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

(11) EP 2 824 055 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.01.2015 Bulletin 2015/03

(51) Int Cl.:
B66B 5/28 *(2006.01)*

(21) Application number: **13175910.2**

(22) Date of filing: **10.07.2013**

(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

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(54) Elevator pit buffer

(57) A pit buffer (1) for an elevator pit (9) comprising a roping (2) running across the elevator shaft (15) and being attached to a stationary support from its both ends, and a buffering structure (5) comprising a cylinder (6), a piston (7) and a guiding structure (8), characterized in that the first end of the roping (2) is attached at or above the point (18a) along the vertical movement path of the elevator car (3) or the counterweight (4) at which the elevator car (3) or counterweight (4) is configured to touch the roping (2), in that the roping (2) is configured to run over the guiding structure (8), and in that the second end of the roping (2) is attached to a point (18b) lower along the vertical movement path of the elevator car (3) or the counterweight (4) than the lowest point to which the guiding structure (8) is configured to retract.

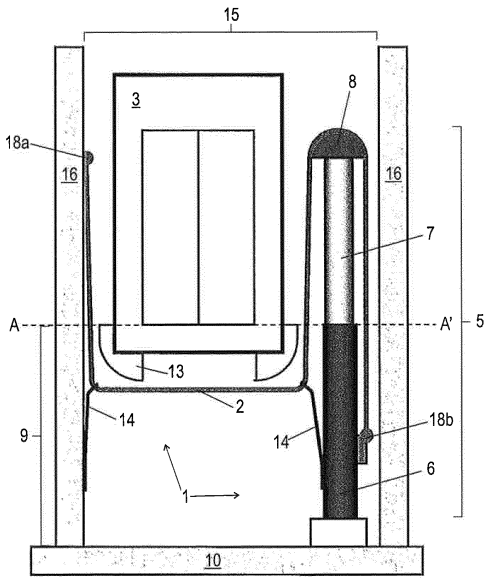

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a pit buffer of an elevator.

BACKGROUND OF THE INVENTION

[0002] During the normal operation of an elevator, an elevator car and a counterweight move reciprocally in a substantially vertical direction between the lowest and highest landing levels served by the elevator. There are several safety mechanisms to ascertain that this normal traveling range is not exceeded, i.e. that the elevator car or the counterweight do not move above or below those vertical points that they are configured to reach.

[0003] A pit buffer is a part of this elevator safety system and is located in the elevator pit at the bottom of the elevator shaft. The purpose of the pit buffer is to decelerate the elevator car or the counterweight in case the elevator car for some reason passes either below the lowest landing level or above the highest landing level with its normal traveling speed. The pit buffer is configured so, that it brings the elevator car or the counterweight to a stop within a distance that is safe for elevator passengers and for the structural components of the elevator.

[0004] Generally, elevators can have either spring buffers or hydraulic buffers receiving the descending elevator car or counterweight. In elevators whose traveling speed exceeds 1 m/s, hydraulic buffers are used.

[0005] Optimally, the elevator pit depth is determined by the distance required for the safe deceleration of the elevator or the counterweight and the safety clearance between the lowest part of the elevator car and the elevator pit floor. However, the structural length of current pit buffers exceeds this at elevator traveling speeds above approximately 2,5 m/s, thus forcing elevator pits to be built deeper than necessary and adding to the cost of elevator construction. Further, in the current pit buffer constructions, the elevator car and the counterweight each have their own buffers and their placement is challenging, since they should be located in the same approximate area as the compensator assembly used for balancing the weight of the hoisting cables and compensating for their elongation.

[0006] In the patent document US 5195616, an elevator pit buffer is disclosed in which the elevator buffer assembly includes a pair of pistons mounted outboard of each side of the elevator car and a rope is reeved about the pistons through a sheave joined at the upper end of the piston. The rope is dead-hitched to the floor or the wall of the elevator pit below the buffer sheaves. The pit buffer assembly for the counterweight is substantially identical to that of the elevator car. In the pit buffer according to US 5195616, the motion retarding stroke of the pit buffer assembly is greater than the buffer piston stroke. Although this disclosure alleviates some of the problems associated with current pit buffer arrangements, it has a total of four separate piston-cylinder constructions making its installation and maintenance costly and time-consuming. Further, the four piston-cylinder constructions require significant space at the bottom of the elevator shaft, which is not always available.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide an improved elevator pit buffer.

[0008] The pit buffer is in particular, but not only, intended for elevators, especially for passenger or cargo elevators of buildings.

[0009] By a roping herein is meant a cable, a belt, a rope or similar, or a combination of them. The roping can comprise one or several individual cables, belts or ropes of different width, diameter and material.

[0010] By a vertical movement path herein is meant the substantially vertical direction in which the elevator car and its counterweight move in alternating opposite directions between different levels served by the elevator.

[0011] By a normal traveling range herein is meant the substantially vertical range of movement of the elevator car and the counterweight between those points that the elevator car and the counterweight are configured to reach, i.e. the lowest and highest landing levels served by the elevator.

[0012] By an elevator pit herein is meant the part of the elevator shaft that is below the normal traveling range of the elevator car and the counterweight. An elevator pit comprises at least a vertical support structure, typically a solid wall, and a floor. Its width can be determined independently of the width of the rest of elevator shaft.

[0013] By a lateral location of the buffering structure is herein meant any position in the elevator pit, in which the buffering structure is not in the path of the elevator car or the counterweight even if one of them descends in to the elevator pit below its normal traveling range.

[0014] In one aspect there is disclosed a pit buffer for an elevator pit, above which an elevator car and a counterweight are intended to run, comprising a roping running across the vertical movement path of the elevator car and/or counterweight, the roping having two ends and each end being fixed to a stationary support, and a buffering structure comprising a cylinder and a co-working piston supporting the roping, the cylinder being configured to offer resistance to the retraction of the piston and located laterally to the vertical movement path of the elevator car and the counterweight, the piston configured to extend outside the cylinder when no force is exerted on the roping, and configured to retract inside the cylinder at least a distance when a force of at least predetermined magnitude is exerted on the roping, and a guiding structure, mounted on the end of the piston, over which the roping is configured to run, **characterized in that** a first

end of the roping is attached at or above the point along the vertical movement path of the elevator car or the counterweight at which the elevator car or counterweight is configured to touch the roping, in that the roping is configured to run over the guiding structure, and in that a second end of the roping is attached to a point lower along the possible vertical movement path of the elevator car or the counterweight than the lowest point to which the guiding structure is configured to retract.

[0015] In another aspect there is disclosed an elevator comprising an elevator pit, an elevator car, a counterweight for the elevator car and a pit buffer, **characterized in that** it comprises a pit buffer according to the present disclosure.

[0016] The pit buffer according to the present disclosure offers at least one the following advantages over prior art:

- The depth of the elevator pit is determined by the distance required for the safe deceleration of the elevator car or the counterweight and the safety clearance between the lowest part of the elevator car and the elevator pit floor, not by the structural length of the pit buffer.
- Placing of the compensator assembly, used for balancing the weight of the hoisting cables and compensating for their elongation, is easier, since the buffering structure of the pit buffer is located laterally to the elevator car and the counterweight.
- It is possible to construct a pit buffer with only one buffering structure in the elevator pit if the elevator car and the counterweight use the same buffering structure.
- The stability of the piston in the buffering structure can be increased with a guide shoe or a guide roller running on a supporting rail allowing the construction of a lighter buffering structure.
- An existing elevator pit can be maximally utilized when an elevator is upgraded to allow the fastest possible elevator traveling speed within the limits of deceleration distance and safety clearance.

[0017] In one embodiment, the buffering structure is intended to be mounted at the bottom of the elevator pit, the elevator pit comprising at least a vertical support structure and a floor, the cylinder is configured to be fixed to the floor and the retracting movement of the piston is configured to be towards the floor.

[0018] In another embodiment, the buffering structure is intended to be mounted at the bottom of the elevator pit, the elevator pit comprising at least the vertical support structure and the floor, and the first end of the roping is configured to be attached to the vertical support structure and the second end of the roping is configured to be attached to the cylinder or to the floor.

[0019] In another embodiment, the guiding structure is a sliding block or a sheave.

[0020] In another embodiment, the piston is supported by a guide shoe or a guide roller running on a supporting rail to increase the stability of the piston.

[0021] In another embodiment, the pit buffer is configured to be used with an elevator car and/or a counterweight that comprises a catching construction to direct the path of the roping across the elevator car and/or counterweight.

[0022] In yet another embodiment, the pit buffer comprises roping guides, and the roping runs through the roping guides that are configured to hold the roping in a predetermined position for receiving the elevator car or counterweight.

[0023] In yet another embodiment, the pit buffer comprises a first roping intended for the elevator car, a second roping intended for the counterweight and one buffering structure that is used for both the elevator car and the counterweight.

[0024] In yet another embodiment, the pit buffer further comprises a support bow fixed to a position above the guiding structure when the piston is in the extended position, and configured to keep the roping of the elevator car or the counterweight in place when force is exerted on the other roping retracting the piston into the cylinder and lowering the guiding structure.

[0025] In yet another embodiment, the support bow is magnetic and the roping is made of ferromagnetic metal or embedded with ferromagnetic metal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention but the invention is not limited to the specific embodiments illustrated in the drawings. In the drawings:

Figure 1 presents the pit buffer according to the present invention in which the elevator car and the counterweight have their own pit buffers (the counterweight and the pit buffer for the counterweight are omitted).

Figure 2A presents the pit buffer according to the present invention in which the same buffering structure is used for the elevator car and the counterweight and when neither the elevator car nor the counterweight have descended to the pit buffer.

Figure 2B presents the pit buffer of Fig. 2A when the elevator car is being decelerated by the pit buffer.

DETAILED DESCRIPTION

[0027] Fig. 1 presents a pit buffer 1 of an elevator in which the pit buffer 1 comprises a roping 2 and a buffering structure 5. In this embodiment the buffering structure 5 comprises a cylinder 6, a piston 7, and a guiding structure 8 for the roping 2. In Fig. 1, the pit buffer 1 of the elevator

car 3 is depicted and the counterweight 4 and its pit buffer 1 are omitted. The lowest floor level is marked with the line A-A' and the space below this level is called the elevator pit 9. The buffering structure 5 has a structural length exceeding the depth of the elevator pit 9, exemplifying an advantage of the current disclosure in which the elevator pit 9 depth is not dependent on the structural length of the buffering structure 5. An elevator car 3 is depicted to be at the lowest floor level, but all other elevator components, such as guide rails for the elevator car 3, hoisting cables and compensator assembly are omitted from the figure.

[0028] The first end of the roping 2 is attached to the elevator shaft 15 wall 16 at a point 18a that is above the level at which the elevator car 3 is configured to touch the roping 2. The roping 2 attachment has to withstand the force exerted by the elevator car 3 on the roping 2 during deceleration by the pit buffer 1 and thus has to be sturdy enough. Many ways to construct such an attachment are possible, as is evident for a person skilled in the art.

[0029] The roping 2 runs through roping guides 14 that suspend the roping 2 in the appropriate position to receive the elevator car 3 if it passes below its normal traveling range. The roping guides 14 are attached to the elevator shaft 15 wall 16, the buffering structure 5 or to other stable structures of the elevator pit 9. Each roping guide 14 can comprise for example a rigid loop or a roller that directs the path of the roping 2 with minimal friction. The roping guides 14 are positioned outside the movement path of the elevator car 3 so, that the elevator car 3 has room to pass them if it descends below its normal traveling range. The design of the roping guides 14 depends on the material of the roping 2 and many solutions are evident for a person skilled in the art.

[0030] The roping 2 runs over a guiding structure 8 mounted at the extended end of the buffering structure 5. The second end of the roping 2 is attached to the cylinder 6 part of the buffering structure 5 at a level 18b below the lowest point to which the guiding structure 8 is configured to retract. Alternatively, the roping 2 could be attached to the elevator pit 9 wall 16, to the elevator pit 9 floor 10 or to any other stable enough structure within the elevator pit 9 at an appropriate height. The strength requirements for the roping 2 attachment for the second end of the roping 2 are similar to those of the roping 2 attachment for the first end of the roping 2.

[0031] The roping 2 can be made of different materials, for example of metal cable or wire, nylon or polyester webbing, or the combination of such materials. Each material has different properties in respect to durability, flexibility, cost, fire resistance properties and the like. Therefore, the selection of material depends on the specifics of the elevator construction in question.

[0032] The buffering structure 5 is located laterally to the elevator car 3 and the counterweight 4. This means that the buffering structure 5 is not in the path of the elevator car 3 or the counterweight 4 even if one of them descends in to the elevator pit 9 below its normal traveling range. The buffering structure 5 can thus be located anywhere in the elevator pit 9, as long as it is not below the elevator car 3 or the counterweight 4.

[0033] The buffering structure 5 comprises a cylinder 6, a piston 7, and the guiding structure 8. The construction of the cylinder 6 and the piston 7 is as known in the art for hydraulic pit buffers and their design is evident for a person skilled in the art. The guiding structure 8 mounted at the top of the buffering structure 5 is configured to convey the force exerted on the roping 2 to the piston 7. The design of the guiding structure 8 depends on the material used for the roping 2. If the roping 2 is made of plastic-based belt, such as nylon, a sliding block 8 with a small radius of curvature might be sufficient, but in case of metal wires, a sheave or a roller 8 would be necessary.

[0034] It would be economical to construct the buffering structure 5 as lightweight as possible. However, due to the buckling tendency of the piston 7 when the elevator car 3 exerts a force on the pit buffer 1, the buffer has to be heavy-built. The pit buffer 1 according to the current disclosure allows a supporting rail (not shown in the figure) to be built alongside the buffering structure 5, since the elevator car 3 does not descend on top of the buffering structure 5. Consequently, a non-retractable structure within the pit buffer 1 is possible. The piston 7 would be slideably connected to the supporting rail through at least one guide shoe or a guide roller from its extended end stabilizing the piston 7 considerably. The supporting rail could be attached either to the cylinder 6, elevator pit 9 floor 10 or to the elevator pit 9 wall 16 and have any design known in the art for such supporting rails.

[0035] In an embodiment where the counterweight 4 has its own pit buffer 1, its structure is substantially identical to that of the pit buffer 1 of the elevator car 3.

[0036] If the elevator car 3 moves below its normal traveling range, it will be received by the roping 2 running across the elevator pit 9. If the elevator car 3 moves below this point, it starts to push the roping 2 downwards. Since both ends of the roping 2 are affixed to the elevator shaft 15 wall 16, the force exerted by the elevator car 3 on the roping 2 pushes the piston 7 into the cylinder 6 of the buffering structure 5 and the roping 2 moves on the guiding structure 8 to release roping 2 to the elevator car 3 side of the buffering structure 5. The buffering structure 5 is constructed so, that the elevator car 3 will stop within a predetermined distance due to the resistance of the hydraulic fluid in the cylinder 6. Due to the configuration of the pit buffer 1, this distance is equal to the distance that the piston 7 retracts into the cylinder 6. The force exerted by the elevator car 3 on the buffering structure 5 varies according to the elevator car 3 speed and weight. The specifics of the buffering structure 5 design thus have to be determined for the elevator in question, as is obvious for the person skilled in the art. There can be a counter force mechanism built into the buffering structure 5 that will elevate the elevator car 3 to the highest point at which the elevator car 3 touches the roping 2 after the

elevator car 3 has been stopped.

[0037] In an embodiment where the counterweight 4 has its own pit buffer 1, it functions substantially identically to the pit buffer 1 of the elevator car 3.

[0038] There can be a catching construction 13 at the underside of the elevator car 3 or the counterweight 4 to direct the path of the roping 2 across the elevator car 3 and/or counterweight 4. The catching construction 13 can be either attached to or form an integral part of the elevator car 3 or the counterweight 4. The catching construction 13 can be located at the lower edges of the elevator car 3 or the counterweight 4 to reduce abrasion directed at the roping 2, by the edges of the elevator car 3 or counterweight 4. In this case, the catching construction 13 can be in the form of rollers or sliding blocks, depending on the material used for the roping 2. For example, rollers are not necessary if the roping 2 is made of easily slidable material, such as a belt with a nylon surface. Alternatively, the catching construction 13 can be located on the underside of the elevator car 3 to guide the path of the roping 2 so, that the roping 2 does not touch the edges of the elevator car 3 or the counterweight 4.

[0039] Fig. 2A presents a pit buffer 1 in which a shared buffering structure 5 is used for the elevator car 3 and the counterweight 4. The numbering of the structures visible in Fig. 2A follows that of Fig. 1 and only the relevant differences between the embodiments are described.

[0040] In Fig. 2A, there are two sets of roping 2a, 2b, each of them constructed as in the embodiment of Fig. 1. The roping 2a is configured to receive the elevator car 3 and the roping 2b the counterweight 4. They are both attached from their first end to the elevator shaft 15 wall 16 above the point 18a at which the elevator car 3 or counterweight 4 is configured to touch the roping 2a, 2b, but on different sides of the elevator shaft 15. Their second end is attached to opposing sides of the cylinder 6 of the buffering structure 5 at a point 18b lower along the vertical movement path of the elevator car 3 or the counterweight 4 than the lowest point to which the guiding structure 8 is configured to retract. The two sets of roping 2a, 2b run through roping guides 14 and over a shared guiding structure 8 mounted at the extended end of the buffering structure 5.

[0041] The guiding structure 8 is constructed as in the embodiment of Fig. 1, except that each set of roping 2a, 2b has its own groove in the guiding structure 8. Alternatively, there could be two separate guiding structures 8 next to each other mounted at the end of the piston 7. This allows the two sets of roping 2a, 2b to run side by side and not to disturb each other's function. As the embodiment of Fig. 1, the buffering structure 5 according to this embodiment can be supported with a supporting rail and at least one accompanying guide shoe or a guide roller.

[0042] The pit buffer 1 according to the embodiment of Fig. 2A further comprises a support bow 17 configured to hold one of the sets of roping 2a, 2b at its original height when the other set of roping 2a, 2b has pressed the guiding structure 8 downwards. To this end, the roping 2a, 2b is made of or is embedded with ferromagnetic metal, and the support bow 17 is magnetic.

[0043] The arrows of opposing directions under the elevator car 3 and the counterweight 4 indicate their opposite alternating movement directions during the normal operation of the elevator.

[0044] Fig. 2B presents the pit buffer 1 of Fig. 2A in which the elevator car 3 has descended below its normal traveling range and is being decelerated by the pit buffer 1, and the roping 2a of the elevator car 3 presses the piston 7 of the buffering structure 5 downwards. The support bow 17 holds the roping 2b of the counterweight 4 at its original height thus preventing it from loosening.

[0045] The roping 2a of the elevator car 3 is in contact with the catching construction 13, which in this embodiment are sliding blocks, but could alternatively be rollers or other friction- or abrasion-reducing devices. The arrows below the elevator car 3 and the counterweight 4 indicate their movement direction in Fig. 2B.

[0046] It should be noted that the structures in the figures are not drawn to proportion. Especially in Figs 2A and 2B, the elevator car 3 and the counterweight 4 are in the opposite vertical ends of the elevator shaft 15 when one of them is in contact with the pit buffer 1. They are both drawn to be visible in the Figs 2A and 2B only for convenience and to exemplify the working mechanism of the pit buffer 1 according to this disclosure.

[0047] It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above, instead they may vary within the scope of the claims. It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. Pit buffer (1) for an elevator pit (9), above which an elevator car (3) and a counterweight (4) are intended to run, comprising
   a roping (2) running across the vertical movement path of the elevator car (3) and/or counterweight (4), the roping (2) having two ends and each end being fixed to a stationary support, and
   a buffering structure (5) comprising
   a cylinder (6) and a co-working piston (7) supporting the roping (2), the cylinder (6) being configured to

offer resistance to the retraction of the piston (7) and located laterally to the vertical movement path of the elevator car (3) and the counterweight (4),
the piston (7) configured to extend outside the cylinder (6) when no force is exerted on the roping (2), and configured to retract inside the cylinder (6) at least a distance when a force of at least predetermined magnitude is exerted on the roping (2), and
a guiding structure (8), mounted on the end of the piston (7), over which the roping (2) is configured to run, **characterized in that** a first end of the roping (2) is attached at or above the point (18a) along the vertical movement path of the elevator car (3) or the counterweight (4) at which the elevator car (3) or counterweight (4) is configured to touch the roping (2), **in that** the roping (2) is configured to run over the guiding structure (8), and **in that** a second end of the roping (2) is attached to a point (18b) lower along the possible vertical movement path of the elevator car (3) or the counterweight (4) than the lowest point to which the guiding structure (8) is configured to retract.

2. The pit buffer (1) according to claim 1, **characterized in that** the buffering structure (5) is intended to be mounted at the bottom of the elevator pit (9), the elevator pit (9) comprising at least a vertical support structure (16) and a floor (10), **in that** the cylinder (6) is configured to be fixed to the floor (10) and **in that** the retracting movement of the piston (7) is configured to be towards the floor (10).

3. The pit buffer (1) according to claim 1 or 2, **characterized in that** the buffering structure (5) is intended to be mounted at the bottom of the elevator pit (9), the elevator pit (9) comprising at least the vertical support structure (16) and the floor (10), and **in that** the first end of the roping (2) is configured to be attached to the vertical support structure (16) and the second end of the roping (2) is configured to be attached to the cylinder (6) or to the floor (10).

4. The pit buffer (1) according to any of the preceding claims, **characterized in that** the guiding structure (8) is a sliding block or a sheave.

5. The pit buffer (1) according to any of the preceding claims, **characterized in that** the piston (7) is supported by a guide shoe or a guide roller running on a supporting rail to increase the stability of the piston (7).

6. The pit buffer (1) according to any of the preceding claims, **characterized in that** the pit buffer (1) is configured to be used with an elevator car (3) and/or a counterweight (4) that comprises a catching construction (13) to direct the path of the roping (2) across the elevator car (3) and/or counterweight (4).

7. The pit buffer (1) according to any of the preceding claims, **characterized in that** the pit buffer (1) comprises roping guides (14), and the roping (2) runs through the roping guides (14) that are configured to hold the roping (2) in a predetermined position for receiving the elevator car (3) or counterweight (4).

8. The pit buffer (1) according to any of the preceding claims, **characterized in that** the pit buffer (1) comprises a first roping (2a) intended for the elevator car (3), a second roping (2b) intended for the counterweight (4) and one buffering structure (5) that is used for both the elevator car (3) and the counterweight (4).

9. The pit buffer (1) according to claim 8, **characterized in that** the pit buffer (1) further comprises a support bow (17) fixed to a position above the guiding structure (8) when the piston (7) is in the extended position, and configured to keep the roping (2a, 2b) of the elevator car (3) or the counterweight (4) in place when force is exerted on the other roping (2a or 2b) retracting the piston (7) into the cylinder (6) and lowering the guiding structure (8).

10. The pit buffer (1) according to claim 9, **characterized in that** the support bow (17) is magnetic and **in that** the roping (2a, 2b) is made of ferromagnetic metal or embedded with ferromagnetic metal.

11. An elevator comprising an elevator pit (9), an elevator car (3), a counterweight (4) for the elevator car (3) and a pit buffer (1), **characterized in that** it comprises a pit buffer (1) according to any of claims 1-10.

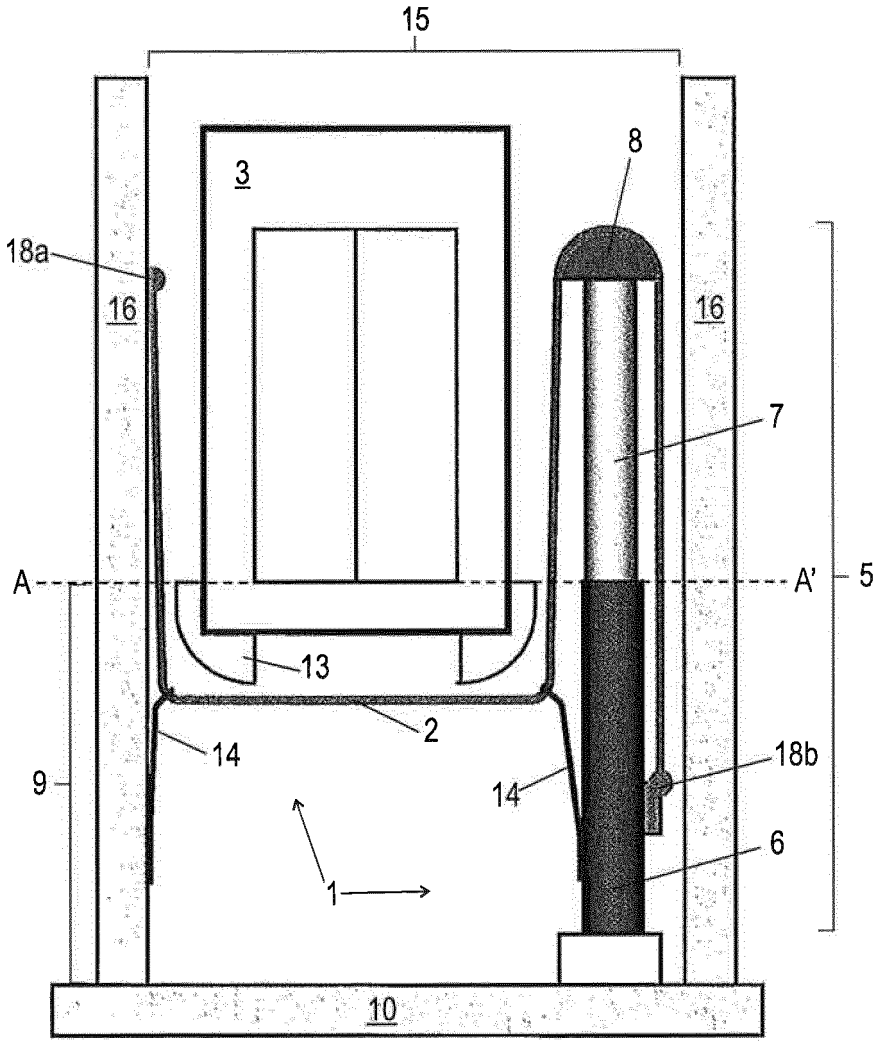

Fig. 1

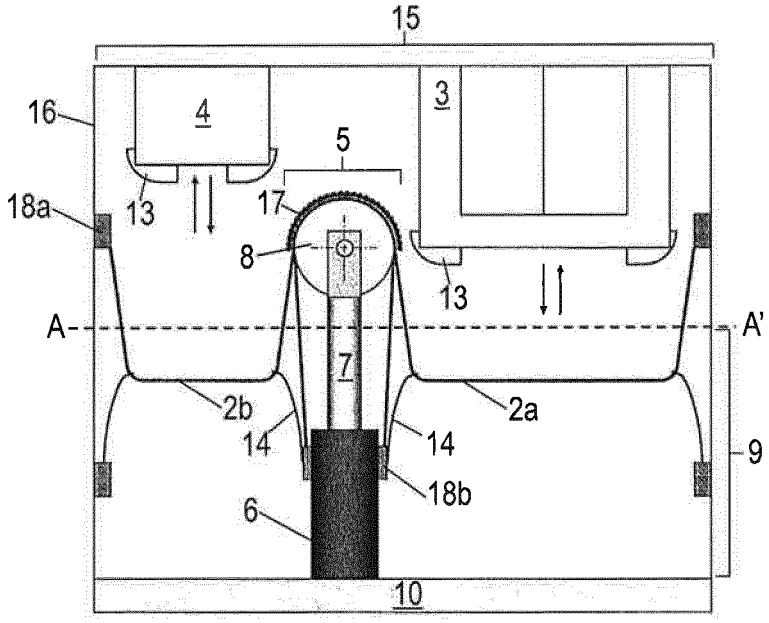
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Fig. 2A

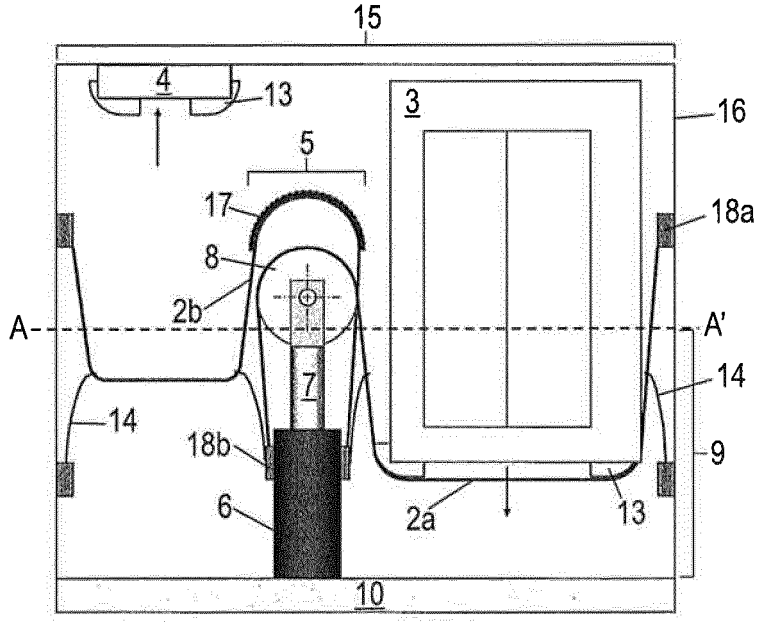
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Fig. 2B

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EUROPEAN SEARCH REPORT

Application Number
EP 13 17 5910

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	CN 202 208 584 U (BEIJING SHENGHUA ELEVATOR GROUP CO LTD) 2 May 2012 (2012-05-02) * abstract * * paragraphs [0017] - [0020] * * figure 2 *	1-7,11 8-10	INV. B66B5/28
A,D	US 5 195 616 A (YOO YOUNG S [US] ET AL) 23 March 1993 (1993-03-23) * abstract * * column 2, line 36 - column 3, line 26 * * figures 1-3 *	1	
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A	CN 2 195 535 Y (SUO SHUANGFU [CN]) 26 April 1995 (1995-04-26) * abstract * * figure 1 *	1	TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 December 2013	Oosterom, Marcel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 5910

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-12-2013

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EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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