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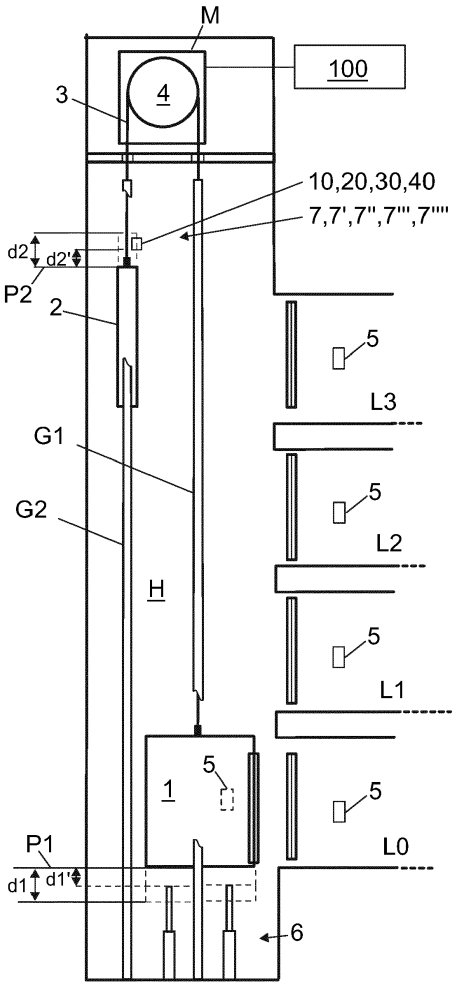
(54) ELEVATOR

(57) The invention relates to an elevator having a normal operation mode wherein the elevator is usable for transporting passengers and/or goods, and while in this mode, the elevator comprises a hoistway (H) comprising a ceiling (C); a first elevator unit (1) movable vertically in the hoistway (H) below the ceiling (C); and a second elevator unit (2) movable vertically in the hoistway (H) below the ceiling (C); and a first stopping arrangement (6) for stopping descent of the first elevator unit (1) more than a distance (d1) below its lower extreme position (P1) and a second stopping arrangement (7,7',7",7"',7"") for stopping ascent of the second elevator unit (2) more than a distance (d2) above its upper extreme position (P2). The second stopping arrangement (7,7',7",7"',7"") comprises an obstructing equipment (10,20,30,40) positioned within the hoistway (H) in vertical direction between the second elevator unit (2) and the hoistway ceiling (C) for obstructing ascent of the second elevator unit (2) more than a distance (d2) above its upper extreme position (P2).

Fig. 1



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Description

FIELD OF THE INVENTION

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

BACKGROUND OF THE INVENTION

[0002] Elevators typically comprise a car and a counterweight interconnected with a suspension roping, which passes around a rope wheel and suspends the car and the counterweight on opposite sides of the rope wheel. Thereby, the car moves upwards when the counterweight unit moves downwards, and vice versa. In this kind of elevators, there is a risk that if the car and counterweight accidentally moves below its lower extreme position of normal use, as far as to hit a buffer below it, the car will suddenly stop, but the counterweight will not. The counterweight may then continue its travel upwards above the level of its upper extreme position of normal use. This causes a risk that the counterweight might hit the ceiling of the hoistway, which might cause serious risk of damage to the elevator or building, which might cause parts dropping and hitting the car and its passengers. A possible further risk is that in such an event the suspension roping would be slackened, followed by a drop to be again suspended by the suspension roping.

[0003] For ensuring safety in accidental events as mentioned above, a space has been designed above the counterweight and the car so as to ensure that if precautions fail and the counterweight or the car ends up jumping after the other has hit its buffer below it, no collision on the ceiling of the hoistway can occur. A drawback has been that in some cases it is difficult to design a space above the car or counterweight. It has been possible to make room above the car and/or counterweight by lowering the height of the car and/or counterweight. This, however can lead to a situation where the internal height of the car for example has to be smaller than customer prefers. On the counterweight side, this can lead to a situation where lead fillers need to be used instead of steel fillers, because pure steel will not give enough weight for a low-sized counterweight.

[0004] Generally in prior art, the risk that a counterweight may continue its travel even though the car has stopped, has been solved with a so called tie-down device acting on a compensation roping that eliminates unbalance of rope weight. The tie-down device limits movement of the compensation roping upwards, whereby it blocks upwards directed movement of the counterweight whenever the car stops. A drawback of this solution has been that it's reliability and ability to stop the upward movement of the counterweight within short distance is dependent on compensation rope condition and properties. Moreover, this solution may not be economical or possible in all elevators.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The object of the invention is to provide a new elevator wherein safety can be ensured space efficiently and economically in a situation where one of the elevator units unintendedly during normal elevator transport use continues its passage below its lower extreme position to such extent that it must be suddenly stopped. 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 safety space above the car can be designed low and/or the height of the car or counterweight can be designed high. Solutions are presented, *inter alia*, wherein the elevator need not have a compensation roping for providing a tie-down function.

[0006] It is brought forward a new elevator having a normal operation mode wherein the elevator is usable for transporting passengers and/or goods. While the elevator is in the normal operating mode, it is as follows. The elevator comprises a hoistway comprising a ceiling; a first elevator unit movable vertically in the hoistway below the ceiling, preferably along at least one vertically oriented guide rail; and a second elevator unit movable vertically in the hoistway below the ceiling, preferably along at least one vertically oriented guide rail. At least one of the elevator units is an elevator car for transporting passengers and/or goods. The other one of the elevator units is either a counterweight or possibly also an elevator car. While the elevator is in the normal operating mode, it moreover comprises a suspension roping passing around a rope wheel and suspending the elevator units on opposite sides of the rope wheel, whereby the first elevator unit is arranged to move upwards when the second elevator unit moves downwards, and vice versa; and one or more user interfaces. The one or more user interfaces preferably comprise one or more user interfaces located at landing(s) of the elevator and/or a user interface inside the elevator unit which is an elevator car and/or one or more user interfaces carried by one or more users of the elevator. The elevator moreover comprises an elevator control arranged to automatically control in said normal operation mode movement of the elevator units in response to signals from one or more of the user interfaces. Each said elevator unit is movable, in particular automatically such that movement of the elevator unit is under automatic control of the elevator control, in said normal operation mode into an upper extreme position and into a lower extreme position, wherein when the first elevator unit is in its lower extreme position the second elevator unit is in its upper extreme position, and vice versa. While the elevator is in the normal operating mode, it moreover comprises a first stopping arrangement for stopping descent of the first elevator unit more than a distance below its lower extreme position; and a second stopping arrangement for stopping ascent of the second elevator unit more than a distance above its upper extreme position. The second stopping arrangement

comprises an obstructing equipment positioned within the hoistway in vertical direction between the second elevator unit and the hoistway ceiling for obstructing ascent of the second elevator unit more than a distance (d2) above its upper extreme position while the elevator is in the normal operating mode. With this solution, one or more of the above mentioned advantages and/or objectives are achieved. Particularly, by an obstructing equipment thus positioned, upwards directed movement of the second elevator unit can be stopped in such a short distance above its upper extreme position that no high space need be provided above the second elevator unit. Preferable further features are introduced in the following, which further features can be combined with the elevator individually or in any combination.

[0007] In a preferred embodiment, when the elevator unit which is the elevator car is in its lower extreme position, it is level with the lowermost landing of the elevator in question. When the car is level with a landing, the sill of the landing and the sill of the car are level with each other.

[0008] In a preferred embodiment, said obstructing equipment of the second stopping arrangement is separate from the second elevator unit.

[0009] In a preferred embodiment, said obstructing equipment of the second stopping arrangement is mounted in the upper end of the hoistway on an immovable structure of the elevator, such as on the ceiling of the hoistway or an element immovably mounted thereon, or one or more guide rails or an element immovably mounted thereon.

[0010] In a preferred embodiment, said the second stopping arrangement is arranged to act on the second elevator unit when the second elevator unit is positioned a maximal allowed distance above its upper extreme position to stop its passage within a stopping distance. Hereby, it is determined up to which point the second elevator unit is free to move without being acted on by the second stopping arrangement. The maximal allowed distance is preferably in within range of 0.05 - 0.5 m, most preferably in within range of 0.05 - 0.2 m. Thus, the second stopping arrangement can be passive during normally operation of the elevator.

[0011] In a preferred embodiment, the first stopping arrangement is arranged to act on the first elevator unit when the first elevator unit is positioned a maximal allowed distance above its upper extreme position which maximal allowed distance is in within range of 0.05 - 0.5 m to stop its passage within a stopping distance, most preferably in within range of 0.05 - 0.2 m.

[0012] In a preferred embodiment, said obstructing equipment comprises one or more buffers. One or more buffers can with a simple structure be designed to reliably stop the second elevator unit in short distance. The one or more buffers are preferably positioned within the hoistway in vertical direction between the second elevator unit and the hoistway ceiling for obstructing ascent of the second elevator unit more than a distance above its upper extreme position. Each buffer is preferably deformable in collision for cushioning the collision. For this purpose each buffer may comprise an elastic member for cushioning the collision or a telescopic cylinder device, retraction of which is dampened e.g. hydraulically. Each buffer can comprise a vertically retractable telescopically operating piston-cylinder -pair, for instance. The one or more buffers is/are preferably arranged to allow a stopping distance to be more than 10 cm.

[0013] In a preferred embodiment, the aforementioned one or more buffers are mounted on an immovable structure of the elevator, such as on the ceiling of the hoistway or an element immovably mounted thereon, or one or more guide rails or an element immovably mounted thereon, the second elevator unit being arranged to collide with the one or more buffers if the second elevator unit moves above preferably more specifically a maximal allowed distance above, its upper extreme position.

[0014] In a preferred embodiment, said obstructing equipment is mounted in the upper end of the hoistway on one or more guide rails of the second elevator unit. The obstructing equipment can be fixed immovably on two vertically oriented guide rails along which and the second elevator unit is movable vertically in the hoistway below the ceiling. The obstructing equipment then preferably forms a beam structure between said two guide rails.

[0015] In a preferred embodiment, the obstructing equipment of the second stopping arrangement is mounted in the upper end of the hoistway on one or more guide rails of the second elevator unit and the second elevator unit comprises a stop face positioned below the obstructing equipment such that it collides with the obstructing equipment if the second elevator unit moves above its upper extreme position, preferably more specifically a maximal allowed distance above its upper extreme position, and the obstructing equipment comprises a gripping device arranged grip a guide rail of the second elevator unit, in particular for taking downwards directed support force (i.e. reaction force) from the guide rail in said collision. Hereby, the reaction force for stopping an upwards moving second elevator unit can be taken from a firm and reliable structure that can simply be provided on any elevator.

[0016] In a preferred embodiment, the aforementioned gripping device comprises a wedging means comprising at least one wedging member wedgeable against the guide rail, and upwards directed movement of the obstructing equipment is arranged to cause the at least one wedging member wedge against a guide rail. Hereby, a strong and holding grip can be achieved between the gripping device and the guide rail. Preferably, the wedging means comprise at least one wedge housing. A wedging space is formed between the wedge housing and the guide rail. The wedging member is preferably placed within the wedging space and wedgeable against the guide rail by upward directed movement of the obstructing equipment. Thereby, upward directed movement of

the obstructing equipment is arranged to cause the at least one wedging member wedge against a guide rail. The wedging space is preferably tapered, having a downwards narrowing cross section. The wedging member can also be tapered having a downwards narrowing cross section, but it could alternatively have some other shape or structure, such as it could be a roller, for instance.

[0017] In a preferred embodiment, said obstructing equipment is suspended by suspension means allowing upwards directed movement of the obstructing equipment. This facilitates that the wedging means can slightly move vertically so that the at least one wedging member wedges forcefully against the guide rail. The wedging means can also be pre-wedged state, i.e. the wedging means are already in wedging state prior the collision. This can be facilitated by a spring mechanism, for instance, arranged to urge the wedging member towards the narrower end of the wedging space. Thereby collision can with only short relative movement of the parts wedge the wedging member against the guide rail more forcefully. The pre-wedging also makes the wedging more reliable.

[0018] In a preferred embodiment, the aforementioned suspension means comprise one or more elongated flexible members such as a cable, rope or chain carrying the weight of the obstructing equipment or at least part of said weight. Preferably, the suspension is moreover implemented such that each said flexible member is attached on the obstructing equipment and on the ceiling of the hoistway as illustrated. In a preferred alternative implementation, the suspension means are suspended by one or more guide rails of the second elevator unit. Then the suspension is preferably moreover implemented such that each said flexible member is attached on the obstructing equipment and on a guide rail of the second elevator unit.

[0019] In a preferred embodiment, said obstructing equipment is mounted on the second elevator unit. Thereby, in this embodiment, said obstructing equipment is arranged to travel together with the second elevator unit. Preferably, then said obstructing equipment comprises one or more buffers. The stopping arrangement then preferably comprises a stop face positioned above the buffer such that the buffer collides with it if the second elevator unit moves above preferably more specifically a maximal allowed distance above, its upper extreme position. Said stop face is preferably a bottom face of an immovable structure of the elevator, such as bottom face of the ceiling of the hoistway or of an element immovably mounted thereon, or a bottom face of a guide rail or of an element immovably mounted thereon.

[0020] In a preferred embodiment, the elevator is such that the suspension roping is fixed by its first end to the first elevator unit and by its second end to the second elevator unit. Both elevator units are thereby suspended by 1:1 suspension ratio.

[0021] In a preferred embodiment, the elevator is such that the elevator units are not interconnected by a further roping in addition to said suspension roping which hangs between them, and passes around a rope wheel mounted in the lower end of the hoistway. Most preferably, the elevator units are preferably not interconnected by any further roping in addition to said suspension roping.

[0022] In a preferred embodiment, the first stopping arrangement comprises at least one buffer mounted in the lower end of the hoistway for stopping descent of the first elevator unit more than a distance below its lower extreme position.

[0023] In a preferred embodiment, the elevator is such that the movement of the elevator units is provided by aid of an electric motor controlled by the elevator control. The elevator is particularly preferably such that it comprises an electric motor for rotating the aforementioned rope wheel around which the suspension roping passes, and the elevator control is arranged to control rotation of the electric motor.

[0024] In a preferred embodiment, the first elevator unit is an elevator car and the second elevator unit is a counterweight.

[0025] In a preferred embodiment, said second distance d2 is within range 0 - 1 meters, preferably within range 0 - 0.5 meters.

[0026] In a preferred embodiment, said first distance d2 is within range 0 - 1 meters, preferably within range 0 - 0.5 meters.

[0027] In a preferred embodiment, said one or more user interfaces comprise one or more user interfaces located at landing(s) of the elevator and/or a user interface inside the elevator unit which is an elevator car and/or one or more user interfaces carried by one or more users of the elevator (e.g. an interface program run on a mobile communication device carried by the user, the mobile communication device preferably being a mobile phone or tablet).

[0028] The elevator is in general preferably such that it comprises an elevator car vertically movable to and from plurality of landings, i.e. two or more vertically displaced landings during its normal operation mode. Preferably, the elevator car has an interior space suitable for receiving a passenger or passengers, and the car can be provided with a door for forming a closed interior space..

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] In the following, the present invention will be described in more detail by way of example and with reference to the attached drawings, in which

Figure 1 illustrates an elevator according to a preferred embodiment.

Figure 2 a first embodiment of the second stopping arrangement of Figure 1.

Figure 3 illustrates further preferred details for the embodiment of Figure 2.

Figure 4 illustrates further preferred details for the

embodiment of Figure 2.

Figure 5 illustrates a second embodiment of the second stopping arrangement of Figure 1.

Figure 6 illustrates a third embodiment of the second stopping arrangement of Figure 1.

Figure 7 illustrates a fourth embodiment of the second stopping arrangement of Figure 1.

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

DETAILED DESCRIPTION

[0030] Figure 1 illustrates an elevator according to a preferred embodiment. The elevator is an elevator for transporting passengers and/or goods.

[0031] The elevator has a normal operation mode wherein the elevator is usable for transporting passengers and/or goods. Figure 1 illustrates the elevator in said normal operation mode. The elevator, while in this normal operation mode, comprises a hoistway H comprising a ceiling C;a first elevator unit 1 movable vertically in the hoistway H below the ceiling C along at least one vertically oriented guide rail G1; and a second elevator unit 2 movable vertically in the hoistway H below the ceiling C along at least one vertically oriented guide rail G2, at least one of the elevator units 1,2 being an elevator car for transporting passengers and/or goods, the other being a counterweight or also an elevator car. In the presented case, one 1 of the elevator units 1,2 is an elevator car for transporting passengers and/or goods, and the other 2 of the elevator units 1,2 is a counterweight. The elevator moreover comprises a suspension roping 3 passing around a rope wheel 4 and suspending the elevator units 1, 2 on opposite sides of the rope wheel 4, whereby the first elevator unit 1 is arranged to move upwards when the second elevator unit 2 moves downwards, and vice versa; and user interfaces 5, and an elevator control 100 arranged to automatically control in said normal operation mode movement of the elevator units 1, 2 in response to signals from one or more of the user interfaces 5. Said user interfaces here comprise user interfaces 5 located at landing(s) L0-L3 and a user interface located inside the elevator unit 1 which is an elevator car. However, the user interfaces 5 could be or include also user interfaces of other kind than presented. For example additionally or alternatively, the user interfaces 5 could comprise one or more user interfaces carried by one or more users of the elevator, e.g. an interface program run on a mobile communication device carried by the user, the mobile communication device preferably being a mobile phone or tablet). In the application, terms user, user of the elevator and passenger are considered to have the same meaning.

[0032] Each said elevator unit 1, 2 is movable in said normal operation mode, in particular automatically such that movement of the elevator unit 1,2 is under automatic control of the elevator control 100, into an upper extreme position P2 and into a lower extreme position P1, wherein when the first elevator unit 1 is in its lower extreme position the second elevator unit 2 is in its upper extreme position, and vice versa. Figure 1 illustrates the first elevator unit 1 is in its lower extreme position P1 the second elevator unit 2 is in its upper extreme position P2.

[0033] When the elevator unit 1 which is the elevator car is in its lower extreme position P1, it is level with the lowermost landing L0 of the elevator. When the elevator unit 1 which is the elevator car is in its upper extreme position, it is level with the uppermost landing L3 of the elevator. When the car is level with a landing the sill of the landing L0,L3 and the sill of the car 1 are level with each other.

[0034] The elevator, while in this normal operation mode, moreover comprises a first stopping arrangement 6 for stopping descent of the first elevator unit 1 more than a distance d1 below its lower extreme position P1. In the preferred embodiment of Figure 1, the first stopping arrangement 6 comprises buffers mounted in the lower end of the hoistway H.

[0035] The elevator, while in this normal operation mode, moreover comprises a second stopping arrangement 7,7',7",7"',7"" for stopping ascent of the second elevator unit 2 more than a distance d2 above its upper extreme position P2 while the elevator is in the normal operating mode. The second stopping arrangement 7,7',7",7"',7"" comprises an obstructing equipment 10,20,30,40 positioned within the hoistway H in vertical direction between the second elevator unit 2 and the hoistway ceiling C for obstructing ascent of the second elevator unit 2 more than a distance d2 above its upper extreme position P2. The second stopping arrangement 7,7',7",7"',7"" is advantageous since it facilitates that the jumping height of the second elevator unit 2 can be reduced in an assumed malfunction situation where the first elevator unit 1 unintendedly during normal elevator use continues its passage below its lower extreme position P1 to such extent that it must be stopped by the stopping arrangement 6. Figure 1 presents the obstructing equipment 10,20,30,40 merely schematically, and Figures 2-7 illustrate preferred embodiments thereof.

[0036] In the embodiment according to Figure 1, the first stopping arrangement 6 is arranged to act on the first elevator unit 1 when the first elevator unit 1 is positioned a maximal allowed distance d1' below its lower extreme position P1 so as to stop its passage within a stopping distance (stopping distance =d1-d1'), wherein the maximal allowed distance d1' is preferably in within range of 0.05 - 0.5 m.

[0037] In the embodiment according to Figure 1, the second stopping arrangement 7 is arranged to act on the second elevator unit 2 when the second elevator unit 2 is positioned a maximal allowed distance d2' above its upper extreme position P2 so as to stop its passage within a stopping distance (d2s=d2-d2'), wherein the maximal allowed distance d2' is preferably in within range of 0.05

- 0.5 m.

[0038] Preferably, each said distance d1 and d2 is within range 0 - 1 meters, more preferably within range 0 - 0.5 meters.

[0039] Figure 2 illustrates a first embodiment of the second stopping arrangement 7,7' of Figure 1. In this case, the obstructing equipment 10 of the second stopping arrangement 7,7' is mounted in the upper end of the hoistway H on one or more guide rails G2 of the second elevator unit.

[0040] The second elevator unit 2, in particular a stopper element thereof, comprises a stop face 2a positioned below the obstructing equipment 10 such that it collides with the obstructing equipment 10, in particular with at least one stop face 10a thereof, if the second elevator unit 2 moves above, preferably more specifically a maximal allowed distance d2' above, its upper extreme position. The obstructing equipment 10 comprises a gripping device 11 arranged grip a guide rail G2 of the second elevator unit 2 for taking downwards directed support force (i.e. reaction force) from the guide rail G2 in said collision. The aforementioned stop face 10a can be practically any part of the obstructing equipment 10. However, it is preferably either a stop face of a gripping device 11 or a lever connected therewith. Thus, enduring force transmission is easy to provide.

[0041] The gripping device 11 comprises a wedging means 12,13,14 comprising at least one wedge housing 12. A wedging space 13 is formed between the wedge housing 12 and the guide rail G2. The wedging means 12,13,14 moreover comprises a wedging member 14 placed within the wedging space 13 and wedgeable against the guide rail G2. Upward directed movement of the obstructing equipment 10 is arranged to cause the at least one wedging member 14 wedge against the guide rail G2.

[0042] The wedging space 13 is particularly tapered having a downwards narrowing cross section. In Figure 2, the wedging member 14 is also tapered having a downwards narrowing cross section, but it could alternatively have some other shape or structure, such as it could be a roller, for instance.

[0043] Figure 3 illustrates further preferred details for the embodiment of Figure 2. In this case, the obstructing equipment 10 forms a beam structure between two vertically oriented guide rails G2 along which and the second elevator unit (2 is movable vertically in the hoistway H below the ceiling C. In the Figure, the second elevator unit 2 is in its upper extreme position P2.

[0044] The obstructing equipment 10 comprises two gripping devices 11 as above described, arranged to grip the two guide rails G2 of the second elevator unit 2 for taking downwards directed support force (i.e. reaction force) from the guide rails G2 in said collision. In this embodiment, the obstructing equipment 10 is suspended by suspension means 15 allowing upwards directed movement of the obstructing equipment 10. The suspension means 15 comprises one or more elongated flexible member such as a cable, rope or chain carrying the weight of the obstructing equipment 10 or at least part of said weight. The suspension means 15 are suspended by the ceiling C of the hoistway H. The suspension is moreover implemented such that each said flexible member 15a is attached on the obstructing equipment 10 and on the ceiling C of the hoistway H as illustrated.

[0045] Figure 4 illustrates further preferred details for the embodiment of Figure 2. In the Figure, the second elevator unit 2 is in its upper extreme position P2.The solution presented is otherwise similar to that of Figure 3 but here the suspension means 15 are suspended by the guide rails G2 of the second elevator unit 2. The suspension is moreover implemented such that each said flexible member 15a is attached on the obstructing equipment 10 and on a guide rail G2 of the second elevator unit 2.

[0046] Figure 5 illustrates a second embodiment of the second stopping arrangement 7" of Figure 1. In this case, the obstructing equipment 20 of the second stopping arrangement 7" is mounted in the upper end of the hoistway H on guide rails G2 of the second elevator unit 2.

[0047] In this embodiment, the obstructing equipment 20 comprises buffers 21 positioned within the hoistway H in vertical direction between the second elevator unit 2 and the hoistway ceiling C for obstructing ascent of the second elevator unit 2 more than a distance d2 above its upper extreme position P2. In the Figure, the second elevator unit 2 is in its upper extreme position P2.

[0048] The obstructing equipment 20 is fixed immovably on two vertically oriented guide rails G2 along which and the second elevator unit 2 is movable vertically in the hoistway H below the ceiling C. The obstructing equipment 20 particularly forms a beam structure between said two guide rails G2.

[0049] The second elevator unit 2 is positioned below the obstructing equipment 20 such that it collides with the obstructing equipment 20, in particular with said buffers 21 thereof, if the second elevator unit 2 moves above, preferably more specifically a maximal allowed distance d2' above, its upper extreme position P2.

[0050] The second stopping arrangement 7' is arranged to act on the second elevator unit 2 when the second elevator unit 2 is positioned a maximal allowed distance d2' above its upper extreme position P2 so as to stop its passage within a stopping distance (d2s=d2-d2'). The maximal allowed distance d2' is preferably in within range of 0.05 - 0.5 m, but it could of course be alternatively be shorter or longer. The aforementioned maximal allowed distance d2' is most preferably in within range of 0.05 - 0.2 m. The buffers 21 are preferably deformable in collision for cushioning the collision. The degree in which the buffers 21 can deform defines the stopping distance, i.e. the distance within which the stopping equipment stops the second elevator unit 2 after collision. The buffers 21 are preferably arranged to allow a stopping distance to be more than 5 cm, more preferably more than 10 cm. Thereby, the impact in collision will not be-

come excessive for the elevator components. The deformability can be achieved by making at least part of each buffer of elastic material, such as rubber.

[0051] Figure 6 illustrates a third embodiment of the second stopping arrangement 7"' of Figure 1. In this case, the obstructing equipment 30 of the second stopping arrangement 7" is mounted in the upper end of the hoistway H. The obstructing equipment 30 comprises two buffers 30 positioned within the hoistway H in vertical direction between the second elevator unit 2 and the hoistway ceiling C for obstructing ascent of the second elevator unit 2 more than a distance d2 above its upper extreme position P2. The buffers 30 are mounted on an immovable structure of the elevator, which is in the presented case the ceiling C of the hoistway H. In Figure 6, the second elevator unit 2 is in its upper extreme position P2.

[0052] Particularly, the second elevator unit 2 is positioned below the obstructing equipment 10 such that it collides with the obstructing equipment 30, in particular with said buffers 30 thereof, if the second elevator unit 2 moves above, preferably more specifically a maximal allowed distance d2' above, its upper extreme position P2. The second stopping arrangement 7' is arranged to act on the second elevator unit 2 when the second elevator unit 2 is positioned a maximal allowed distance d2' above its upper extreme position P2 so as to stop its passage within a stopping distance (d2s=d2-d2'). The aforementioned maximal allowed distance d2' is preferably in within range of 0.05 - 0.5 m, but it could of course be alternatively be shorter or longer. The aforementioned maximal allowed distance d2' is most preferably in within range of 0.05 - 0.2 m.

[0053] The buffers 30 preferably are deformable in collision for cushioning the collision. The degree in which the buffers 30 can deform defines the stopping distance, i.e. the distance within which the stopping equipment stops the second elevator unit 2 after collision. The one or more buffers 30 is/are preferably arranged to allow a stopping distance (d2s=d2-d2') to be more than 5 cm, more preferably more than 10 cm. Thereby, the impact in collision will not become excessive for elevator components.

[0054] For achieving deformability, each buffer 30 may comprise an elastic member for cushioning the collision or be a telescopic cylinder device as disclosed in Figure 6, where retraction of the telescopic cylinder device is dampened e.g. hydraulically or pneumatically. In the presented embodiment, each buffer 30 comprises a vertically retractable telescopically operating piston-cylinder -pair.

[0055] Figure 7 illustrates a fourth embodiment of the second stopping arrangement 7"" of Figure 1. The obstructing equipment 40 comprises two buffers 40 positioned within the hoistway H in vertical direction between the second elevator unit 2 and the hoistway ceiling C for obstructing ascent of the second elevator unit 2 more than a distance d2 above its upper extreme position P2. In this embodiment, the buffers 40 are mounted on the second elevator unit 2. Thereby it is arranged to travel together with the second elevator unit 2. In Figure 6, the second elevator unit 2 is in its upper extreme position P2.

[0056] The stopping arrangement 7"" comprises a stop face Ca positioned above each said buffer 40 such that the buffer 40 collides with it if the second elevator unit 2 moves above, preferably more specifically a maximal allowed distance d2' above, its upper extreme position P2. In the illustrated case, said stop face Ca is a bottom face of an immovable structure of the elevator, in particular a bottom face of the ceiling C of the hoistway H.

[0057] The second stopping arrangement 7"" is arranged to act on the second elevator unit 2 when the second elevator unit 2 is positioned a maximal allowed distance d2' above its upper extreme position P2 so as to stop its passage within a stopping distance (d2s=d2-d2'). The aforementioned maximal allowed distance d2' is preferably in within range of 0.05 - 0.5 m, but it could of course be alternatively be shorter or longer. The aforementioned maximal allowed distance d2' is most preferably in within range of 0.05 - 0.2 m.

[0058] The buffers 40 preferably are deformable in collision for cushioning the collision. The degree in which the buffers 40 can deform defines the stopping distance, i.e. the distance within which the stopping equipment stops the second elevator unit 2 after collision. The buffers 40 are preferably arranged to allow a stopping distance (d2s=d2-d2') to be more than 5 cm, more preferably more than 10 cm. Thereby, the impact in collision will not become excessive for elevator components.

[0059] For achieving deformability, each buffer 40 may comprise an elastic member for cushioning the collision or be a telescopic cylinder device as disclosed in Figure 6, where retraction of the telescopic cylinder device is preferably dampened e.g. hydraulically or pneumatically. In the presented embodiment, each buffer 40 comprises a vertically retractable telescopically operating piston-cylinder -pair.

[0060] The movement of the elevator units 1,2 is preferably provided by aid of an electric motor m controlled by the elevator control 100. The elevator is particularly preferably such that it comprises an electric motor M for rotating the rope wheel 4, and the elevator control 100 is arranged to control rotation of the electric motor M.

[0061] Generally, the elevator units 1,2 are preferably not interconnected by a further roping in addition to said suspension roping 3, which further roping hangs between the elevator units 1,2, and passes around a rope wheel mounted in the lower end of the hoistway H. Most preferably, the elevator units 1,2 are not interconnected by any further roping in addition to said suspension roping 3.

[0062] 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 having a normal operation mode wherein the elevator is usable for transporting passengers and/or goods, and while in this mode, the elevator comprises
a hoistway (H) comprising a ceiling (C);
a first elevator unit (1) movable vertically in the hoistway (H) below the ceiling (C), preferably along at least one vertically oriented guide rail (G1), and a second elevator unit (2) movable vertically in the hoistway (H) below the ceiling (C), preferably along at least one vertically oriented guide rail (G2), at least one of the elevator units (1,2) being an elevator car for transporting passengers and/or goods, the other being a counterweight or also an elevator car; and
a suspension roping (3) passing around a rope wheel (4) and suspending the elevator units (1, 2) on opposite sides of the rope wheel (4), whereby the first elevator unit (1) is arranged to move upwards when the second elevator unit (2) moves downwards, and vice versa; and
one or more user interfaces (5); and
an elevator control (100) arranged to automatically control in said normal operation mode movement of the elevator units (1, 2) in response to signals from one or more of the user interfaces (5), each said elevator unit (1, 2) being movable in said normal operation mode into an upper extreme position (P1) and into a lower extreme position (P2), wherein when the first elevator unit (1) is in its lower extreme position (P1) the second elevator unit (2) is in its upper extreme position (P2), and vice versa; and
a first stopping arrangement (6) for stopping descent of the first elevator unit (1) more than a distance (d1) below its lower extreme position (P1);
a second stopping arrangement (7,7',7",7"',7"") for stopping ascent of the second elevator unit (2) more than a distance (d2) above its upper extreme position (P2);
characterized in that the second stopping arrangement (7,7',7",7"',7"") comprises an obstructing equipment (10,20,30,40) positioned within the hoistway (H) in vertical direction between the second elevator unit (2) and the hoistway ceiling (C) for obstructing ascent of the second elevator unit (2) more than a distance (d2) above its upper extreme position (P2).

2. An elevator according to claim 1, wherein when the elevator unit (1) which is the elevator car is in its lower extreme position (P1), it is level with the lowermost landing (L0) of the elevator.

3. An elevator according to any of the preceding claims, wherein said obstructing equipment (10,20,30) of the second stopping arrangement (7,7',7",7"') is mounted in the upper end of the hoistway (H) on an immovable structure (G2, C) of the elevator, such as on the ceiling (C) of the hoistway (H) or an element immovably mounted thereon, or one or more guide rails (G2) or an element immovably mounted thereon.

4. An elevator according to any of the preceding claims, wherein said obstructing equipment (10,20,30) of the second stopping arrangement (7,7',7",7"') is separate from the second elevator unit (2).

5. An elevator according to any of the preceding claims, wherein said second stopping arrangement (7,7',7",7"') is arranged to act on the second elevator unit (2) when the second elevator unit (2) is positioned a maximal allowed distance (d2') above its upper extreme position (P2) to stop its passage within a stopping distance.

6. An elevator according to any of the preceding claims, wherein said obstructing equipment (20,30,40) comprises one or more buffers positioned within the hoistway (H) in vertical direction between the second elevator unit (2) and the hoistway ceiling (C) for obstructing ascent of the second elevator unit (2) more than a distance (d2) above its upper extreme position (P2).

7. An elevator according to any of the preceding claims, wherein said obstructing equipment (20,30,40) comprises one or more buffers mounted on an immovable structure of the elevator, such as on the ceiling (C) of the hoistway (H) or an element immovably mounted thereon, or one or more guide rails (G2) or an element immovably mounted thereon, the second elevator unit (2) being arranged to collide with the one or more buffers if the second elevator unit (2) moves above, preferably more specifically a maximal allowed distance (d2') above, its upper extreme position (P2).

8. An elevator according to any of the preceding claims, wherein said obstructing equipment (10,20) is mounted in the upper end of the hoistway (H) on one or more guide rails (G2) of the second elevator unit (2).

9. An elevator according to any of the preceding claims, wherein said obstructing equipment (40) is mounted on the second elevator unit (2).

10. An elevator according to any of the preceding claims, wherein the obstructing equipment (10) of the second stopping arrangement (7) is mounted in the upper end of the hoistway (H) on one or more guide rails (G2) of the second elevator unit (2) and the second elevator unit (2) comprises a stop face (2a) positioned below the obstructing equipment (10) such that the stop face (2a) collides with the obstructing equipment (10) if the second elevator unit (2) moves above its upper extreme position (P2), preferably more specifically a maximal allowed distance (d2') above its upper extreme position (P2), and the obstructing equipment (10) comprises at least one gripping device (11) arranged grip a guide rail (G2) of the second elevator unit (2).

11. An elevator according to any of the preceding claims, wherein said gripping device (11) comprises a wedging means (12,13,14) comprising at least one wedging member (14) wedgeable against a guide rail (G2), and upwards directed movement of the obstructing equipment (10) is arranged to cause the at least one wedging member (14) wedge against the guide rail (G2).

12. An elevator according to any of the preceding claims, wherein said obstructing equipment (10) is suspended by suspension means (15) allowing upwards directed movement of the obstructing equipment (10).

13. An elevator according to any of the preceding claims, wherein the elevator units (1, 2) are not interconnected in addition to said suspension roping (3) by a further roping, which hangs between them, and passes around a rope wheel mounted in the lower end of the hoistway (H).

14. An elevator according to any of the preceding claims, wherein the first elevator unit (1) is an elevator car and the second elevator unit (2) is a counterweight.

15. An elevator according to any of the preceding claims, wherein said second distance (d2) is within range 0 - 1 meters, preferably within range 0 - 0.5 meters.

Fig. 1

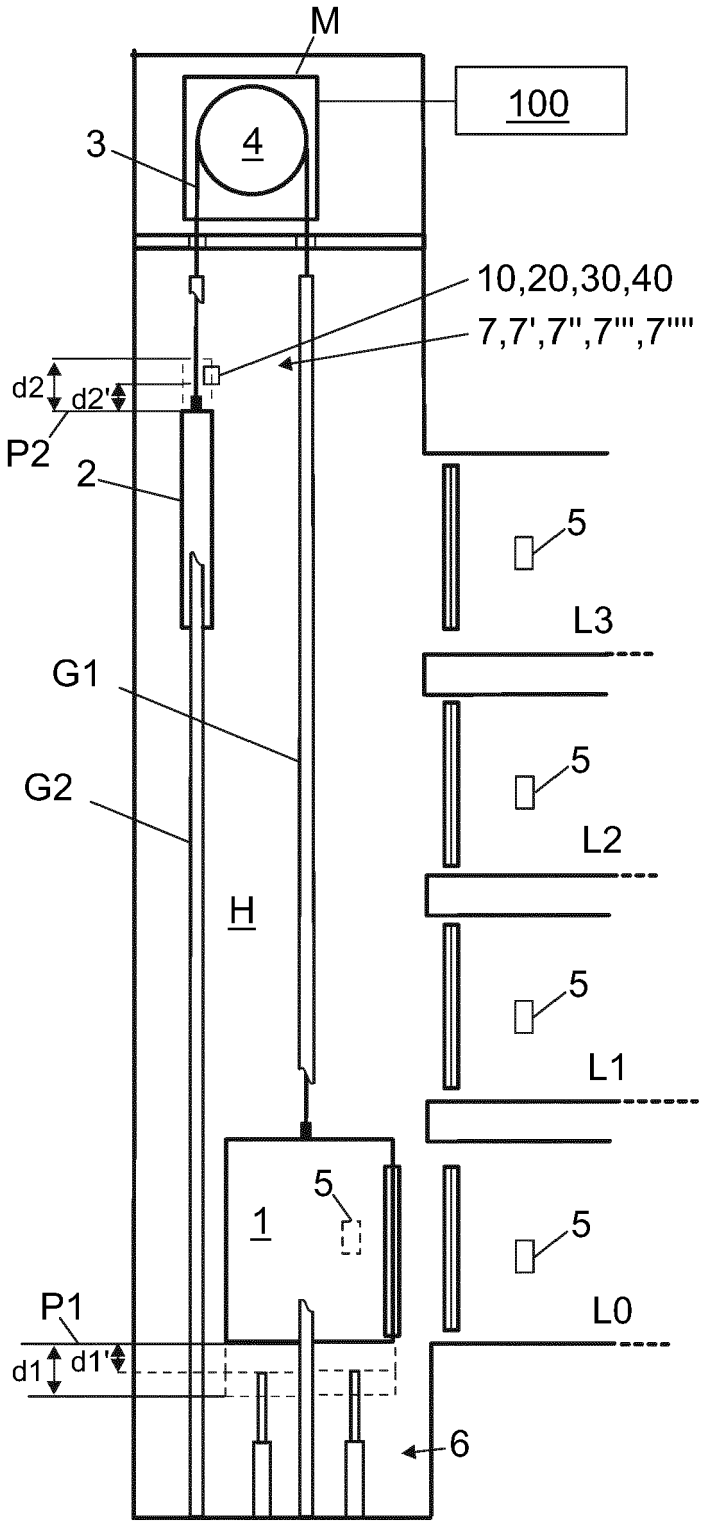

M
100
4
3
10,20,30,40
7,7',7'',7''',7''''
d2
d2'
P2
2
5
L3
G1
5
G2
L2
H
5
L1
5
1
5
P1
d1
d1'
L0
6

Fig. 2

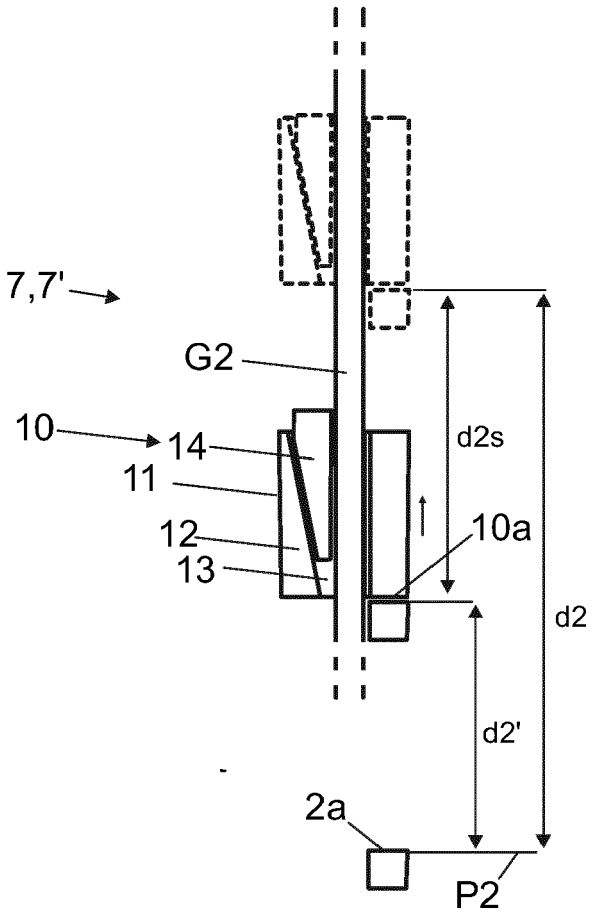


Fig. 3

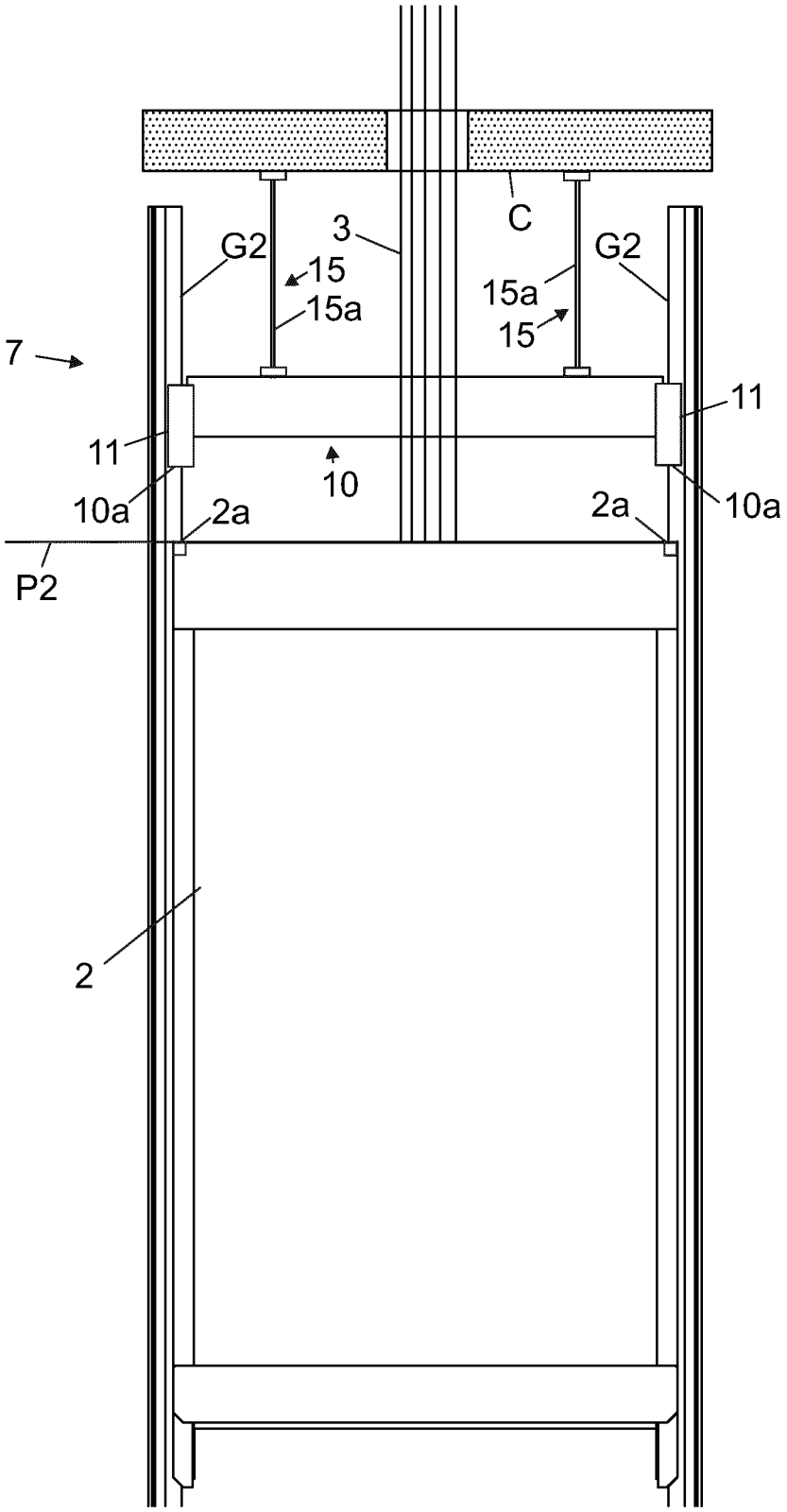


Fig. 4

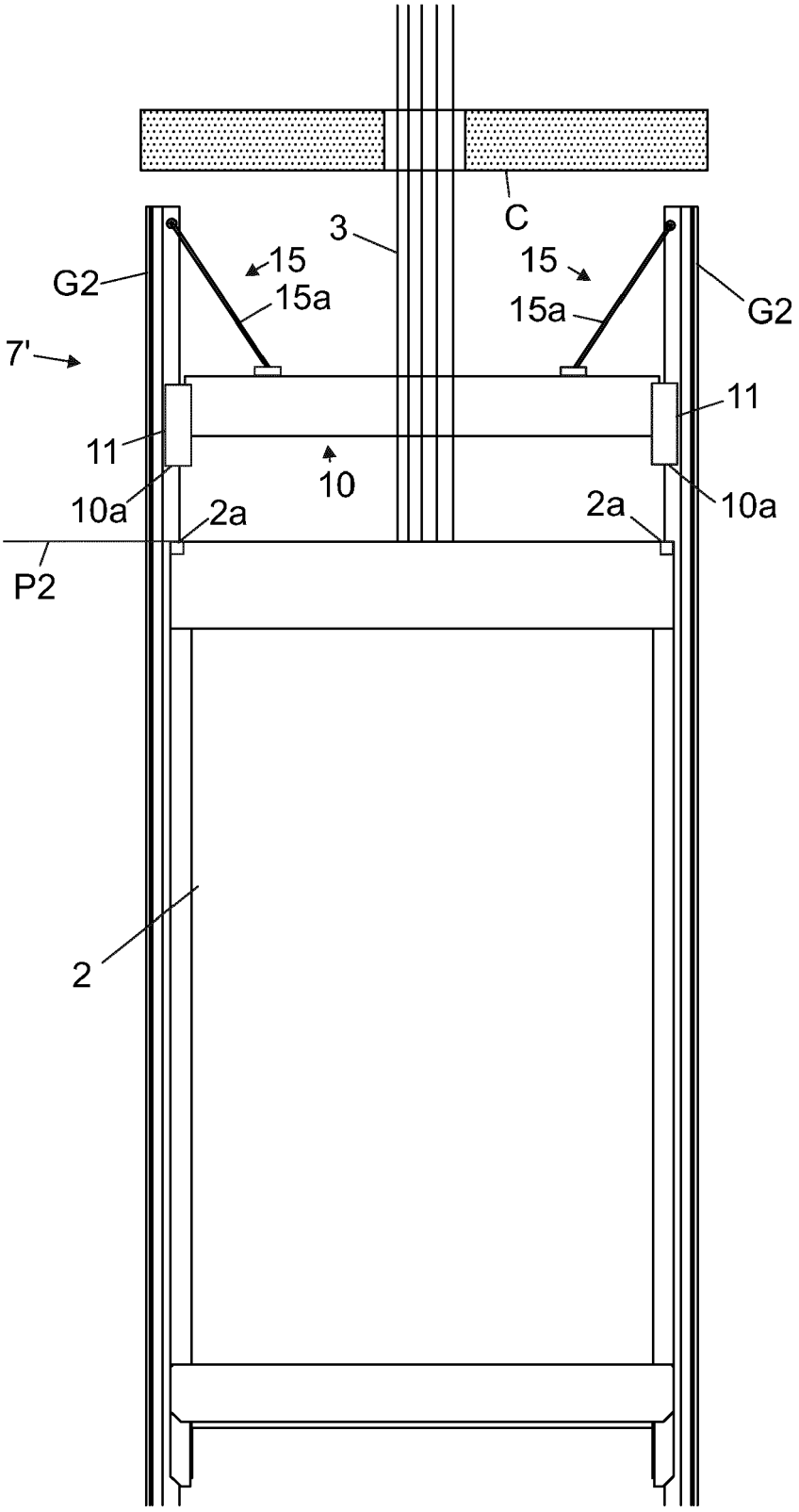


Fig. 5

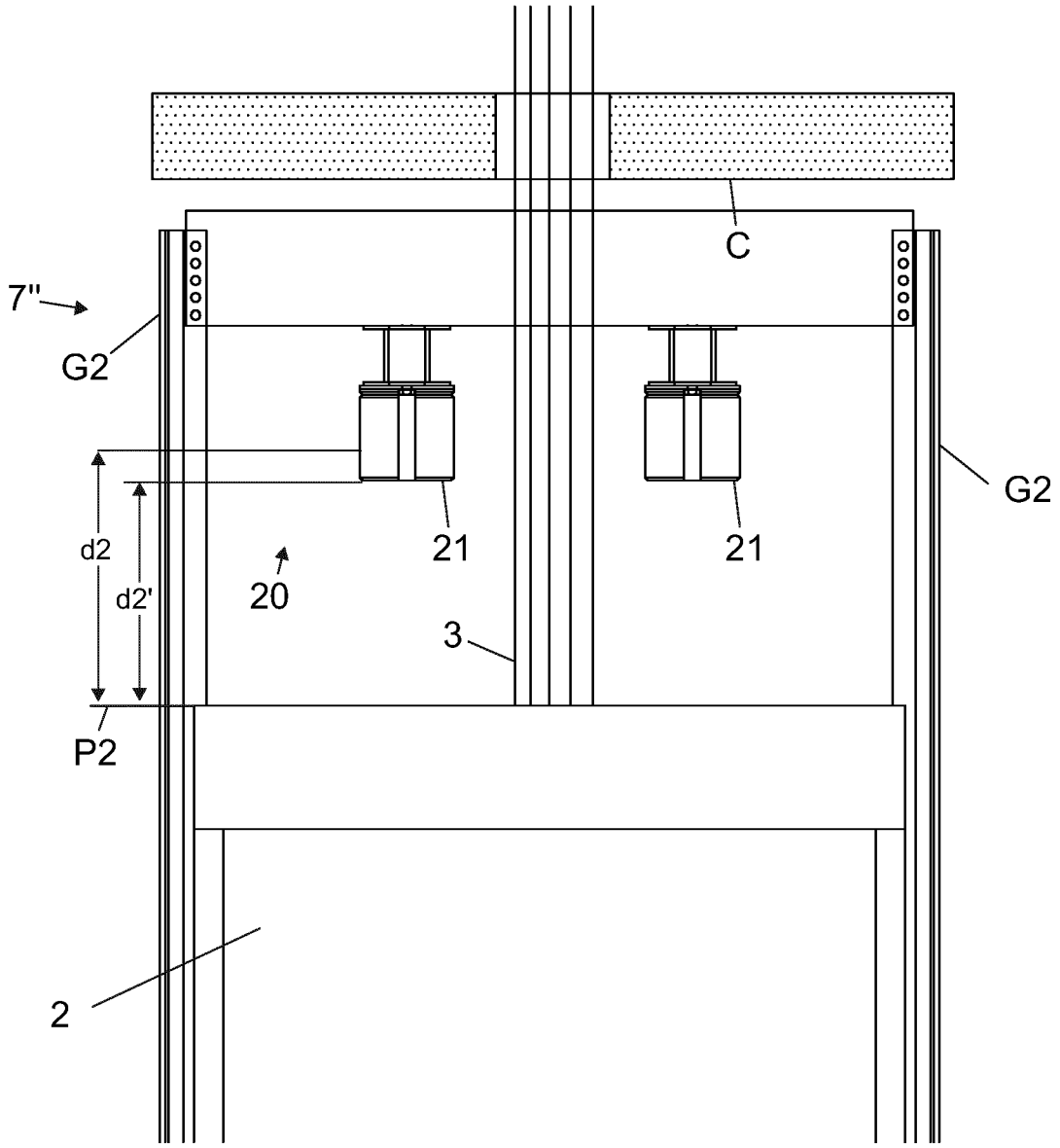


Fig. 6

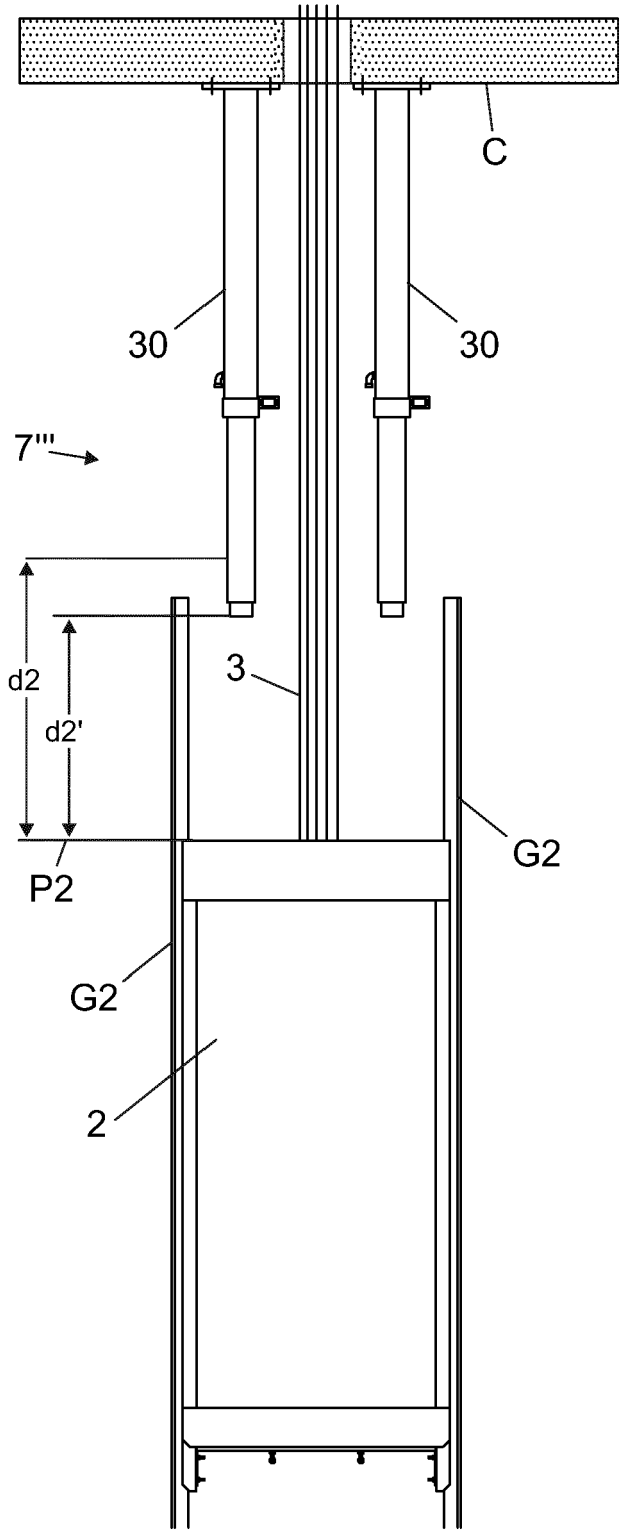
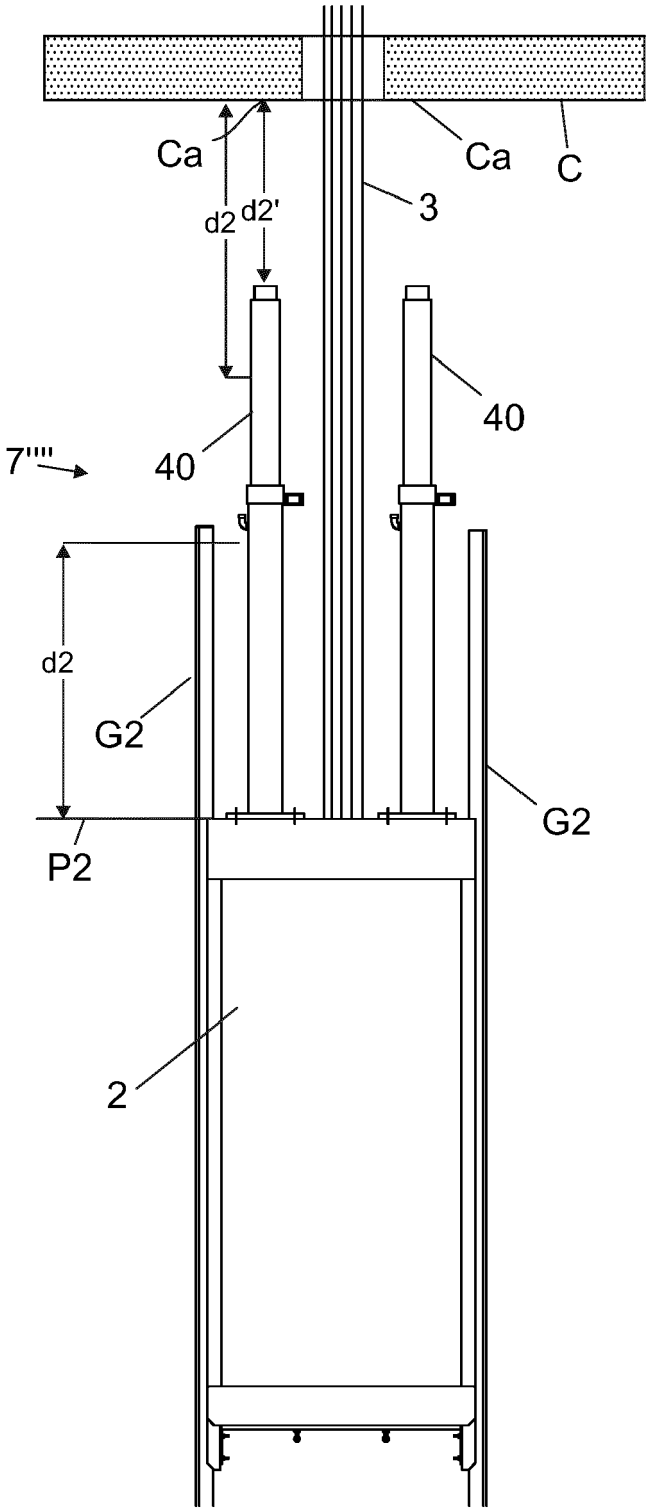


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 18 16 6821

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 Y A	JP 2002 356284 A (MITSUBISHI ELECTRIC CORP) 10 December 2002 (2002-12-10) * paragraph [0015] - paragraph [0021] * * paragraph [0033] - paragraph [0035] * * paragraph [0041] - paragraph [0043] * -----	1-7, 11-14 1 8-10,15	INV. B66B5/28
Y	JP S61 169475 A (MITSUBISHI ELECTRIC CORP) 31 July 1986 (1986-07-31) * figure 2 * -----	1	
Y	JP 2003 252546 A (MITSUBISHI ELECTRIC CORP) 10 September 2003 (2003-09-10) * figure 11 * -----	1	

TECHNICAL FIELDS SEARCHED (IPC)

B66B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 October 2018	Szován, Levente

CATEGORY OF CITED DOCUMENTS

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17-10-2018

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