular elevator in context of a new elevator installation as well as when modifying an existing elevator e.g. so as to improve user experience of the elevator. It is possible that all of the weight elements 4,5 of the aforementioned plurality of weight elements 4,5 are oscillation dampers 4 for dampening vertical oscillation of the car 1, but possibly one or more of the plurality of weight elements 4,5 are dead weight elements 5 not serving as oscillation dampers 4 for dampening vertical oscillation of the car 1. Most preferably, the aforementioned plurality of weight elements 4,5 comprises 3 or more oscillation dampers 4 for dampening vertical oscillation of the car 1. The aforementioned plurality of weight elements 4,5 can comprise for example 3-15 os-

cillation dampers 4 for dampening vertical oscillation of the car 1. In Figure 1, the aforementioned plurality of weight elements 4,5 comprises six oscillation dampers 4 for dampening vertical oscillation of the car 1.

[0043] Preferably, the center of gravity of each said weight element 4,5 is below the cross beam 3a and within the vertical projection thereof. Thus, the weight element 4,5 are advantageously positioned with regard to how they exert forces on the car 1. For example in this way problems, such as tilting of the car 1, caused by the vertical downwards pulling force the weight elements 4,5 exert on the cross beam 3a can be simply avoided.

[0044] Figure 2 illustrates preferred details of the aforementioned oscillation damper. In the preferred embodiment illustrated, each said oscillation damper comprises a damper body 4a engaged with the cross beam 3a in particular in vertical direction at least substantially immovably; and one or more weight blocks 4b carried by the damper body 4a and vertically movable relative to the damper body 4a; and deformable members 4c, 4d between the one or more weight blocks 4b and the damper body 4a for resisting vertical movement of the one or more weight blocks 4b relative to the damper body 4a. Vertical movement of the one or more weight blocks 4b relative to the damper body is arranged to cause the deformable members 4c, 4d to deform and resist vertical movement of the one or more weight blocks 4b relative to the damper body 4a. Figure 2 shows in solid line the edges of an individual weight block 4b in case of the option that the oscillation damper 4 comprises only one weight block 4b. Figure 2 shows in broken line the opposing edges of the individual weight blocks 4b in case of the option that the oscillation damper 4 comprises more than one weight blocks 4b.

[0045] In the preferred embodiment illustrated in Figure 2, said deformable members 4c, 4d include elastically deformable members 4c (here two of them) and one shock absorber 4d. The principle works that in adding another mass/spring system to the elevator case system, the original natural frequency of the system splits into two frequencies. This shifts the frequencies slightly, and introduces another mode shape. By tuning the second mode shape, much of the vibration energy can be absorbed by the damper 4. The number of said deformable members 4c, 4d could alternatively be some other than what is shown and described in context of Figures (e.g. 1-5 deformable members 4c and 1-5 deformable members 4d).

[0046] In the preferred embodiment illustrated in Figure 2, said elastically deformable members 4c are springs, in particular coil springs. Said shock absorber 4d is suitable for absorbing kinetic energy of the one or more weight blocks 4b, and preferably converting it into heat and preferably dissipating it. In the presented embodiment, said shock absorber 4d is a pneumatic shock absorber 4d, in particular a device comprising a piston movable in a pneumatic cylinder. In the embodiment of Figure 2, compressed fluid outflow from a chamber end

in piston movement caused by movement of the weight block(s) 4b is allowed in a restricted manner, in this case via the gap between the piston and the cylinder wall, but optionally via a passage formed in the piston end part or a wall of the chamber end. Alternatively, said shock absorber 4d could be a hydraulic shock absorber 4d, in particular a device comprising a piston movable in a hydraulic cylinder. Then preferably, compressed fluid outflow from a chamber end in piston movement caused by movement of the weight block(s) 4b would be allowed in a restricted manner, such as via a passage formed in the piston end part separating two hydraulic chambers of the device or via a gap between the piston and the cylinder wall or via a passage formed in the piston end part or a wall of the chamber end. In the case where the shock absorber 4d is of a hydraulic kind, the space right above the piston end part would preferably be closed.

[0047] The deformable members 4c, 4d are connected to the one or more weight blocks 4b and the damper body 4a. The connection is preferably such that each said spring 4c is fixedly connected with the one or more weight blocks 4b as well as fixedly connected with the damper body 4a.

[0048] The shock absorber 4d is connected to the one or more weight blocks 4b and the damper body 4a. The connection is preferably such that the shock absorber 4d is fixedly connected with the one or more weight blocks 4b as well as fixedly connected with the damper body 4a.

[0049] Said one or more deformable members 4c, 4d between the one or more weight blocks 4b and the damper body 4a include an elastically deformable member 4c and a shock absorber 4d in parallel configuration.

[0050] Figure 3 illustrates preferred details of the aforementioned dead weight element 5. The dead weight elements 5 does not comprise a vertically movable weight element carried by a damper body. The dead weight element is preferably made of concrete or at least 50 % of its weight is concrete.

[0051] Preferably, each of weight elements 4,5 weighs 5 kg or more. It is advantageous that the weight of each weight element 4,5 is such that a very high number of them need not to be installed so as to gain substantial effect of dampening and/or sufficient addition of weight on the car 1.

[0052] The weight blocks 4b of an individual oscillation damper 4, regardless of whether there is only one or plurality of them comprised in the oscillation damper 4, preferably weighs more than 1 kg altogether, most preferably at least 2 kg.

[0053] The weight elements 4,5 are substantially plate-shaped, which provides that a great number of them can be stacked in small space measured in longitudinal direction of the line L. Each weight element 4,5 has thickness t width w and height h, the thickness t being substantially smaller than width w and height h, and the weight elements 4,5 are disposed such that their thickness directional side faces in longitudinal direction of the line L.

[0054] The weight elements 4,5 are preferably shaped to have plurality of faces facing in perpendicular direction to the thickness direction which are aligned when viewed in longitudinal direction of the line L, as shown in Figures 1-3. Such faces include in the preferred embodiment at least faces facing towards opposite lateral sides, as well as downwards facing face of the weight elements 4,5.

[0055] Figure 4 illustrates further preferred details of the elevator partially shown and described with reference to Figure 1. The elevator of Figure 4 comprises a hoistway H wherein the elevator car 1 is vertically movable. The elevator car 1 is suspended by a roping R via the car frame 3. The elevator moreover comprises a counterweight 6 suspended by the roping R and vertically movable in the hoistway H.

[0056] The roping R passes around a rope wheel 4 and suspends the elevator car 1 and counterweight 6 on opposite sides of the rope wheel 7, whereby the first elevator unit 1 is arranged to move upwards when the second elevator unit 2 moves downwards, and vice versa. The rope wheel 7 is preferably a drive wheel, since in this context the weight elements 4,5 advantageously increase traction.

[0057] The elevator moreover comprises a motor M for driving the drive wheel 7 and an elevator control 100 arranged to automatically control rotation of the motor.

[0058] The elevator comprises plurality of landings L1-L3, and the elevator car is vertically movable to and from each of said plurality of landings L1-L3. The car 1 is provided with a doorway d for allowing access into the interior 2 of the elevator car from landings L1-L3 of the elevator. The interior 2 of the elevator car 1 is accessible from each said landing L1-L3 through the doorway d.

[0059] In a preferred embodiment of a method for modifying an existing elevator, an existing elevator is modified to be as described with reference to Figure 1.

[0060] Figures 5 and 6 illustrate more specifically how the existing elevator is preferably modified. The existing elevator comprises an elevator car 1 comprising walls w, ceiling c and floor f delimiting an interior 2 for receiving the load (such as passengers and/or goods) to be transported, and a car frame 3 via which the car 1 is suspended by a roping R. The frame 3 carries the walls w, ceiling c and floor f and comprises at least one horizontally oriented cross beam 3a, which extends across the vertical projection of the interior 2 below the interior 2. In this regard, the car structure of the existing elevator can be as described referring to Figure 1. The elevator car 1 moreover comprises a plurality of weight elements 5 suspended by the cross beam 3a. At this point of method, the weight elements 5 are dead weight elements as shown in Figure 5. The plurality of weight elements 5 forms a line L0 of weight elements 5. Particularly, the weight elements 5 are disposed successively along a straight line 1.

[0061] In the method replacing one or more of the aforementioned weight elements 5 are replaced with one or more weight elements 4, which are oscillation dampers 4 for dampening vertical oscillation of the car 1. Since

there is already some dead mass added to the elevator, such as to increase traction, the idea here is to use the mass of an oscillation damper to provide the function of providing the elevator additional weight (ballast). Hereby, an existing elevator can be modified to be improved in terms of its comfort of use due to reduced oscillation. This can be realized simply and cost-effectively, since in the modification only small amount of changes need to be done. The costs are caused essentially only by the deformable members of the damper.

[0062] The method may further comprise changing order of the weight elements in the line L0 and/or in the line L.

[0063] It is possible that all or only a group of the weight elements 5 of the existing elevator are replaced as defined. It is also possible that additional weight elements are added, which are dead weight elements or oscillation dampers 4 as defined. It is also possible that some of the weight elements 5 of the existing elevator are permanently removed.

[0064] In Figures 1, 5 and 6 some of the weight elements 5 have been illustrated in broken line so as to show that their presence is optional. This means, that it is not necessary that in the elevator shown partially in Figures 1 and 6 the dead weight elements shown in broken line are present.

[0065] In general, the car frame and the walls w, ceiling c and floor f carried by them can be connected together with any type of solution. The car frame 3 can for instance be of conventional type wherein it is a ring-shaped beam structure surrounding a cabin box comprising said walls w, ceiling c and floor f, as disclosed in Figures 1 and 4, or alternatively the car frame can be integral with one or more of said walls w, ceiling c and floor f.

[0066] Figure 7 illustrates an advantageous alternative embodiment, where the shock absorber 4d' is an elastomeric shock absorber. Otherwise, the solution is in line with what is described with reference to Figure 2. In the preferred embodiment, said elastomeric shock absorber 4d' preferably is (or at least comprises) a shock absorber element 4d' made of cellular polymer, preferably of cellular polyurethane, but alternatively of some other cellular polymer material such as cellular rubber, for instance. In Figure 7, the elastomeric shock absorber 4d' has been illustrated as a substantially cylindrical member having uneven outer face, since this is a preferred shape for the elastomeric shock absorber. Such shock absorbers are commercially available. An elastomeric shock absorber is advantageous since it provides shock absorbing function without use of oil, which is in an elevator environment advantageous since in this way there is no risk of oil leakage. An elastomeric shock absorber is also advantageous since it can replace a combination of a hydraulic shock absorber and a spring and still the original natural frequency becomes changed such that oscillation is advantageously reduced in a reasonable degree. In Figure 7, parallel with the elastomeric shock absorber 4d', springs 4c have been illustrated, but their presence is

not necessary.

[0067] In the invention, the oscillation dampers 4 are suitable for dampening vertical oscillation of the car 1. It is however possible that additionally also facilitate dampening of the horizontal oscillation of the car 1.

[0068] 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 elevator comprising an elevator car (1), the elevator car (1) comprising

an interior (2) for receiving a load to be transported;

a car frame (3) via which the elevator car (1) is suspended by a roping (R), the car frame (3) comprising a horizontally oriented cross beam (3a) extending across the vertical projection of the interior (2); and

a plurality of weight elements (4,5) forming a line (L) of weight elements and being suspended by the cross beam (3a),

characterized in that one or more of the weight elements (4,5) are oscillation dampers (4) for dampening vertical oscillation of the car (1).

2. An elevator according to claim 1, **characterized in that** the oscillation damper (4) comprises

a damper body (4a), preferably engaged with the cross beam (3a); and

one or more weight blocks (4b) carried by the damper body (4a) and vertically movable relative to the damper body (4a); and

one or more deformable members (4c, 4d; 4c,4d') between the one or more weight blocks (4b) and the damper body (4a) for resisting vertical movement of the one or more weight blocks (4b) relative to the damper body (4a).

3. An elevator according to any of the preceding claims, **characterized in that** the weight elements (4,5) of said plurality of weight elements are disposed successively along a straight line (1).

4. An elevator according to any of the preceding claims,

characterized in that the weight elements (4,5) are below the interior (2) within the vertical projection thereof.

5. An elevator according to any of the preceding claims, **characterized in that** each of weight elements (4,5) weighs more than 5 kg.

6. An elevator according to any of the preceding claims, **characterized in that** the center of gravity of each said weight element (4,5) is below the cross beam (3a) and within the vertical projection thereof.

7. An elevator according to any of the preceding claims, **characterized in that** said one or more deformable members (4c, 4d; 4c,4d') include an elastically deformable member (4c) and/or a shock absorber (4d;4d').

8. An elevator according to the previous claims, **characterized in that** said shock absorber (4d;4d') is a pneumatic or a hydraulic shock absorber (4d) or an elastomeric shock absorber (4d').

9. An elevator according to the previous claims, **characterized in that** said elastically deformable member (4c) is a spring, such as a coil spring.

10. An elevator according to any of the preceding claims, **characterized in that** said one or more deformable members (4c, 4d; 4c, 4d') between the one or more weight blocks (4b) and the damper body (4a) include an elastically deformable member (4c) and a shock absorber (4d;4d') in parallel configuration.

11. An elevator according to any of the preceding claims, **characterized in that** each said weight element (4,5) has thickness (t), width (w) and height (h), the thickness (t) being substantially smaller than width (w) and height (h), and the weight elements (4,5) are disposed such that their thickness directional side faces in longitudinal direction of the line (L) of weight elements (4,5).

12. An elevator according to any of the preceding claims, **characterized in that** said weight elements (4,5) are substantially plate-shaped

13. A method for modifying an existing elevator, the method comprising modifying an existing elevator to be as defined in any of the preceding claims.

14. A method according to the preceding claim, **characterized in that** the existing elevator comprises an elevator car (1) comprising an interior (2) for receiving the load to be transported; a car frame (3) via which the car (1) is suspended by a roping (R) and which comprises a horizontally

oriented cross beam (3a) extending across the vertical projection of the interior (2); and
a plurality of weight elements (5) forming a line (L0) of weight elements and being suspended by the cross beam (3a),
and the method comprises replacing one or more of the aforementioned weight elements (5) with one or more weight elements (4), which are oscillation dampers (4) for dampening vertical oscillation of the car (1).

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15. A method according to any of the preceding claims 13-14, **characterized in that** the oscillation damper (4) comprises

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a damper body (4a), preferably engaged with the cross beam (3a); and
one or more weight blocks (4b), which are carried by the damper body (4a) and vertically movable relative to the damper body (4a); and
one or more deformable members (4c, 4d; 4c, 4d') between the one or more weight blocks (4b) and the damper body (4a) for resisting vertical movement of the one or more weight blocks (4b) relative to the damper body (4a).

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Fig. 1

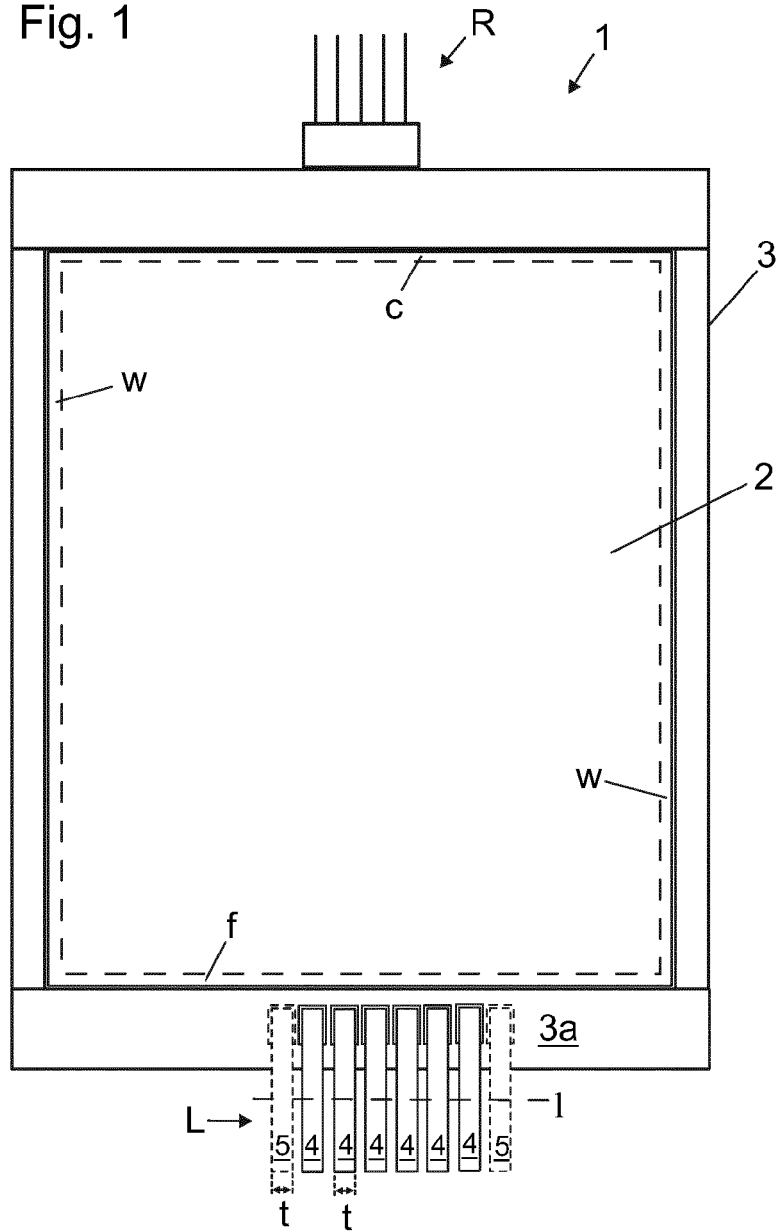


Fig. 2

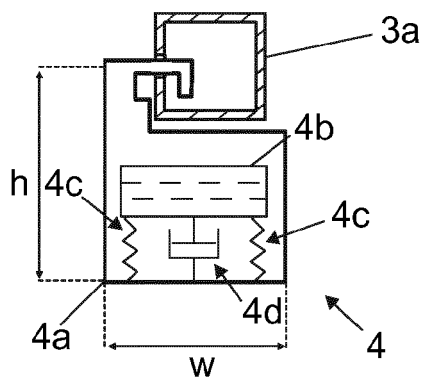


Fig. 3

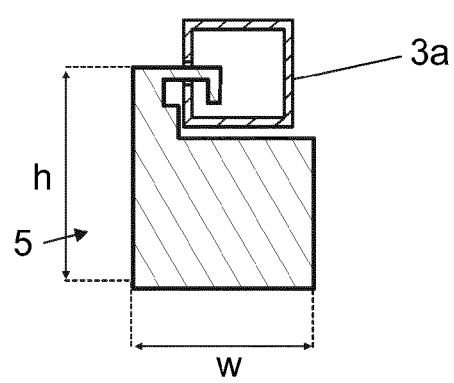


Fig. 4

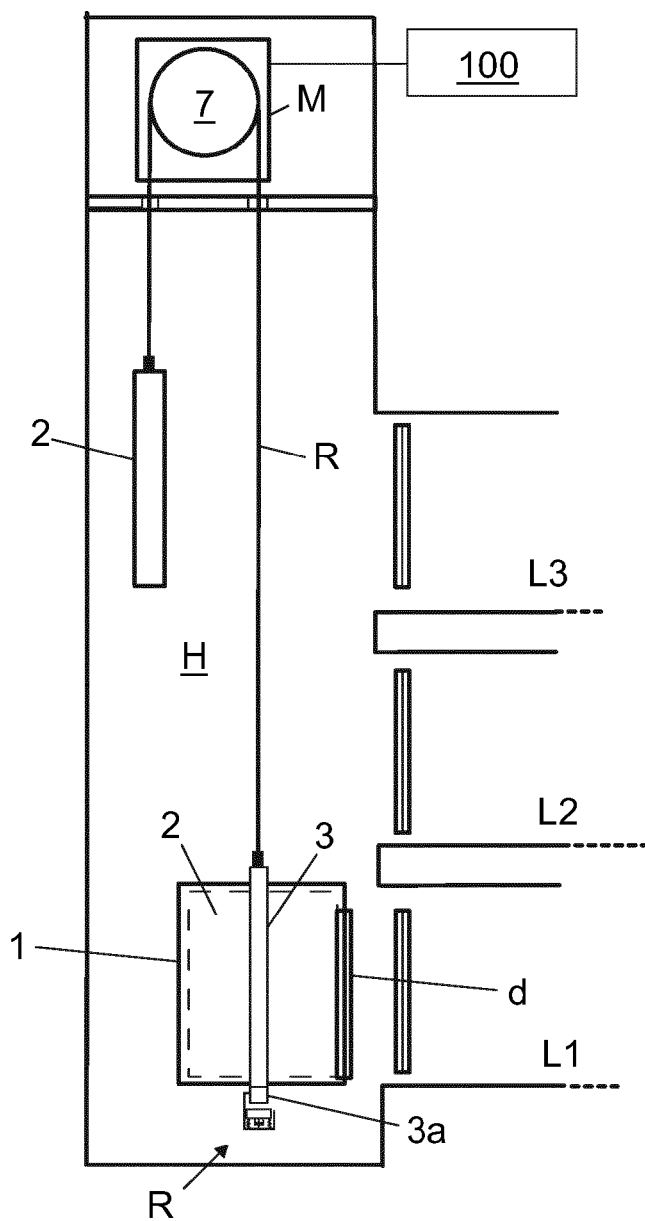


Fig. 5

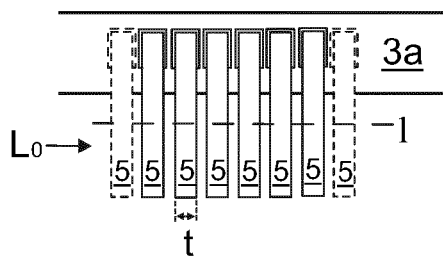


Fig. 6

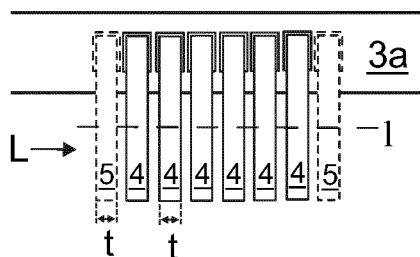
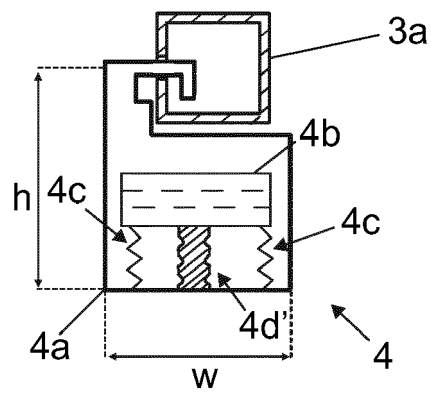


Fig. 7





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			B66B
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Place of search The Hague		Date of completion of the search 19 March 2019	Examiner Lenoir, Xavier
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