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(54) **Building hoist**

(57) A hoisting apparatus (500) for hoisting a person (P0) and/or material (MTR), the apparatus (500) may comprise:
- a carrier (100),
- a control system (400) arranged to move the carrier (100) according to a movement command signal (COM1), and
- a roof presence indicator device (S5) for providing a roof signal (COM2) indicative of the presence of a roof (50) on the carrier (100).

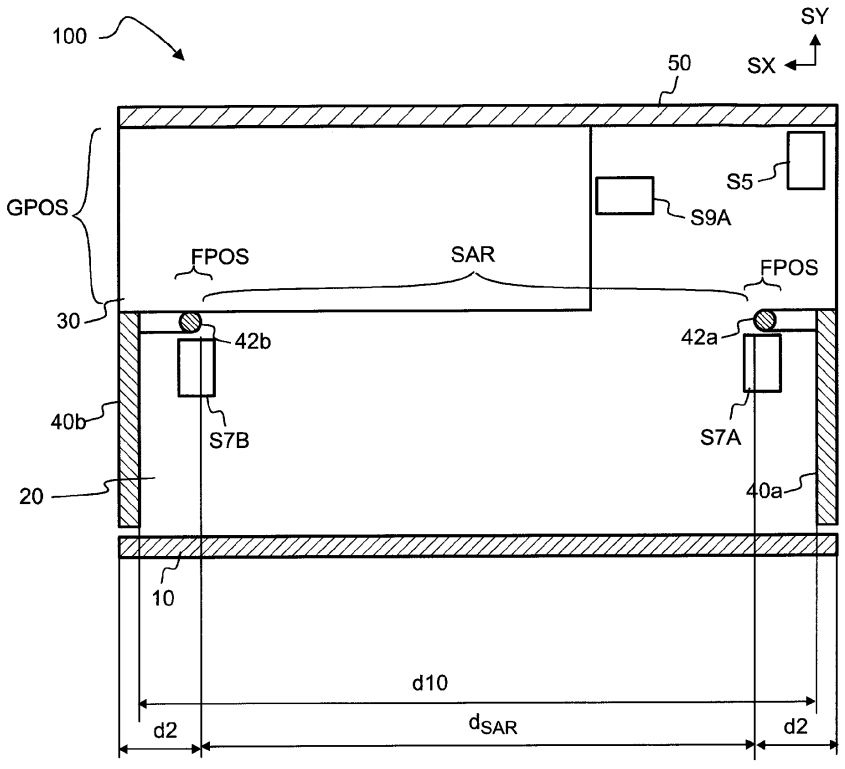

Fig. 4a

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to hoisting people and/or material.

BACKGROUND

[0002] Hoists are used in construction sites for moving people and material between ground and landings of a building.

[0003] The hoisting apparatus comprises a carrier, which is arranged to move along substantially vertical masts. The hoisting apparatus comprises a user interface for giving movement commands.

[0004] A European patent EP1023236B1 discloses a lift, which has changeover means for changing between a passenger platform mode and a builder's hoist mode. The speed of the platform is greater in the builder's hoist mode than in the passenger platform mode.

SUMMARY

[0005] An object of the invention is to provide an apparatus for safe hoisting of people and/or large objects. An object of the invention is to provide a method for safe hoisting of people and/or large objects.

[0006] According to a first aspect of the invention, there is provided a hoisting apparatus (500) for hoisting a person (P0) and/or material (MTR), the apparatus (500) comprising:

- a carrier (100),
- a control system (400) arranged to move the carrier (100) according to a movement command signal (COM1), and
- a roof presence indicator device (S5) for providing a roof signal (COM2) indicative of the presence of a roof (50) on the carrier (100).

[0007] According to a second aspect of the invention, there is provided a method for hoisting a person (P0) and/or material (MTR) by using a carrier (100), the method comprising:

- moving the carrier (100) according to a movement command signal (COM1), and
- providing a roof signal (COM2) indicative of the presence of a roof (50) on the carrier (100).

[0008] Further aspects of the invention are defined in the dependent claims.

[0009] The apparatus 500 may have two or more operating modes depending on the state of one or more safety devices. The apparatus 500 may have two or more operating modes depending on the position of one or more safety structures.

[0010] The apparatus 500 may have two or more operating modes e.g. depending on the position of the roof 50 of the carrier 100.

[0011] In particular, the control system 400 of the apparatus 500 may be arranged to require verification of authorization of a user depending on the roof signal COM2 provided by the roof presence indicator device S5.

[0012] By removing the roof 50, a skilled user may temporarily use the carrier 100 for transporting very large objects. When the carrier 100 has a roof 50, also an untrained person may be allowed to use the carrier 100. Thus, the untrained person may safely use the apparatus for hoisting people and/or smaller objects, but the skilled user may use the same apparatus for hoisting large objects.

[0013] The apparatus 500 may have a first operating mode MOD1, a second operating mode MOD2, and/or a third operating mode MOD3, depending on the state of one or more safety devices.

[0014] In an embodiment, the apparatus 500 may have the first operating mode MOD1 and the second operating mode MOD2, but not the third operating mode MOD3.

[0015] In an embodiment, the apparatus 500 may have the first operating mode MOD1 and the third operating mode MOD3, but not the second operating mode MOD2.

[0016] In an embodiment, the apparatus 500 may have the second operating mode MOD2 and the third operating mode MOD3, but not the first operating mode MOD1.

[0017] Advantageously, the apparatus 500 may have three operating modes MOD1, MOD2, MOD3. In the first operating mode MOD1, the carrier 100 may be called e.g. as a "building hoist" (Fig. 1). In the second operating mode MOD2, the carrier 100 may be called e.g. as a "material hoist" (Fig. 2). In the third operating mode MOD3, the carrier 100 may be called e.g. as a "transport platform" (Fig. 3).

[0018] In the first mode MOD1, the safety elements and the control of the apparatus may be arranged such that the

user does not need to have special training for using the carrier 100. In the second mode MOD2, one or more safety elements may be removed e.g. in order to transport larger objects, wherein the user should have special training. In the third mode MOD3, the number of safety elements may be further reduced, wherein the user may be allowed to move the carrier only by using non-latching control (dead man's switch).

[0019] A user who has suitable training and legal permission to use the carrier in the second mode MOD2 and in the third mode MOD3 may be authorized to use the carrier, i.e. he may be an authorized user. The authorized user may also be called as an authorized operator. An authorized user may have e.g. a mechanical key, password code (e.g. a personal identification number, a PIN code) or an RFID token in order to technically prove the authorization. RFID refers to radio frequency identification.

[0020] The user may operate the carrier 100 by giving movement commands via a user interface U1, U2, U0. The user may e.g. push a "down" button B1 or an "up" button B2 (See Fig. 7a and 9a).

[0021] The embodiments of the invention and their benefits will become more apparent to a person skilled in the art through the description and examples given herein below, and also through the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] In the following examples, the embodiments of the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1 shows, in a three dimensional view, a carrier having upper side guards and a roof,

Fig. 2 shows, in a three dimensional view, the carrier without the roof,

Fig 3 shows, in a three dimensional view, the carrier without the upper side guards and without the roof,

Fig. 4a shows, in a cross-sectional side view, a carrier comprising safety sensors,

Fig. 4b shows, in a cross-sectional side view, defining a safe area in the carrier by using safety fences,

Fig. 5a shows, in a cross-sectional side view, a carrier having upper side guards and a roof,

Fig. 5b shows, in a cross-sectional side view, the carrier of Fig. 5a with an open door,

Fig. 5c shows, in an end view, the carrier of Fig. 5a,

Fig. 5d shows, in a top view, the carrier of Fig. 5a

Fig. 6a shows, in a cross-sectional side view, a carrier without upper side guards and without a roof,

Fig. 6b shows, in a cross-sectional side view, the carrier of Fig. 6a

Fig. 7a shows, by way of example, a user interface,

Fig. 7b shows, by way of example, an indicator light unit of a user interface,

Fig. 8a shows an authorization status unit comprising a keypad,

Fig. 8b shows an authorization status unit comprising a barcode reader,

Fig. 8c shows an authorization status unit comprising an RFID reader,

Fig. 8d shows an authorization status unit comprising a camera,

Fig. 8e shows an authorization status unit comprising a fingerprint reader,

Fig. 9a shows, by way of example, a user interface and a sign for showing a message,

Fig. 9b shows, by way of example, a display of a user interface,

Fig. 10 shows, by way of example, a control system of the carrier,

Fig. 11a shows, by way of example, speed of a carrier at different heights when the carrier is moving upwards,

Fig. 11b shows, by way of example, speed of the carrier as a function of time when the carrier is moving upwards,

Fig. 11c shows, by way of example, speed of a carrier at different heights when the carrier is moving downwards,

Fig. 11d shows, by way of example, speed of the carrier as a function of time when the carrier is moving downwards,

Fig. 12 shows, in a three dimensional view, a carrier with upper side guards and a roof.

DETAILED DESCRIPTION

[0023] Fig. 1 shows a carrier system 500 for hoisting people P0, P2, P3 and/or material between a ground level GND and landings L1, L2 of a building 900.

[0024] The carrier system 500 may also be called as an elevator system, a lift system, a hoisting apparatus, or a hoist.

[0025] The carrier system 500 may comprise a carrier 100, one or more substantially vertical masts 200, and a control system 400 (Fig. 10).

[0026] The carrier 100 may be arranged to move along the masts 200 upwards and downwards e.g. by using a rack and pinion system driven by one or more (electric) motors 92. A user may control movements of the carrier 100 by using a user interface U0, U1 (Fig. 2), and/or U2 (Fig. 5a). The user may be e.g. the person P0, P2 or P3.

[0027] SX, SY and SZ denote orthogonal directions. The direction SY denotes the vertical direction and the directions SX and SZ are horizontal directions.

[0028] The masts 200 may also be called as guides or rails. The masts 200 may be supported by a base 210. If desired, the masts 200 may be attached to an outer wall of a building 900 by using ties 220, in order to improve stability.

[0029] The carrier 100 may comprise a platform 10, lower side guards 20, and one or more doors 40a (Fig. 2), 40b. The carrier 100 may further comprise one or more removable or movable upper side guards 30, a removable or moveable roof 50, and one or more safety fences 42a (Fig. 2), 42b. The roof 50 may protect people inside the carrier 100 against falling lightweight objects. The safety fences 42a, 42b may reduce the risk of falling from the carrier 100 when the fences 42a, 42b are in a safety position. Also the upper side guards 30 may reduce the risk of falling from the carrier 100.

[0030] The carrier 100 may comprise one or more mast guards 22 arranged to prevent persons inside the carrier 100 from accidentally touching of the masts 200.

[0031] The carrier system 500 may further comprise a safety fence 720 and one or more gates 700, 800. A ground fence 720 may be arranged to limit access of people P3 to a landing area LAR of the carrier 100 on the ground level GND. The ground fence may have a gate 700.

[0032] A gate 800 may be attached to the building 900 to prevent people P2 from falling from the landings L1, L2. A landing L1, L2 may have an opening 850.

[0033] In the first operating mode MOD1, the carrier 100 may have a roof 50, upper side guards 30, and the safety fences 42a, 42b may be in the safety position FPOS (Fig. 4a).

[0034] In the first operating mode MOD1, the roof 50 may be positioned such that persons P0 and/or objects in the carrier are substantially protected against (lightweight) falling objects.

[0035] In the first operating mode MOD1, the carrier 100 may comprise upper side guards 30, and safety fences 42a, 42b, which are arranged to confine persons and/or objects to a safe area SAR (Fig. 4b).

[0036] In the first operating mode MOD1 persons inside the carrier 100 may be protected by the roof, side guards, and fences such that the carrier 100 can be safely operated by untrained persons and/or operation of the carrier 100 may be allowed in the latching control mode LATCH.

[0037] Thanks to the safety fences 42a, 42b, the doors 40a, 40b of the carrier 100 may have reduced height. The height of the door 40a, and/or 40b may be e.g. smaller than 1.8 m. In particular, the height h1 of the door 40a and/or 40b may be e.g. substantially equal to 1.1 m (see e.g. Fig. 5a).

[0038] If the minimum height of the side guards 20 is greater than or equal to a predetermined height (e.g. ≥2.0 m), the upper side guards 30 may be omitted in the first operating mode MOD1. If the minimum height of a door 40a, 40b is is greater than or equal to a predetermined height (e.g. ≥2.0 m), the safety fence 42a, 42b may be omitted in the first operating mode MOD1.

[0039] Referring to Fig. 2, the carrier 100 may be operated without the roof 50 in a second operating mode MOD2.

[0040] In the second operating mode MOD2, the roof 50 may be at least partially moved or removed when compared to the first operating mode MOD1.

[0041] Operation without the roof 50 may facilitate transportation of large objects by using the carrier 100. Operation

without the roof 50 may reduce the weight of the carrier 100. Thus, the weight of a payload may be increased. Assembly of the carrier 100 at a worksite may be faster when installation of the roof is omitted.

[0042] In the second operating mode MOD2, persons P0 in the carrier 100 are not fully protected by the roof 50 against falling objects. In this operating mode MOD2, use of the carrier 100 may be restricted to authorized persons only.

[0043] The authorized user may check e.g. that all persons in the carrier 100 should be wearing helmets (i.e. hard hats) when the carrier 100 does not have a roof 50.

[0044] In this operating mode MOD2, only authorized users may be allowed to move the carrier 100 up and down. In particular, the control system 400 of the carrier 100 may be arranged to require verification of authorization of the user before moving the carrier 100 up and down.

[0045] In the second operating mode MOD2, the carrier 100 may have the upper side guards 30 and the safety fences 42a, 42b may be in a safety position such that the risk of falling is reduced. Thus, operation of the carrier 100 may be allowed in the latching control mode LATCH.

[0046] If the minimum height of the side guards 20 is greater than or equal to a predetermined height (e.g. 2.0 m), the upper side guards 30 may be omitted. If the minimum height of a door 40a, 40b is is greater than or equal to a predetermined height (e.g. 2.0 m), the safety fence 42a, 42b may be omitted.

[0047] Referring to Fig. 3, the carrier 100 may be operated without the upper side guards 30, and/or the carrier 100 may be operated so that at least one of the safety fences 42a, 42b is not in the safe position FPOS.

[0048] The safety fences 42a, 42b may be removed or moved to another position such that even larger objects may be transported in the carrier 100.

[0049] In the third operating mode MOD3, the safety fence(s) 42a, 42b may be moved or removed such that persons and/or objects in the carrier 100 are confined to a larger area than in the first operating mode MOD1 and/or in the second operating mode MOD2

[0050] The carrier 100 may have movable or removable upper side guards 30. Operation without the upper side guards 30 may facilitate loading material into the carrier 100. The weight of the carrier 100 may be reduced when the carrier is operated without the upper side guards 30. Assembly of the carrier 100 at a worksite may be faster when installation of the upper side guards 30 is omitted.

[0051] However, the carrier 100 does not need to have removable upper side guards 30. The minimum height of the (lower) side guards 20 may be greater than or equal to a predetermined limit (e.g. $\geq$ 2.0 m). Also the height of one of the doors 40a, 40b may be greater than or equal to a predetermined limit (e.g. $\geq$ 2.0 m).

[0052] Latching control mode LATCH means that the duration of giving the movement command is substantially shorter than duration of corresponding operation of a moving motor 92 (Fig. 1, Fig. 10). Non-latching control mode NONLATCH means that the duration of giving the movement command is substantially equal to the duration of corresponding operation of the motor 92. The non-latching control mode is also known as the "dead man's switch control", i.e. operation of the (hoisting) motor 92 may stop almost immediately after the user ceases to push the control button B1, B2 (See Fig. 7a).

[0053] It may be assumed that the user is more likely to rapidly stop the movement of the carrier in case of a dangerous situation when the carrier is controlled in the non-latching control mode NONLATCH. When the carrier is controlled in the latching control mode LATCH, a delay between noticing a dangerous situation and pushing an emergency stop button may be several seconds. If the carrier is operated by a non-trained person, he might not even recognize that there is a dangerous situation until someone gets injured.

[0054] Referring to Fig. 4a, the carrier 100 may comprise a roof sensor S5, which is arranged to detect the presence of the roof 50. The roof sensor S5 may provide a signal COM2 indicative of the presence of the roof 50 to a control unit 410 (Fig. 10). The signal COM2 is shown in Fig. 10.

[0055] If the carrier has at least one low door 40a, 40b (e.g. when h1<2.0 m), the carrier 100 may comprise a fence sensor S7A, S7B, which is arranged to detect whether the safety fence 42a, 42b is in a safe position FPOS. The fence sensor S7A, S7B may provide a signal indicative of the presence of a fence 42a, 42b in the safe position FPOS.

[0056] If the carrier comprises at least one removable (upper) side guard 30, the carrier 100 may comprise a guard sensor S9A, which is arranged to detect whether the upper side guard 30 has been properly installed. The carrier 100 may comprise a guard sensor S9A, which is arranged to detect whether the upper side guard 30 is in a safe position GPOS.

[0057] The sensor S5, S7A, S7B, and/or S9A may be e.g. an optical sensor. The sensor S5, S7A, S7B, and/or S9A may be e.g. an optical proximity sensor, magnetic proximity sensor, inductive proximity sensor or mechanical proximity sensor. The sensor S5, S7A, S7B, and/or S9A may be e.g. an optotransistor, Hall sensor, or a micro switch. A signal provided by a sensor S5, S7A, S7B, and/or S9A may be e.g. an electrical signal or an optical signal. The signal may comprise e.g. a (Boolean) value indicating the state of the sensor.

[0058] When the fences 42a, 42b are in the safe position FPOS, they may confine people to a safe area SAR in the carrier 100.

[0059] Referring to Fig. 4b, the fence 42a, and/or 42b may define a minimum horizontal distance d2 between the edge of the platform 10 and the body of a person standing in the carrier 100 in order to prevent accidental contact between the person P0 and the building 900.

[0060] The distance d2 may also be substantially equal to a horizontal distance between the inner portion of the fence 42a and the outer portion of the door 40a when the door 40a is in the closed position. The distance d2 may be e.g. greater than or equal to 0.2 m. Advantageously, the distance d2 may be greater than or equal to 0.35 m. Preferably, the distance d2 is substantially equal to 0.35 m.

[0061] The safety distance d2 should not be too large, because this may needlessly reduce the inner area of the carrier 100 available for hoisting people and large objects. The distance d2 may be e.g. smaller than 1.0 m.

[0062] The safety distance d2 may reduce the risk of falling from the carrier. This may also reduce the risk that the hand of a person moved by the carrier would accidentally contact the wall of the building 900 when the carrier 100 is moving.

[0063] Thanks to the fence 42a, 42b, the height h1 of the door 40a and/or 40b may be reduced. This may facilitate operation of the door, in particular when the door is used as a bridge or ramp. This may also save material costs and/or weight. The use of low doors 40a, 40b may improve visibility to and from the carrier 100.

[0064] The doors 40a, 40b may also be of different heights. For example, the height of the door 40a facing the building 900 may be substantially equal to 1.1 m, and the height of the door 40b facing away from the building 900 may be substantially equal to 2.0 m.

[0065] The safety fences 42a, 42b may be e.g. movable or removable handrails.

[0066] d10 denotes the inner length of the carrier 100. d_{SAR} denotes the length of the safe area SAR when the fences 42a, 42b are in the safe position FPOS. The length D_{SAR} of the safe area SAR is shorter than the inner length d_{10} of the carrier 100. Referring to Fig. 6a, moving or removing at least one of the fences 42a, 42b may increase the usable inner length of the carrier 100 e.g. for hoisting large objects.

[0067] The fence 42a may be supported e.g. by a (lever) mechanism, which is arranged to operate such that the fence 42a remains in the safe position FPOS even when several people lean against the fence 42a. The fence 42a may have a mechanical locking mechanism and/or an electrical locking mechanism which should be opened before the fence 42a can be displaced from the safe position FPOS.

[0068] A vertical distance between the upper portion of the fence 42a, 42b and the platform 10 may be e.g. in the range of 0.8 to 1.5 m. In particular, the distance may be substantially equal to the height h1 of the door 40a (see Fig. 5a). In particular, the distance may be substantially equal to 1.1 m.

[0069] Each sensor S5, S7A, S7B S9A may provide a corresponding sensor signal to a control unit 410 (Fig. 10). The control unit 410 may be arranged to control operation of the carrier 100 based on the sensor signals provided by the sensors.

[0070] The carrier system 500 may comprise an indicator device S5 for providing a signal COM2 indicative of the presence of the roof 50 on the carrier 100. The carrier system 500 may comprise an indicator device S9A for providing a signal indicative of the presence of the upper side guard 30 in the position GPOS. The carrier system 500 may comprise an indicator device S7A, S7B for providing a signal indicative of the presence of the fence 42a, 42b in the position FPOS.

[0071] Advantageously, the indicator device S5, S7A, S7B, and/or S9A is an automatic sensor. Removing the roof 50 or removing the fence 42a may automatically change the state of the signal provided by the sensor S5 or S7A so that there is no need to manually operate a switch. This may provide improved safety and reliability.

[0072] However, in an embodiment, an indicator device S5, S7A, S7B S9A may also be a manually operated switch, which is not in direct contact with the roof, guard or fence. When the roof, guard or fence is installed or removed, a switch S5, S7A, S7B, and/or S9A may be manually set to a corresponding state. However, a problem with manually operated switches may be that the position of the switches might not always correspond to the real situation.

[0073] Referring to Figs. 4b and 5a, the carrier 100 may be arranged to move with respect to the building 900 so that a distance d1 between the carrier 100 and the building 900 is greater than or equal to a predetermined limit. The distance d1 may be e.g. greater than or equal to 0.5 m. The fence 42a may define the additional safety distance d2 when the fence 42a is in the safe position FPOS. The additional safety distance d2 may be e.g. 0.35 cm. Thus, a minimum distance d0 between the body (torso) of a person standing in the carrier 100 and the wall of the building 900 may be equal to d1 + d2. In particular, the minimum distance d0 may be e.g. substantially equal to 0.85 m.

[0074] The length d_{ARM} of an extended human arm is typically shorter than 0.85 m. Thus, the fence 42a may prevent accidental contact between the wall of the building 900 and an arm of a person P0 standing in the carrier 100. The fence 42a increases the probability that the distance d_{HND} between the building 900 and the hand of a person standing in the carrier 100 may be kept greater than zero.

[0075] The carrier 100 may be used for hoisting a person P0 and/or material MTR. The material MTR may be cement bags, for example, as shown in Fig. 4b.

[0076] Also large items may be hoisted in the second operating mode MOD2 and/or in the third operating mode MOD3. An example of a "large" item may be e.g. a compact wheel loader.

[0077] Referring to Fig. 5a, the combined height h2 of the lower side guard 20 and the upper side guard 30 may be e.g. in the range of 1.6 m to 3.0 m. Advantageously, the height h2 is in the range of 2.0 m to 2.5 m. If the carrier 100 does not have a removable upper side guard 30, the height of the side guard 20 may be in the range of 1.6 m to 3.0 m, in particular in the range of 2.0 m to 2.5 m.

[0078] The carrier 100 may comprise a mast guard 22, which is arranged to prevent accidental contact between the person P0 and the mast 200.

[0079] A landing L1 may have a user interface U2 for controlling movements of the carrier 100.

[0080] A landing L1 may have a gate 800 for preventing people from falling.

[0081] A ramp 810 may be used to reduce risk of stumbling and to facilitate loading heavy material over the fence 42a and/or over the edge of the door 40a.

[0082] When the carrier 100 has a safety fence 42a, 42b to define the additional safety distance d2, the height h1 of the doors 40a, 40b may be e.g. in the range of 0.8 m to 1.6 m. Advantageously, the height h1 of the doors 40a, 40b may be e.g. in the range of 1.1 m to 1.6 m. Preferably, the height h1 of the doors 40a, 40b may be substantially equal to 1.1 m. The doors 40a,40b may also be of different heights (see Fig 12).

[0083] d800 denotes a minimum distance between a gate 800 of a landing L1 and the carrier 100 (Fig. 5a). If the distance d800 is too small, an extended arm of a person P3 standing on the landing L1 may accidentally contact the moving carrier 100. The distance d800 may be e.g. greater than or equal to 0.50 m or even greater than or equal to 0.85 m in order to minimize the risk of accidental contact. The distance d800 may be greater than or equal to the safety distance d1.

[0084] Referring to Fig. 5b, the platform 10 of the carrier 100 may be temporarily linked to a landing L1 by a bridge element, which crosses the gap between the platform 10 and the landing L1.

[0085] In particular, the door 40a may be used as the bridge element. The door 42a, 42b may be pivoted with respect to a horizontal axis AX1 (Fig. 5a) such that the door 42a, 42b can be used as a bridge element.

[0086] A fence 820 may be arranged to prevent people from falling down the bridge. The fence 820 may be attached to the gate 800 or to the door 40a.

[0087] Fig. 5c shows, in an end view, the carrier 100 of Fig. 5a. The carrier 100 may have mast guards 22, which are arranged to prevent accidental contact between the person P0 and the mast 200. The safety distances d3 and h3 may be e.g. greater than or equal to 0.5 m.

[0088] The lower part of the carrier 100 may have sliding blocks or roller blocks 94 for sliding/rolling along the masts 200, in order to improve stability of the carrier 100.

[0089] Fig. 5d shows, in a top view, the carrier 100 of Fig. 5a. The masts 200 may be closer to the first door 40a than to the second door 40b such that the lengths of the ties 220 (Fig. 1) can be minimized. Alternatively, the distance between a mast 200 and the first door 40a may be substantially equal to the distance between the mast 200 and the second door 40b, in order to balance the carrier 100 (See Fig. 12) and in order to minimize bending stress of the masts 200.

[0090] When the ties are used, each tie 220 may be positioned such that persons inside the carrier 100 do not accidentally touch the ties. A tie may be positioned such that the horizontal distance between the platform 10 and the tie 220 may be e.g. greater than or equal to 0.85 m.

[0091] Referring to Fig. 6a. the fences 42a and/or 42b may be moved or removed in order to facilitate hoisting of large objects.

[0092] The safety fence 42a and/or 42b may have a first position FPOS and a second position POS2. In the first position FPOS, the safety fence 42a, 42b may be arranged to keep the distance between the body of a standing person P0 and the door 40a, 40b greater than or equal to a predetermined limit. In the second position POS2, the safety fence 42a, 42b may be retracted or removed such that the body (torso) of a standing person P0 may contact the door 40a, 40b.

[0093] When the fence 42a is moved or removed, the horizontal distance d2' defined by the edge of the platform 10 and the inner surface of the fence 42a or the inner surface of the door 40a may be e.g. smaller than or equal to 0.15 m.

[0094] Also the roof 50 and/or the upper side guard 30 may be removed in order to facilitate loading of material to the carrier.

[0095] The fence 42a may be moved (e.g. lifted upwards) e.g. such that it serves as an extension of the door 40a.

[0096] Fig. 6b shows the carrier of Fig. 6a with an open door 42a.

[0097] Referring to Fig. 7a, movements of the carrier 100 may be controlled by using a user interface U1, U2 or U0.

[0098] U1 refers to a user interface, which is located in the carrier 100. U2 refers to a user interface, which is located on a landing L1, L2 (Fig. 5a). U0 refers to a user interface, which is located on the ground level GND (Fig. 1). The user interface U2 and/or U0 may be substantially similar to the user interface U1. The carrier 100 may be called or sent from one level to another by using the interfaces U0, U2 even when the user is not in the carrier 100.

[0099] The carrier 100 may also be controlled by using a portable user interface (not shown). Thus, the carrier 100 may also be controlled by secure remote control (e.g. by radio control).

[0100] A control panel of a user interface U1 may comprise e.g. a first control button B1 for moving the carrier 100 upwards and a second control button B2 for moving the carrier downwards. The functions of the buttons or indicator lights may be indicated to the user by graphical symbols or text GRF.

[0101] The control buttons B1, B2 may be used e.g. for non-latching control of the operation.

[0102] The control panel may further comprise buttons B10, B11, B12, B13, B14, B15 for selecting a landing L1 - L6 where the carrier should be moved.

[0103] The control buttons B10-B15 may be used for latching control LATCH.

[0104] The control panel may comprise an emergency stop button CS.

[0105] The control buttons may be arranged to provide movement control signals COM1.

[0106] Instead of buttons, the user interface may comprise e.g. switches which are operated by pulling or twisting a knob. In particular, the buttons B1, B2 may be replaced with a joystick. The user interface U1 may be positioned in a recess and/or behind a protective structure (e.g. behind protective bars) in order to reduce risk of accidental operation and/or to reduce risk of damaging the user interface.

[0107] The user interface U1 may optionally comprise an indicator panel (Fig. 7b) and/or a display 490 (Fig. 9b).

[0108] The control system 400 of the hoisting apparatus 500 may further comprise an authorization status unit 450 arranged to provide an authorization indicator S_{AUT} indicative of an authorization of a movement command signal COM1.

[0109] A movement command signal COM1 may be authorized when said movement command signal COM1 is provided via a user interface by an authorized user P0 or when it is provided via a user interface by a person who may be assumed to be an authorized user.

[0110] The signal COM1 is not authorized, if the signal is provided (via a user interface) by a user who does not fulfill at least one of the following two conditions:

- first condition: the user is authorized,
- second condition: there is basis for assuming that the user is authorized.

[0111] The authorization indicator S_{AUT} comprises information about the authorization status of the movement command signal COM1. In the second operating mode MOD2 and/or in the third operating mode MOD3, the control system 400 of the apparatus 500 may prevent movements of the carrier 100 when the authorization indicator S_{AUT} indicates that a movement command signal COM1 is not authorized.

[0112] The control system 400 may be arranged to operate such that a movement command signal COM1 is considered to be authorized when the movement command signal COM1 is associated with an authorization indicator S_{AUT}, which indicates that the movement command signal COM1 is authorized. The movement command signal COM1 is not considered to be authorized when the movement command signal COM1 is associated with an authorization indicator S_{AUT}, which indicates that the movement command signal COM1 is not authorized, respectively.

[0113] The authorization indicator S_{AUT} comprises information about an authorization status. Thus, the authorization indicator S_{AUT} may also be called as a "status indicator".

[0114] Operation of the apparatus may be controlled based on the authorization indicator S_{AUT}. Hence, the authorization indicator S_{AUT} may also be called as a "control parameter" or a "control parameter value".

[0115] The control unit 410 of the apparatus 500 may comprise the authorization status unit 450. The value of the authorization indicator S_{AUT} may be stored in a memory. The control system 400 may comprise a memory area (register) for storing and communicating the authorization indicator S_{AUT} to a control unit 410.

[0116] The authorization indicator S_{AUT} may have a value. The value may be stored in a memory and/or the value may be carried by a signal. The authorization indicator S_{AUT} may be e.g. a Boolean variable having a value 0 or 1. For example, the value 0 may indicate positive authorization (i.e. the user/signal is authorized), and the value 1 may indicate negative authorization (i.e. the user / signal is not authorized). Alternatively, the value 1 may indicate positive authorization, and the value 0 may indicate negative authorization. The Boolean value may also be e.g. yes or no, true or false, "current" or "no current", "high voltage" or "low voltage".

[0117] The authorization indicator S_{AUT} may be communicated e.g. by using a current signal, voltage signal, or an optical signal. For example, a higher voltage may indicate authorization and a lower voltage (e.g. zero voltage) may indicate missing authorization. Alternatively, a lower voltage may indicate authorization and a higher voltage may indicate missing authorization. For example, a higher electric current may indicate authorization, and a lower electric current (e.g. zero current) may indicate missing authorization.

[0118] An authorization status unit 450 providing the indicator S_{AUT} may be separate from the control unit 410 of the apparatus 500, A separate authorization status unit 450 may be arranged to send a signal to the control unit 410 such that the signal comprises the authorization indicator S_{AUT}.

[0119] The authorization status unit 450 may be arranged to determine the value of the authorization indicator S_{AUT} based on one or more credentials provided by a user. The credential may be e.g. a physical object (i.e. an authorization item), a piece of knowledge (password) or a biometric property of the user (e.g. a fingerprint).

[0120] Alternatively, the authorization status unit 450 may be arranged to determine the value of the authorization indicator S_{AUT} depending on whether a regulatory message is displayed. The carrier 100 and/or a user interface outside the carrier may comprise a regulatory sign 440 or a display 490 for showing a regulatory message INFO1 "Operation by authorized personnel only". When this message INFO1 is displayed, a user operating the carrier 100 may be assumed to be an authorized user. The authorization status unit 450 may be arranged to detect whether the message INFO1 is displayed, and the authorization status unit 450 may be arranged to provide the authorization indicator S_{AUT} based on

the result of the detection. When the message INFO1 is displayed, the authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT}, which indicates that the movement command signal COM1 is authorized.

[0121] However, an unauthorized operator may sometimes ignore the displayed message INFO1. A more reliable (and safer) system may be provided when the authorization indicator S_{AUT} is determined based on one or more credentials provided by the user, i.e. when the authorization of the user is technically verified.

[0122] The authorization status unit 450 may be arranged to provide the authorization indicator S_{AUT} based on one or more credentials provided by the user.

[0123] When the authorization status unit 450 is arranged to provide the authorization indicator S_{AUT} based on one or more credentials, this means that the authorization of the user is verified technically. In this case the authorization status unit may also be called as an authorization verification unit or as an authentication unit.

[0124] The (value of the) authorization indicator S_{AUT} may be determined by comparing one or more credentials provided by a user with a control list. The control list may comprise one or more reference credentials associated with one or more authorized users.

[0125] A credential used for verifying the authorization may be e.g. a physical object (i.e. an authorization item), a piece of knowledge (password) or a biometric property of the user (e.g. a fingerprint).

[0126] The authorization item may be e.g. a mechanical key, an RFID token, a badge comprising a barcode, a badge comprising a predetermined graphical symbol, or a smartcard comprising a microcomputer chip. A user interface U0, U1, U2 may comprise a reader for reading (i.e. obtaining) information from an authorization item carried by the user.

[0127] The reader may be separate from the authorization status unit 450. The reader may send information obtained from the authorization item to a remote authorization status unit 450, which may subsequently determine the authorization indicator S_{AUT} based on the information received from the reader.

[0128] Alternatively, the authorization status unit 450 may comprise a reader for obtaining information from an authorization item carried by the user.

[0129] The piece of knowledge used as a credential may be e.g. a password code. The password code may be e.g. a word, a number, or a combination of letters, numbers, and/or symbols. The user may provide the password code via a user interface U0, U1, U2. The user interface U0, U1, U2 may comprise e.g. a keypad, touch screen and/or a microphone for entering a password code to an authorization status unit 450. The password code may be spoken by the user and entered via a microphone.

[0130] A biometric credential, i.e. a personal biometric property of the user may read e.g. by fingerprint recognition (Fig. 8e), by recognition of facial features (Fig. 8d), by scanning of hand geometry, by analysis of distinctive voice characteristics, by iris scanning, and/or by retinal scanning.

[0131] When authorization status unit 450 is arranged operate based on biometrics, the authorization status unit 450 may be arranged:

- to obtain biometric data from a user,
- to determine an identifier based on the biometric data,
- to compare the identifier with one or more reference identifiers associated with users appearing in a list of authorized users, and
- to provide the authorization indicator S_{AUT} based on said comparison.

[0132] The identifier may be determined e.g. based on fingerprint recognition (Fig. 8e), recognition of facial features (Fig. 8d), and/or voice biometrics.

[0133] The determined identifier may be e.g. a unique identification number or compressed data associated with a person. For example, in case of fingerprint recognition, the identifier may be e.g. retrieved from a memory based on analysis of a fingerprint, the identifier may be determined from the fingerprint by using an algorithm, or a digital image of the fingerprint may be used as the identifier as such.

[0134] If the identifier of a person matches with a reference identifier associated with an authorized user, the authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT}, which indicates that said person is an authorized user. The authorization status unit may comprise a memory which contains one or more reference identifiers. When a new person is authorized or an authorization is cancelled, the list of reference identifiers stored in the memory may be updated e.g. via the user interface, via internet and/or via a mobile telephone network.

[0135] When the authorization status unit 450 is arranged operate based on an authorization item carried by a user, the authorization status unit 450 may be arranged:

- to determine an identifier based on an authorization item,
- to compare the identifier with one or more reference identifiers, and
- to provide the authorization indicator S_{AUT} based on said comparison.

[0136] The authorization item may be e.g. an RFID token (Fig. 8c), a smart card, or a badge comprising a barcode (Fig. 8b).

[0137] When the identifier matches with a reference identifier associated with an authorization, the authorization status unit may be arranged to provide an authorization indicator S_{AUT}, which indicates that the user carrying the authorization item is an authorized user. The authorization status unit may comprise a memory which contains the reference identifiers. When a new person is authorized or an authorization is cancelled, the list of reference identifiers stored in the memory may be updated e.g. via the user interface, via internet and/or via a mobile telephone network.

[0138] A password code may be provided e.g. via a keypad (Fig. 8a), touch screen and/or by analyzing information content of spoken words by voice recognition.

[0139] When the verification is based on using a password code, the authorization status unit 450 may be arranged:

- to receive a password code from a user,
- to compare the password code with one or more reference codes, and
- to provide the authorization indicator S_{AUT} based on said comparison.

[0140] When the user provides a valid password code, the authorization status unit may be arranged to provide an authorization indicator S_{AUT} which indicates that the user is an authorized user

[0141] The use of the authorization item and/or password code may also be anonymous. In other words, several different users may have identical authorization items. Several different users may have the same password code.

[0142] The authorization item may also be a mechanical key, and the user interface U0, U1, U2 may comprise a lock. The authorization status unit 450 may be arranged:

- to compare the key with one or more reference forms of the lock, and
- to provide the authorization indicator S_{AUT} based on said comparison.

[0143] If the user has a valid key, he may operate the authorization status unit (e.g. turn the key in a keyhole) so that the authorization indicator S_{AUT} provided by the unit indicates that the user is an authorized user.

[0144] The apparatus 500 may comprise:

- an authorization status unit 450 arranged to provide an authorization indicator S_{AUT} indicative of an authorization of the movement command signal COM1, and
- a control unit 410 arranged to prevent movements of the carrier 100 when the roof signal COM2 indicates that a roof 50 of the carrier is not in a protecting position and the value of the authorization indicator S_{AUT} indicates that said movement command signal COM1 is not authorized.

[0145] The apparatus 500 may comprise an authorization status unit 450 arranged to technically verity authorization of a user P0, wherein the authorization status unit 450 may be arranged to operate such that the authorization indicator S_{AUT} indicates that the movement command signal COM1 is authorized only when data derived from one or more credentials provided by the user P0 indicate that the user P0 is an authorized user.

[0146] In principle, also an unauthorized person might sometimes use someone other's credentials. However, in order to ensure adequate degree of safety at a worksite, it may be sufficient when possession of a valid password code and/or possession of a valid authorization item are considered to be sufficient proof of authorization of a user.

[0147] The apparatus 500 may comprise a reader for checking credentials of a user. The authorization status unit 450 may comprise the reader or the reader may be arranged to provide information to the authorization status unit 450.

[0148] Referring to Fig. 7a, the apparatus 500 may comprise e.g. a lock operated by a key (Fig. 7a). The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when the lock is unlocked by using a (predetermined mechanical) key.

[0149] Referring to Fig. 8a, the authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when the user P0 provides a predetermined password code. The user interface U1 may comprise e.g. a keypad 452 or a touch screen for inputting the password code.

[0150] Referring to Fig. 8b, the apparatus 500 may comprise a barcode reader 454 for reading data from a barcode 455. The barcode may also be a two-dimensional matrix barcode. The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when data derived from the barcode 455 matches with data associated with a person appearing on a list of authorized users. For example, an identification badge of the user P0 may comprise the barcode 455.

[0151] Referring to Fig. 8c, the apparatus 500 may comprise an RFID reader 454 for retrieving data from an RFID transponder 457. RFID refers to radio frequency identification. The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when a code provided by an RFID transponder 457

matches with a code of a person appearing on a list of authorized users. The transponder 457 may attached e.g. to an identification badge or of a user P0.

[0152] Referring to Fig. 8d, the apparatus 500 may comprise a facial recognition unit 458. The facial recognition unit 458 may comprise a camera, which is arranged to take a photo of the face of the user. The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when the facial features of the user P0 substantially match with facial features of a person appearing on a list of authorized users.

[0153] Referring to Fig. 8e, the apparatus 500 may comprise a fingerprint reader 459. The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when the fingerprint FP0 of the user P0 substantially matches with a fingerprint of a person appearing on a list of authorized users. The fingerprint reader 459 may also be called as a fingerprint recognition unit.

[0154] The apparatus 500 may comprise a speech recognition unit for receiving a spoken password from the user.

[0155] The apparatus 500 may comprise a receiver for receiving an authentication message sent e.g. from a mobile telephone via a mobile telephone network.

[0156] The apparatus 500 may comprise a receiver for receiving an authentication message sent from a radio frequency transmitter carried by the user.

[0157] The apparatus 500 may comprise a receiver for receiving an authentication message sent from a portable transmitter carried by the user. The transmitter may send e.g. a sequence of light pulses. In particular, the light pulses may be pulses of infrared light (IR).

[0158] The apparatus 500 may comprise a reader for obtaining authentication data from a magnetic stripe. An authentication card or an authentication badge carried by the user may comprise a magnetic stripe

[0159] The apparatus 500 may comprise a reader for obtaining authentication data from a microcomputer chip. An authentication card (smartcard) or an authentication badge carried by the user may comprise a microcomputer chip for verifying authorization.

[0160] The apparatus 500 may comprise a camera or an optical scanner for capturing an image of an optical symbol or an optical code. An authentication card or an authentication badge carried by the user may comprise the symbol or code.

[0161] An authorized user may have a portable radio frequency transmitter or an optical (infrared) transmitter, which is arranged to send a (radio frequency or optical) authentication signal to an authorization status unit 450, in order to provide an authorization indicator S_{AUT}. A portable user interface carried by an authorized user may comprise the transmitter, which is arranged to send an authentication signal to an authorization status unit 450.

[0162] Referring back to Fig. 7b, the user interface U1 may comprise an indicator panel 490, which is arranged to provide information to the user P0. The indicator panel may comprise e.g. graphical symbols or text GRF and indicator lights LED2. For example, an indicator light associated with the text "Overload" may indicate that the load is too heavy. For example, an indicator light associated with the text "Roof" may indicate that the roof is missing or that the roof is not in a safe position.

[0163] The user interface U1 may comprise a loudspeaker (not shown) for providing audio information to the user. For example, when the user P0 pushes the "up" button B1 but the door 40a is still open, the control system 400 may prevent movement of the carrier 100. In this case, the control system 400 may play a pre-recorded message "door open" to the user via the loudspeaker.

[0164] In order to improve safety, movement control buttons in all user interfaces may be temporarily disabled when at least one door or gate of the carrier system is not properly locked (See also Fig. 10).

[0165] Referring to Fig. 9a, the authorization status unit 450 may be arranged to automatically detect the presence of a (regulatory) sign 440. The authorization status unit 450 may be arranged to provide an authorization indicator S_{AUT} indicating authorization when the sign 440 is attached to a predetermined position in the vicinity of the authorization status unit 450.

[0166] The authorization status unit 450 may comprise a sign detector arranged to detect presence of the sign 440, and the authorization status unit 450 may be arranged to provide the authorization indicator S_{AUT} based on an output signal of the sign detector.

[0167] The sign 440 may show e.g. a regulatory message "Operation by authorized personnel only".

[0168] The sign 440 may be optionally arranged to temporarily cover one or more control buttons of the user interface U1. In particular, when the sign is positioned such that an authorization indicator S_{AUT} indicates authorization, the sign 440 may temporarily prevent the use of the buttons B10-B15 in the latching control mode LATCH.

[0169] Referring to Fig. 9b, the user interface U1 may further comprise a display 490 for displaying information to the user P0. The display 490 may be arranged to display e.g. the weight of the payload and/or other information relevant to the operation of the carrier 100. For example, the display 490 may indicate that one of the gates is open.

[0170] The roof sensor S5 and the authorization status unit 450 may operate independently, i.e. such that the authorization indicator S_{AUT} does not depend on the signal provided by the roof sensor S5, and the signal provided by the roof sensor S5 does not depend on the authorization indicator S_{AUT}. In order to maximize operational safety, the authorization status unit 450 may be arranged to technically verify authorization of the user.

[0171] In an embodiment, the user interface U1 may be arranged to operate such that a regulatory message INFO1 "Operation by authorized personnel only" is (automatically) displayed on the display 490 when the authorization indicator S_{AUT} provided by the authorization status unit 450 indicates that the commands COM1 are authorized. Thus, the regulatory sign 440 may be replaced with a regulatory message INFO1 displayed on the display 490. In this case, the authorization status unit 450 may comprise e.g.

- a manually operated switch,
- a keypad for inputting a password,
- a lock operated by a key, or
- other means for technically verifying authorization of the user, as discussed above (e.g. in the context of Figs. 8a-8e).

[0172] The display 490 may be arranged to display the regulatory message INFO1. Displaying the regulatory message INFO1 ("Operation by authorized personnel only") may be controlled based on the presence of the roof 50. Displaying the regulatory message INFO1 ("Operation by authorized personnel only") may be controlled based on a signal provided by the roof sensor S5. Thus, the display 490 may be arranged to (automatically) display the regulatory message INFO1 when the roof 50 is not in a safe position.

[0173] In an embodiment, the user may be assumed to obey the displayed regulatory message INFO1, and the authorization status unit 450 may be arranged to provide the authorization indicator S_{AUT} depending on whether the regulatory message INFO1 is displayed on the display 490.

[0174] In an embodiment, the user may be assumed to obey the displayed regulatory message INFO1, and the control system 400 may also be arranged to operate such that authorization of a control signal COM1 and/or authorization of the user is not technically checked.

[0175] Fig. 10 shows, by way of example, a control system 400 for controlling operation of the carrier 100.

[0176] The carrier 100 may be moved along the masts 200 by the motors 92. The motors 92 may be driven by a motor driver unit 420. The motor driver unit 420 may be arranged to drive a first motor and a second motor based on a signal provided by a balance sensor S1 such the platform 10 of the carrier 100 is kept in a substantially horizontal position.

[0177] Stopping of the carrier 100 may be assisted by using brakes BRK1, BRK2. The brakes may apply friction to the masts 200 or to a rotating component of a rack and pinion drive system. In certain systems, the motors 92 may also be used as brakes.

[0178] The motor driver unit 420 may be arranged to drive the motors according to a control signal provided by a control unit 410. The motor driver unit 420 may be based e.g. on relays, thyristors and/or transistors.

[0179] The control unit 410 may be based on e.g. relays, programmable logic circuits and/or microprocessors. The control system 400 may comprise a memory MEM1 for storing computer program code, which when executed by a data processor 410 is for performing the method according to the invention.

[0180] The control unit 410 may receive movement command signals COM1 from the user interfaces U0, U1, U2 (U2A, U2B).

[0181] A movement command signal may be e.g. an electrical or optical signal. The signal may comprise data for specifying a movement command (i.e. a movement instruction). The data may be communicated e.g. in digital or analog format.

[0182] The control unit 410 may receive an authorization indicator S_{AUT} from separate authorization status unit(s) 450. The authorization status unit(s) may be attached to the user interface(s). Alternatively, the control unit 410 may comprise an authorization status unit 450.

[0183] The control unit 410 may receive sensor signals from various sensors. The sensors may include e.g:

- a position sensor S2 for determining the height of the carrier,
- an overload sensor S3 for detecting when the load is too heavy,
- an anti-crushing sensor S4 for detecting objects or persons under the carrier 100,
- a roof sensor S5 for detecting the presence of the roof 50,
- fence sensors S7A, S7B for detecting positions of the fences 42a, 42b,
- door lock sensors S8A, S8B for detecting whether the doors 40a, 40b are properly locked,
- guard sensors S9A, S9B for detecting whether the upper side guards 30 have been properly installed,
- gate sensors S10, S11, S12 for detecting whether the gates 700,800 are properly locked.

[0184] The anti-crushing sensor S4 may also be called as a crushing prevention sensor. The sensor S4 may be arranged to detect mechanical contact between the carrier and an object under the carrier, in order to prevent crushing the object when the carrier is moving downwards. The sensor S4 may be arranged to detect presence or proximity of an object under the carrier, in order to prevent crushing the object when the carrier is moving downwards

[0185] The sensors may provide corresponding sensor signals to the control unit 410. As discussed above in the

context of Fig. 4a, one or more of the sensors may also be replaced with manually operated indicator devices.

[0186] The control unit 410 may provide signals for closing the locks C1, C2, C10, C11, C12 of the doors 40a, 40b and the gates 700, 800.

[0187] The control system 400 may comprise a timer for providing timing signals. The timer may be integrated in the control unit 410.

[0188] The control system 400 may comprise a sound signal unit SPK1 and/or a light signal unit LED1 for providing warning signals.

[0189] The control unit 410 may be arranged to automatically select an operating mode of the carrier 100 based on outputs of the sensors (indicator devices). In particular, the control unit 410 may be arranged to automatically select an operating mode of the carrier 100 based on outputs of the sensors S5, S7A and S9A, according to the table 1.

[0190] In a practical situation, all set-ups of the carrier 100 corresponding to the different rows of the table 1 may be realized. For example, moving the fence 42a away from the safe position FPOS may automatically change the operating mode from MOD1 to MOD3 even when the carrier 100 still has roof 50 and the upper side guards 30.

Table 1. Automatic selection of operating mode based on sensor signals.

Roof sensor	Fence sensor	Guard sensor	Mode
0	0	0	MOD3 (transport platform)
0	0	1	MOD3 (transport platform)
0	1	0	MOD3 (transport platform)
0	1	1	MOD2 (material hoist)
1	0	0	MOD3 (transport platform)
1	0	1	MOD3 (transport platform)
1	1	0	MOD3 (transport platform)
1	1	1	MOD1 (building hoist)
Roof sensor value 1 indicates that the roof is in the safe position. Roof sensor value 0 indicates that the roof is not in safe position. Fence sensor value 1 indicates that both fences 42a, 42b are in the safe position FPOS. Fence sensor value 0 indicates that at least one fence 42a, 42b is not in the safe position FPOS. Guard sensor value 1 indicates that side guards 30 are in the safe position GPOS. Guard sensor value 0 indicates that at least one side guard 30 is not in the safe position GPOS.			

[0191] The control unit 400 may be arranged to accept movement command signals COM1 from the user interface (s) according to the automatically selected operating mode. In particular, the control unit 400 may be arranged to require authorization of the user according to the automatically selected operating mode (See table 2).

Table 2. Control modes of the carrier in the different operating modes.

Operating mode	MOD1	MOD2	MOD3
Roof	Yes	No (Not necessary)	No (Not necessary)
Fence(s) in position FPOS	Yes	Yes	No (Not necessary)
Side guard(s) in position GPOS	Yes	Yes	No (Not necessary)
Authorization of user required	No	Yes	Yes
Control mode	Latching	Latching	Non-latching (dead man's switch)

[0192] In an embodiment, both latching and non-latching control modes may be allowed in the first operating mode MOD1 and/or in the second operation mode MOD2.

[0193] If the minimum height of the side guards 20 is always higher than or equal to a predetermined safe value (e.g. 2.0 m), this means that the side guards are always in the safe state, and the guard sensor value related to the table 1 may always be equal to 1. This means that switching between latching control mode and the non-latching control mode is determined by the fence sensor(s).

[0194] If the minimum height of doors 40a, 40b is always higher than or equal to a predetermined safe value (e.g. 2.0 m), this means that the fences 42a, 42b are not needed. The fence sensor value related to the table 1 may always be equal to 1. This means that switching between latching control mode and the non-latching control mode is determined by the guard sensor(s).

[0195] If the minimum height of the side guards 20 is always higher than or equal to a predetermined safe value (e.g. 2.0 m), and if the minimum height of doors 40a, 40b is always higher than or equal to a predetermined safe value (e.g. 2.0 m), the guard sensor value related to the table 1 may always be equal to 1, and also the fence sensor value related to the table 1 may always be equal to 1. This means that the system does not operate in the third mode MOD3.

[0196] In general, the control system 400 may be arranged to move the carrier 100 up or down along the mast 200 according to a movement command signal COM1 provided by the user P0 via a user interface U0, U1, U2 unless the movement is prevented by a safety device. The safety device may be e.g. one of the sensors shown in Fig. 10.

[0197] The carrier system 500 may comprise:

- a carrier 100, and
- a control system 400 arranged to move the carrier 100 according to a movement command signal COM1,
- a roof sensor S5 arranged to detect the presence of a roof 50,
- an authorization status unit 450 arranged to provide an authorization indicator S_{AUT} indicative of an authorization of a user P0, and
- a control unit 410 arranged to prevent movements of the carrier 100 when the presence of the roof 50 is not detected and the authorization indicator S_{AUT} indicates that authorization of the user P0 to give the command COM1 has not been verified.

[0198] The carrier system 500 may comprise:

- a carrier 100, and
- a control system 400 arranged to move the carrier 100 according to a movement command signal COM1,
- a roof sensor S5 arranged to detect the presence of a roof 50,
- an authorization status unit 450 arranged to provide an authorization indicator S_{AUT} indicative of an authorization of the command COM1, and
- a control unit 410 arranged to prevent movements of the carrier 100 when the presence of the roof 50 is not detected and the authorization indicator S_{AUT} indicates that the command COM1 is not authorized.

[0199] The method for moving the carrier 100 may comprise:

- detecting the presence of a roof 50,
- providing an authorization indicator S_{AUT} indicative of an authorization of a movement command signal COM1, and
- preventing moving the carrier 100 when the presence of the roof 50 is not detected and the authorization indicator S_{AUT} indicates that the movement command signal COM1 is not authorized.

[0200] Thus, the control system may be arranged to accept commands only from an authorized user when the roof has been removed.

[0201] The carrier system 500 may comprise a fence sensor S7A, S7B arranged to detect position of a fence 42a, wherein the control system 400 may be arranged to enable operation of the carrier 100 in the latching control mode LATCH when the fence(s) 42a, 42b is/are in the safe position FPOS, provided that the other fence 42b (if any) and the upper side guards 30 (if any) are in the safe position.

[0202] Thus, the control system may be arranged to switch between latching control mode (LATCH) and non-latching control mode (NOLATCH) based on the position of the safety fence 42a of the door 40a.

[0203] The control system 400 may be arranged to enable operation of the carrier 100 in the non-latching control mode NONLATCH when at least one fence 42a is not in the predetermined fence position FPOS.

[0204] The carrier system 500 may comprise a fence sensor S7A, S7B arranged to detect position of a fence 42a, 42b wherein the control system 400 may be arranged to disable operation of the carrier 100 in the latching control mode LATCH when at least one of the fence(s) 42a, 42b is/are not in the safe position FPOS.

[0205] The control system 400 may be arranged to enable operation of the carrier 100 in the non-latching control mode NONLATCH only when an authorization indicator S_{AUT} indicates that a movement command signal COM1 is authorized.

[0206] Thus, the control system 400 may be arranged to check the authorization in addition to checking the position of the fence 42a.

[0207] The control system 400 may be arranged to disable operation of the carrier 100 in a latching control mode LATCH if at least one side guard 30 is not in the safe position GPOS.

[0208] Differences between the operating modes are listed in table 3.

Table 3. Operating modes of the carrier (by way of example).

Operating mode	MOD1 Building hoist	MOD2 Material hoist	MOD3 Transport platform
Maximum number of persons in carrier	Depends on the size and load capacity of the carrier. May be e.g. greater than 12.	≤12	≤12
Roof	Yes	No (Not necessary)	No (Not necessary)
Fence(s) in position FPOS	Yes	Yes	No (Not necessary)
Safety distance d0	≥ 0.85 m	≥ 0.85 m	≥ 0.5 m
Side guard(s) in position GPOS	Yes	Yes	No (Not necessary)
Height of side guards	≥ 2.0 m	≥ 2.0 m	≥ 1.1 m
Authorization of user required	No	Yes	Yes
Control mode	Latching	Latching	Non-latching (dead man's switch)
Maximum speed v2	≤ 36 m/min	≤ 36 m/min	≤ 36 m/min
Approach speed v1	≤ 12 m/min	≤ 12 m/min	≤ 12 m/min
Ground fence	Yes	Yes	Not necessary
Anti-crushing sensor under carrier	Yes	Yes	Not necessary
Door lock	Mechanical and electrical interlocking devices may be required	A mechanical interlocking device may be required (electrical interlocking device not necessary)	A mechanical interlocking device may be required (electrical interlocking device not necessary)

[0209] Technical requirements for hoisting devices are listed e.g. in the following European standards:

- EN 12159:2000,
- EN12158:2000, and
- EN1495:1998.

[0210] Referring to Figs. 11a - 11d, the carrier may be moved at two or more different speeds, depending on the position of the carrier 100, and depending on the direction of movement.

[0211] The curve of Fig. 11 a shows the speed of the carrier 100 at different heights y when the carrier 100 is moved upwards from the ground GND to a second landing L2.

[0212] Fig. 11b shows the speed of the carrier 100 as a function of time t when the carrier 100 is moved upwards from the ground GND to the second landing L2.

[0213] The curve of Fig. 11c shows the speed of the carrier 100 as different heights y when the carrier 100 is moved downwards from the second landing L2 to the ground GND.

[0214] Fig. 11d shows the speed of the carrier 100 as a function of time t when the carrier 100 is moved downwards from the second landing L2 to the ground GND.

[0215] Referring to Fig. 11a, when the carrier 100 starts to move from the ground level GND, the carrier may be first accelerated from zero velocity to a lower velocity v1. After the carrier has reached a height level y_A, the carrier may be accelerated to a higher velocity v2. The height y_A may be e.g. in the range of 2.0 - 2.5 m.

[0216] The lower velocity v1 may be e.g. in the range of 5 m/min to 20 m/min (meters per minute). The higher velocity v2 may be e.g. in the range of 2 to 4 times the lower velocity v1.

[0217] In particular, the lower velocity v1 may be e.g. substantially equal to 12 m/min, and the higher velocity v2 may be e.g. substantially equal to 36 m/min or even equal to 42 m/min.

[0218] When the carrier is approaching the final landing L2, the speed of the carrier 100 may be slowed down to zero by using the lower velocity v1 as an intermediate step. The carrier 100 may approach the landing at the lower speed v1. The speed may be lower than or equal to v1 when the height level y is higher than a value y_B. y_{L1} denotes the level of the first landing L1, and y_{L2} denotes the level of the second landing L2.

[0219] Referring to Fig. 11b, moving of the carrier may start at a time to. At a time t_1, the carrier may reach a level y_A, and the speed may be accelerated to v2. The carrier may pass the first landing L1 at the time t_2, without stopping at the landing L1. The speed may be decelerated from the speed v2 at the time t_3. At the time t_4, the carrier may be stopped at the second landing L2.

[0220] Figs. 11c and 11d relate to a situation where the carrier is moving downwards.

[0221] Referring to Fig. 11c, moving the carrier may be started from the second landing L2, i.e. from a level y_{L2}. At a level Y_c, the speed may be accelerated from v1 to v2. The carrier may pass the first landing L1 (level y_{L1}) without stopping.

[0222] When the carrier is approaching the ground GND, the speed of the carrier 100 may be slowed down to zero at a predetermined height h_{PS} by using the lower velocity v1 as an intermediate step. The duration t_{PS} of the pre-stop may be e.g. in the order of 3 s (Fig. 11 d). The height h_{PS} may be e.g. in the range of 2.0 to 2.5 m. The height h_{PS} may be substantially equal to the level y_A shown in Fig. 11a.

[0223] Fig. 11d shows the speed as a function of time when the carrier is moving downwards. The movement starts at the time t_{10}. The speed may be accelerated from v1 to v2 at the time t_{11}. The carrier may pass the first landing L1 at the time t_{12} without stopping. The carrier may be stopped at the height h_{PS} at the time t_{13}. After the pre-stop above ground, the carrier 100 may finally be moved to the ground level GND at the lower velocity v1.

[0224] The carrier may start approaching the ground level at the time t_{14}. The carrier may be stopped on ground GND at the time t_{15}. The duration t_{PS} of the pre-stop may be e.g. in the range of 1.0 s to 10 s. In particular, the duration t_{PS} of the pre-stop may be e.g. in the order of 3 s. The height h_{PS} may be e.g. in the range of 2.0 m to 2.5 m.

[0225] The control unit 410 may be arranged to temporarily stop the carrier 100 when the carrier 100 is approaching ground GND and a distance between the carrier 100 and the ground GND is substantially equal to a predetermined height h_{PS}.

[0226] When approaching ground, a sound signal and a light signal may be provided e.g. at the predetermined height h_{PS} in order to warn people on the ground GND. The signals may be provided by the warning signal units SPK1, LED1 (Fig. 10).

[0227] The system 500 may comprise a warning signal device SPK1,LED1 arranged to provide a warning signal when the carrier 100 is approaching ground and a distance between the carrier 100 and the ground (GND) is substantially equal to a predetermined height h_{PS}.

[0228] The velocity curves shown in Figs. 11a-11d may be applied e.g. in the first operating mode MOD1, in the second operating mode MOD2, and/or in the third operating mode MOD3, i.e. the velocity curves applied operating modes MOD1, MOD2, MOD3 may be substantially similar.

[0229] The velocity curves applied in modes MOD1 and MOD2 may also deviate from the velocity curves applied in mode MOD3. For example, if the height of the ground fence 720 is greater than or equal to 2.0 m, the preliminary stop when approaching the ground GND may be omitted in the modes MOD1 and MOD2. However, a lower ground fence (height e.g. 1.1 m) may be built at lower costs and/or it may be faster to assemble.

[0230] In the first operating mode MOD1 and in the second operating mode MOD2, movements of the carrier may be controlled by using e.g. the buttons B10-B15 (Fig. 7a) in the latching control mode LATCH, i.e. the control system 400 may be requested to move the carrier to a desired level by momentarily pushing one of the control buttons B10-B15.

[0231] In the third operating mode MOD3, movements of the carrier may be controlled in the non-latching control mode by using e.g. the buttons B1, B2.

[0232] In general, a carrier 100 may be arranged to move a person P0 and/or material between a first height level L1 and a second height level L2.

[0233] A carrier 100 may be arranged to move between different levels L1, L2 of an industrial facility, e.g. an oil refinery or a power plant. A carrier 100 may be arranged to move between different levels L1, L2 of a ship hull in a shipyard. A carrier 100 may be arranged to move between different levels L1, L2 of a mountainside.

[0234] The carrier system 500 may have one mast or two masts. The carrier system 500 may have three or four masts to further add stability and/or to increase load carrying capacity.

[0235] Advantageously, the masts 200 may have triangular braced structure in order to provide a lightweight structure,

which is easy move, easy to assemble, and easy to inspect for fractures and/or corrosion. Alternatively, the masts 200 may be e.g. L-beams (i.e. the cross-section resembles the shape of the letter L), U-beams, H-beams, circular tubular beams, rectangular tubular beams or triangular tubular beams.

[0236] The driving motor 92 or motors 92 of the carrier 100 may have a first set of windings to implement a lower nominal rotating speed, and a second set of windings to implement a higher nominal rotating speed. Thus, the same (induction) motor may be used to implement the two different velocities v1, v2 without a need to change a transmission ratio of a gearbox or without a need to electronically change the frequency of alternating current supplied to the motor.

[0237] The speed of the carrier may be changed by changing the transmission ratio of a gearbox or by changing the frequency of the alternating current. When using a variable frequency drive, the speed may be adjusted continuously.

[0238] The carrier system 500 may be driven by one motor 92 or by two motors 92. A single motor may be arranged to drive two pinion and rack systems in a synchronized manner by using a long shaft or belt.

[0239] Preferably, the carrier 100 may be moved e.g. by using a rack and pinion system powered by a motor 92. Alternatively the carrier 100 may be moved e.g. by using a cable winding system or by using hydraulic actuators. The carrier 100 may comprise an independent emergency brake, which is arranged to reduce falling speed in case of a catastrophic failure of the primary moving system. The emergency brake may be e.g. centrifugal brake, which is arranged to grip the mast 200 when falling speed exceeds a predetermined value.

[0240] The carrier system 500 may further comprise a motor and/or gearbox for moving the carrier at a very low speed (crawling speed) e.g. for assembly and dismantling sections of the mast 200.

[0241] There may be a need to temporarily work on the roof 50 of the carrier 100, e.g. during assembly and removal of mast sections 200. The removable roof 50 of the carrier 100 may optionally have a roof hatch (Fig. 12) to cover a manhole. The carrier 100 may have ladders for climbing to the roof via the manhole (not shown). The roof 50 may have fences (not shown).

[0242] The carrier may have removable extension platforms (not shown) e.g. to facilitate installation of the gates 800 or mast ties 220 to the wall of the building 900.

[0243] A user who has a special training and legal permission to use the carrier in the second mode MOD2 and in the third mode MOD3 may be authorized to use the carrier, i.e. he may be an authorized user. An authorized user may have an authorization item, e.g. a mechanical key, password code (e.g. personal identification number) or an RFID token in order to technically prove the authorization.

[0244] The control system 400 may be arranged to verify the authorization of the user. Authorization may be verified e.g. each time after a door of the carrier has been closed. The controls may be disabled e.g. if the carrier has not been moved during a predetermined time (e.g. 5 minutes) after verification of the authorization.

[0245] In the operating mode MOD3, control from the ground level GND or a landing L2 may be (temporarily) disabled if the authorized user cannot visually check the internal parts of the carrier from the location. For example, control buttons on the ground may be (temporarily) disabled when the carrier is on the landing L1. Internal parts of the carrier may also be checked by using a video camera.

[0246] The side guards 30 may be at least partially transparent in order to improve visibility. The side guards 30 may be made of e.g. polycarbonate plastic.

[0247] The height h7 of the ground fence 720 may be e.g. in the range of 0.5 to 3.0 m. Advantageously, the height h7 of the fence 720 may be greater than or equal to 1.1 m. Preferably, the height h7 of the fence 720 may be substantially equal to 1.1 m.

[0248] The carrier 100 and the masts 200 may be outside a building 900.

[0249] The masts 200 may be supported by a base 210. A mast 200 may be attached to the building 900 or to another supporting structure by using one or more ties 220. The ties 200 may be anchored to the building 900. The building 900 may be complete or under construction. Also another building, a large rock or a hull of a ship may be used as the supporting structure.

[0250] Fig. 12 shows a carrier 100 having a door 40a which is pivoted with respect to a vertical axis. The carrier 100 may further comprise a bridge element 41 a for linking the platform 10 to a landing L1. Prior to moving the carrier 100, the bridge element 41 a may be pivoted with respect to a horizontal axis to a vertical position. Alternatively, the bridge element 41 may be slided e.g. under or into the platform 10 in the direction SX so that the carrier 100 can be safely moved in the vertical direction SY. The carrier system 500 may have triangular braced masts 200. The (removable) roof 50 may have a hatch 52. The other door 40b facing away from the building 900 may be higher than the door 40b facing the building 900. The distance between the mast 200 and the door 40a may be substantially equal to the distance between the mast 200 and the door 40b in order to improve balance of the carrier 100.

[0251] Fig. 12 shows that the door 42b facing away from the building is open. However, the control system 400 may be arranged to prevent opening the door 42b when the carrier is not at the ground level GND. Accidental opening of the doors may be prevented e.g. by using mechanical and/or electrical interlocking devices (e.g. locks C1, C2 of Fig. 10).

[0252] Advantageously, the apparatus 500 may have a first operating mode MOD1, a second operating mode MOD2, and/or a third operating mode MOD3.

[0253] However, in an embodiment, the apparatus 500 may have the first operating mode MOD1 and the second operating mode MOD2, but not the third operating mode MOD3. For example, the height of the side guards 20 and the doors 40a, 40b may be permanently higher than or equal to 2.0 m.

[0254] In an embodiment, the apparatus 500 may have the first operating mode MOD1 and the third operating mode MOD3, but not the second operating mode MOD2. For example, an upper side side guard 30 may be attached to the roof 50 such that the upper side guard 30 is removed together with the roof 50.

[0255] In an embodiment, it may be presumed that the carrier is always operated by (an) authorized person(s). In this case, checking the presence of the roof may be omitted or ignored.

[0256] In particular, the apparatus 500 may have the second operating mode MOD2 and the third operating mode MOD3, but not the first operating mode MOD1. For example, the carrier 100 may be operated long periods without a roof 50. In this case, the control system 400 may set the operating mode to MOD2 or MOD3 e.g. based on the position of a safety fence 42a and/or 42b. The control system may be arranged to switch between latching control mode (LATCH) and non-latching control mode (NOLATCH) based on the position of the safety fence 42a of the door 40a.

[0257] In particular, a hoisting apparatus (500) for hoisting a person (P0) and/or material (MTR) may comprise:

- a carrier (100),
- a control system (400) arranged to move the carrier (100) according to a movement command signal (COM1), and
- a fence sensor (S7A) arranged to detect position of a fence (42a),

wherein the control system (400) is arranged to disable operation of the carrier (100) in a latching control mode (LATCH) when the fence (42a) is not in a predetermined fence position (FPOS).

[0258] The control system (400) may be arranged to enable operation of the carrier (100) in a latching control mode (LATCH) when the fence (42a) is in the predetermined fence position (FPOS) and when no other safety device of the hoisting apparatus prevents operation of the carrier (100) in the latching control mode (LATCH).

[0259] For the person skilled in the art, it will be clear that modifications and variations of the apparatus and the methods according to the present invention are perceivable. All drawings are schematic. The particular embodiments described above with reference to the accompanying drawings and tables are illustrative only and not meant to limit the scope of the invention, which is defined by the appended claims.

Claims

1. A hoisting apparatus (500) for hoisting a person (PO) and/or material (MTR), wherein the apparatus (500) comprises:

- a carrier (100), and
- a control system (400) arranged to move the carrier (100) according to a movement command signal (COM1),

characterized in that the apparatus (500) further comprises:

- a roof presence indicator device (S5) for providing a roof signal (COM2) indicative of the presence of a roof (50) on the carrier (100).

2. The apparatus (500) of claim 1, wherein the control system (400) is arranged to control movements of the carrier (100) based on the roof signal (COM2).

3. The apparatus (500) of claim 1 or 2, wherein the carrier (100) comprises a display (490), which is arranged to display a message (INFO1) based on the roof signal (COM2).

4. The apparatus (500) according to any of the claims 1 to 3 comprising:

- an authorization status unit (450) arranged to provide an authorization indicator (S_{AUT}) indicative of an authorization of the movement command (COM1), and
- a control unit (410) arranged to prevent movements of the carrier (100) when the roof signal (COM2) indicates that a roof (50) of the carrier is not in a protecting position and the authorization indicator (S_{AUT}) indicates that the movement command signal (COM1) is not authorized.

5. The apparatus (500) of claim 4, wherein the authorization status unit (450) is arranged to provide the authorization indicator (S_{AUT}) based on one or more credentials (455, 457, FP0) provided by a user (P0).

6. The apparatus (500) of claim 4 or 5 wherein a user interface (P0, P1, P2) of the apparatus (500) comprises a

mechanical lock, a keypad (452) for receiving a password, a touch screen (490) for receiving a password, a barcode reader (454) for reading a barcode (455), an RFID reader (456) for obtaining information from an RFID transponder (457), a facial recognition unit (458), a fingerprint reader (459), a magnetic card reader and/or a voice recognition unit.

7. The apparatus (500) according to any of the claims 1 to 6 comprising a fence sensor (S7A) arranged to detect position of a fence (42a), wherein the control system (400) is arranged to disable operation of the carrier (100) in a latching control mode (LATCH) when the fence (42a) is not in a predetermined fence position (FPOS).

8. The apparatus (500) according to any of the claims 1 to 7 comprising a fence sensor (S7A) arranged to detect position of a fence (42a), wherein the control system (400) is arranged to enable operation of the carrier (100) in a non-latching control mode (NONLATCH) when the fence (42a) is not in a predetermined fence position (FPOS) and the authorization indicator (S_{AUT}) indicates that the movement command signal (COM1) is authorized.

9. The apparatus (500) of claim 7 or 8 wherein the carrier (100) has a door (40a) such that the height (h1) of the door (40a) is lower than 1.8 m and the distance between the fence (42a) and the door (40a) is smaller than 1.0 m.

10. The apparatus (500) according to any of the claims 1 to 9 further comprising a guard presence indicator device (S9A) arranged to provide a guard signal indicative of the presence of a guard (30) in a predetermined position (GPOS), wherein the control system (400) is arranged to disable operation of the carrier (100) in a latching control mode (LATCH) when the guard signal indicates that the guard (30) is not in the predetermined position (GPOS).

11. The apparatus (500) according to any of the claims 1 to 10 wherein the carrier (100) has a door (40a), and the door (40a) is arranged to be used as a bridge between a building (900) and the platform (10) of the carrier (100).

12. The apparatus (500) according to any of the claims 1 to 11 comprising:

- a bridge for linking the platform (10) of the carrier (100) to a landing (L1,L2) of a building (900), and
- a side fence (820) arranged to prevent falling from the bridge,

wherein the side fence (820) is attached to the door (40a).

13. A method for hoisting a person (P0) and/or material (MTR) by using a carrier (100), the method comprising:

- moving the carrier (100) according to a movement command signal (COM1), and
- providing a roof signal (COM2) indicative of the presence of a roof (50) on the carrier (100).

14. The method of claim 13 comprising controlling movements of the carrier (100) based on the roof signal (COM2).

15. The method of claim 14 comprising

- providing an authorization indicator (S_{AUT}) indicative of an authorization of the movement command signal (COM1), and
- preventing movements of the carrier (100) when the roof signal (COM2) indicates that a roof (50) of the carrier is not in a protecting position and the authorization indicator (S_{AUT}) indicates that said movement command signal (COM1) is not authorized.

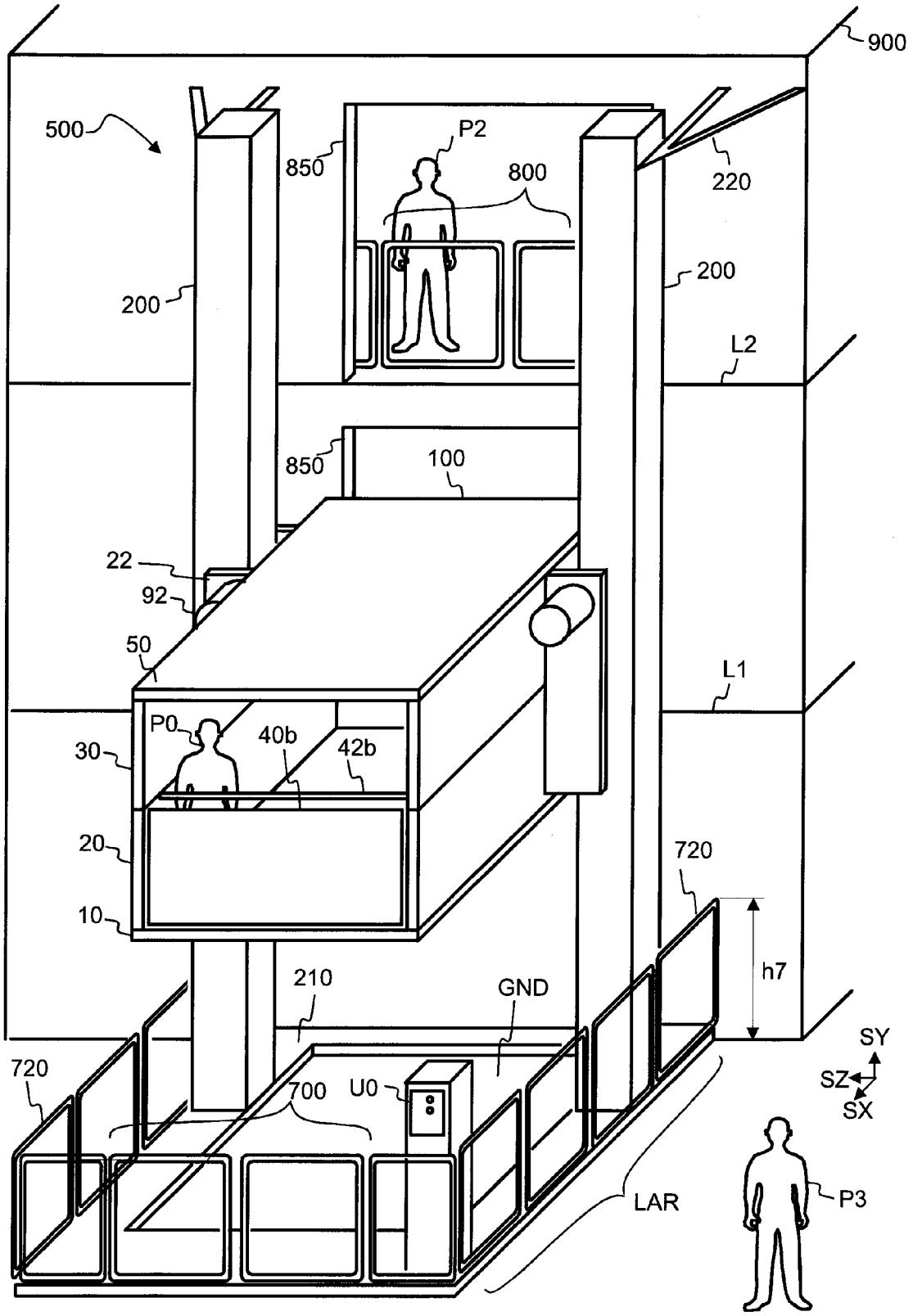
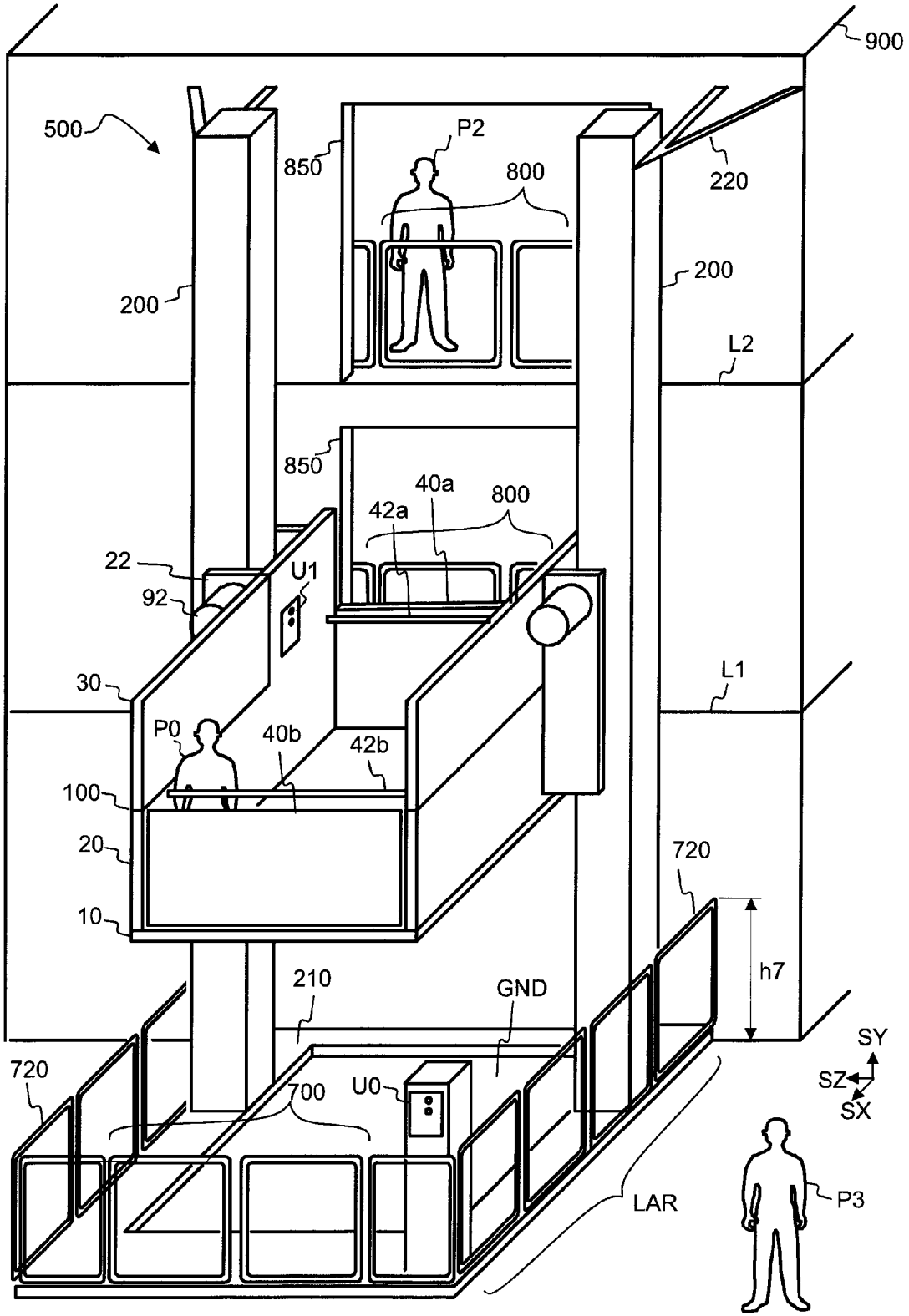

900
500
850
P2
800
220
200
200
L2
850
100
22
92
50
L1
P0
40b
42b
30
20
720
10
h7
210
GND
720
700
U0
SY
SZ
SX
LAR
P3

Fig. 1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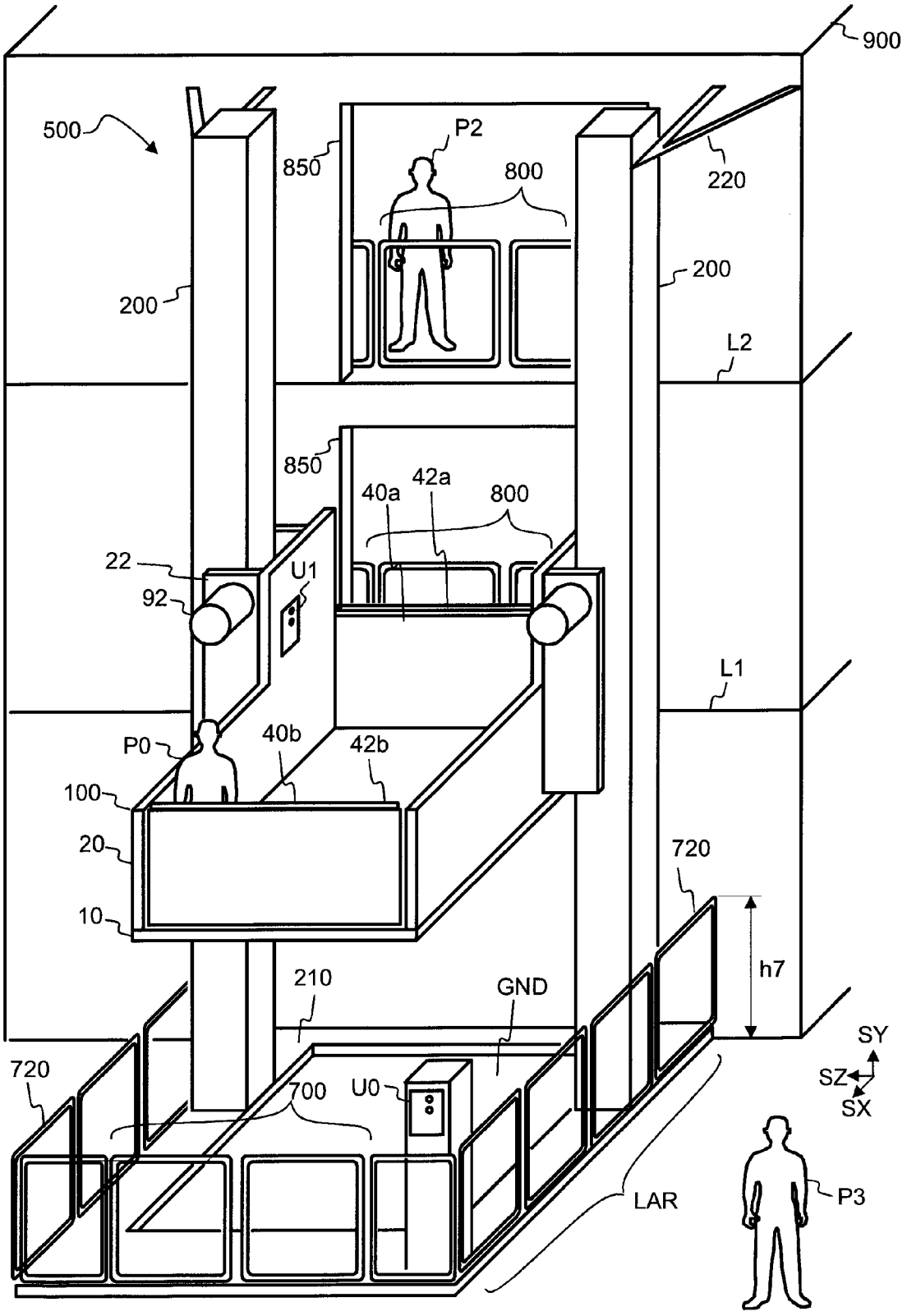
500
850
P2
800
220
200
200
L2
850
40a
800
42a
22
U1
92
30
L1
P0
40b
42b
100
20
720
10
h7
210
GND
720
700
U0
SY
SZ
SX
LAR
P3

Fig. 2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500
850
P2
800
220
200
200
L2
850
40a
42a
800
22
U1
92
L1
P0
40b
42b
100
20
720
10
h7
210
GND
SY
SZ
SX
720
700
U0
LAR
P3

Fig. 3

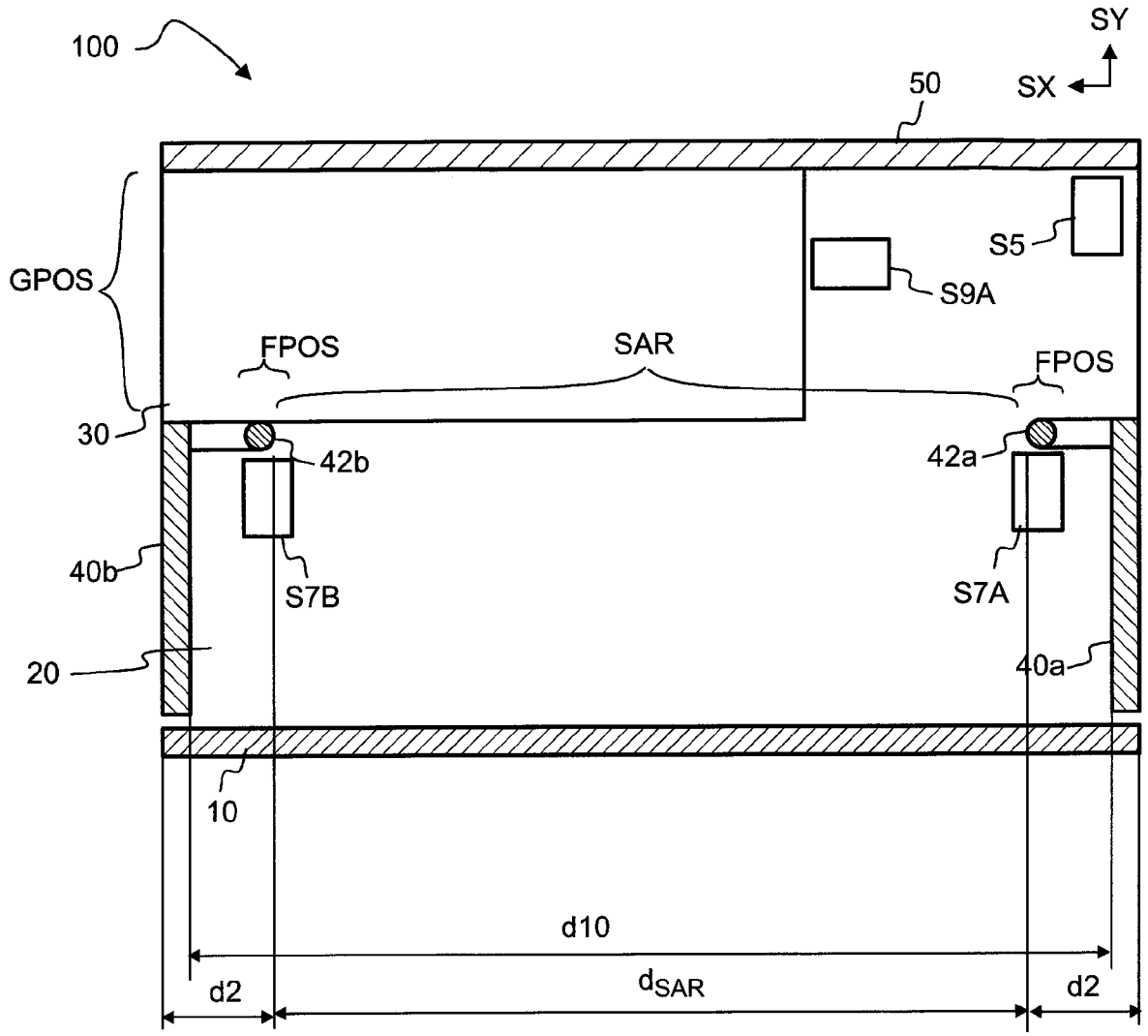

100
SY
SX
50
S5
S9A
GPOS
FPOS
SAR
FPOS
30
42b
42a
40b
S7B
S7A
20
40a
10
d10
d2
d_{SAR}
d2

Fig. 4a

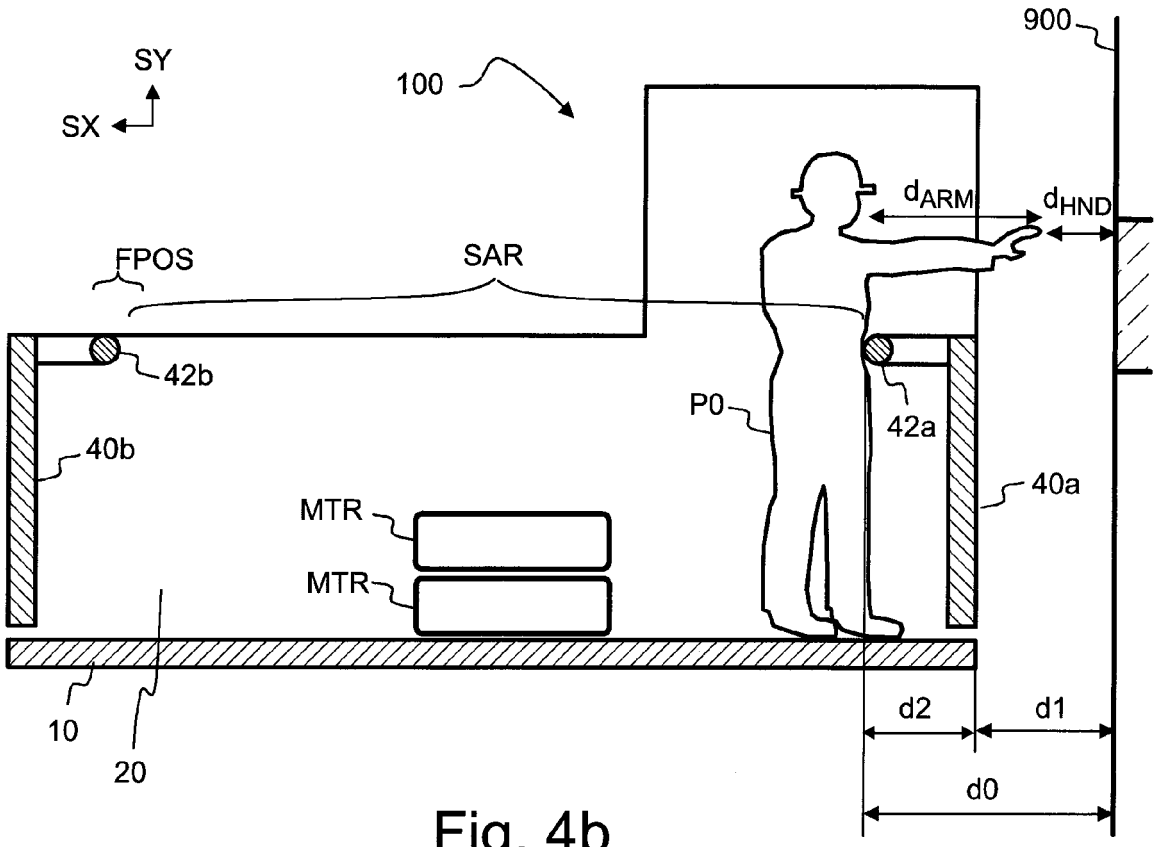

SY
SX
100
900
d_{ARM}
d_{HND}
FPOS
SAR
42b
40b
P0
42a
40a
MTR
MTR
10
20
d2
d1
d0

Fig. 4b

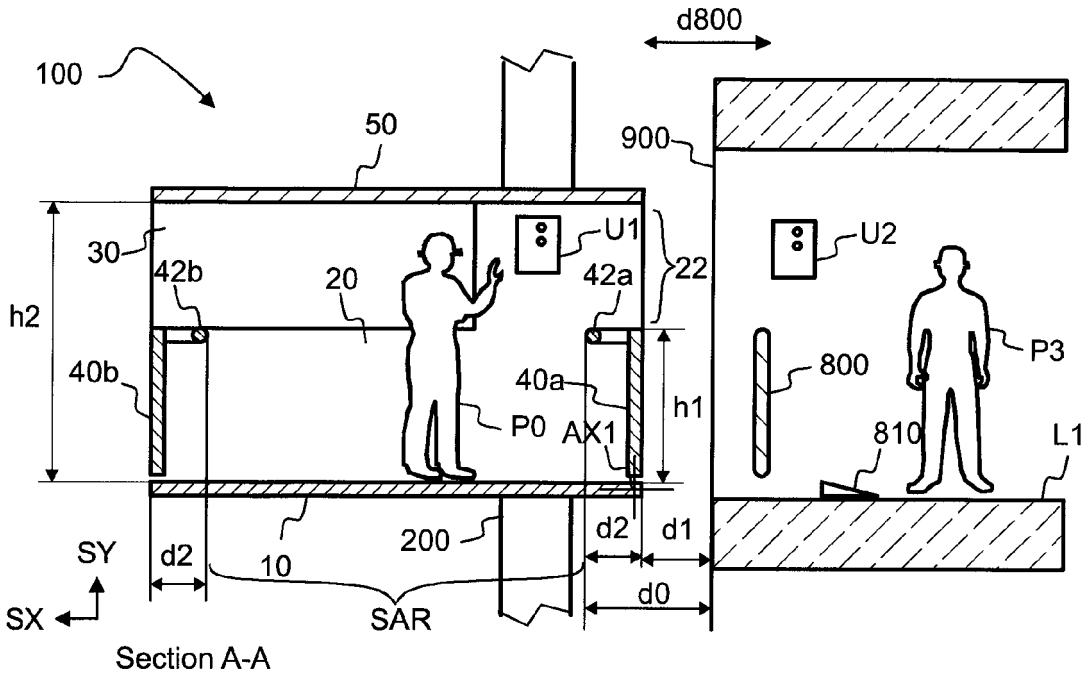
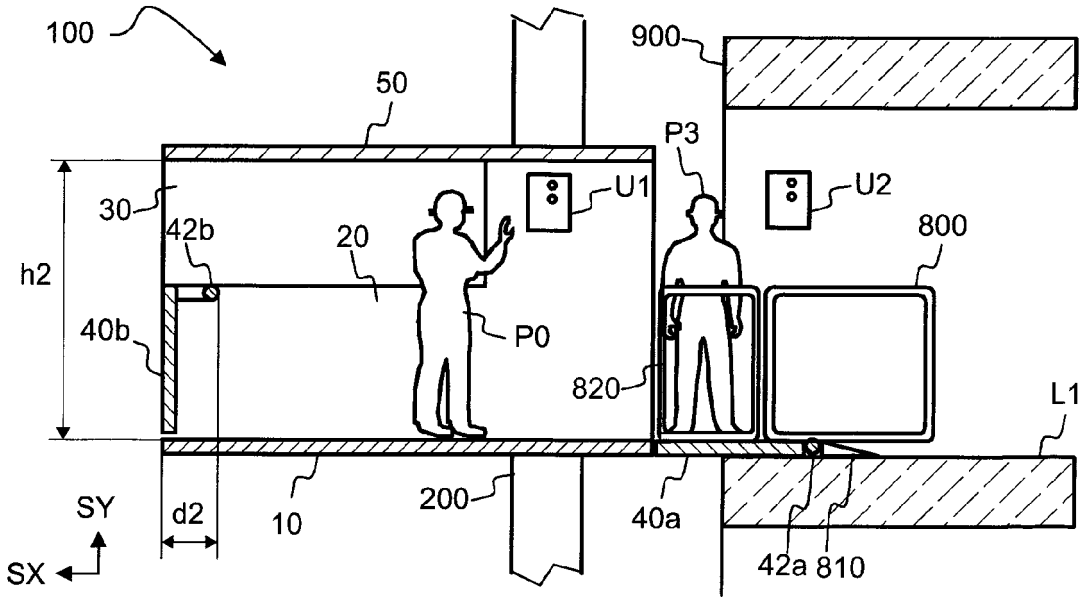

d800
100
50
900
U1
U2
30
42b
20
42a
22
h2
40b
40a
h1
P0
AX1
P3
800
810
L1
SY
d2
10
200
d2
d1
d0
SX
SAR
Section A-A

Fig. 5a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900
50
P3
U1
U2
30
42b
20
800
h2
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P0
820
L1
SY
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10
200
40a
42a
810
SX

Fig. 5b

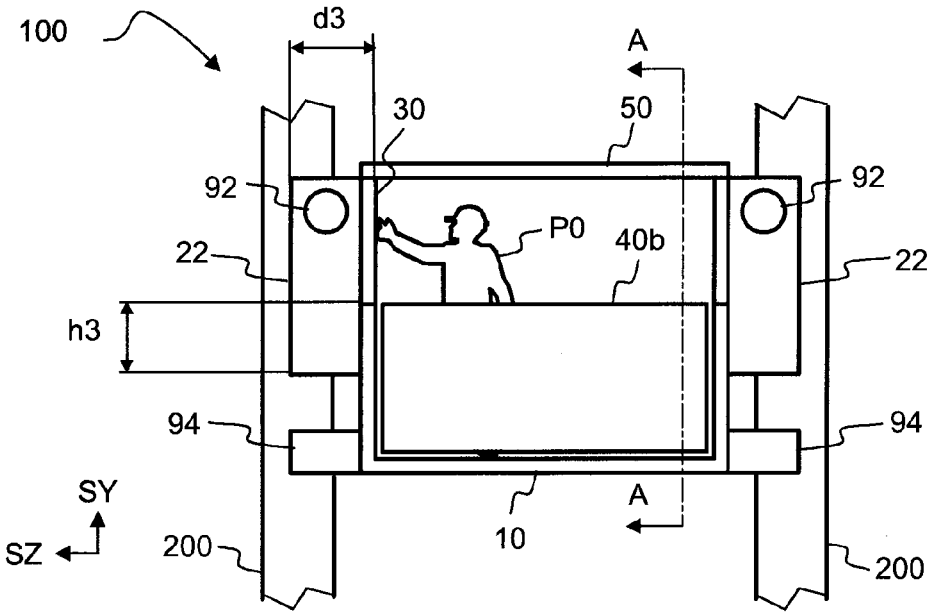
100
d3
A
30
50
92
92
P0
40b
22
22
h3
94
94
SY
SZ
A
200
10
200

Fig. 5c

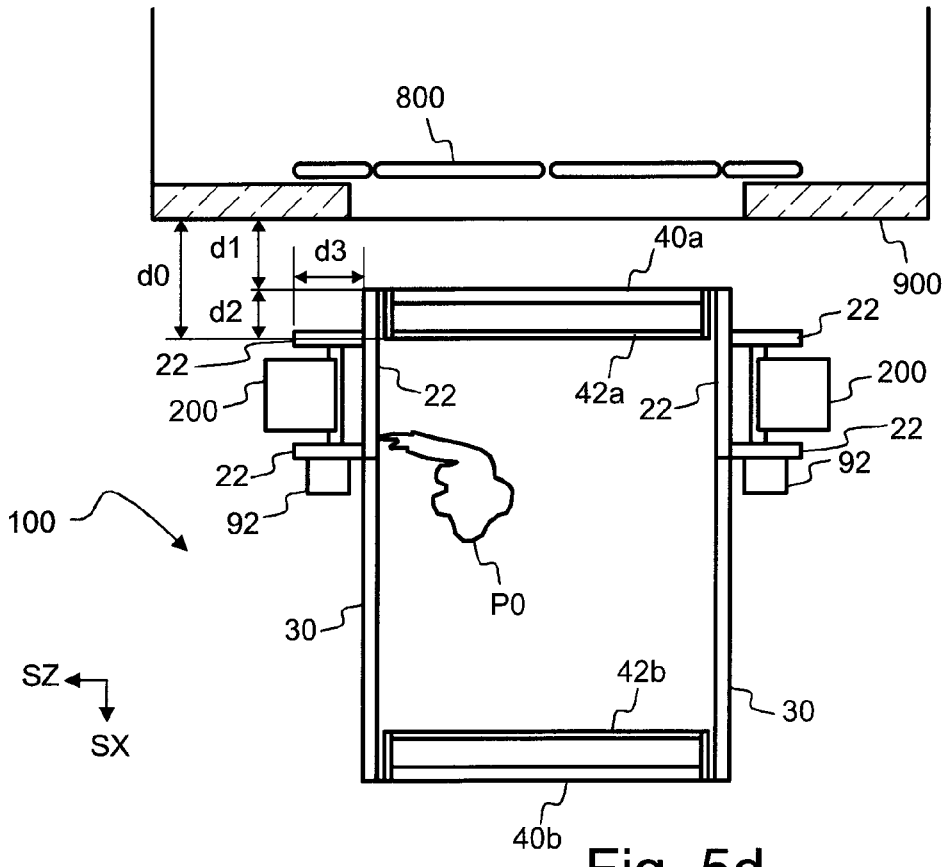
800
d1
d3
40a
900
d0
d2
22
22
22
200
22
42a
22
200
22
22
92
92
100
P0
30
SZ
42b
30
SX
40b

Fig. 5d

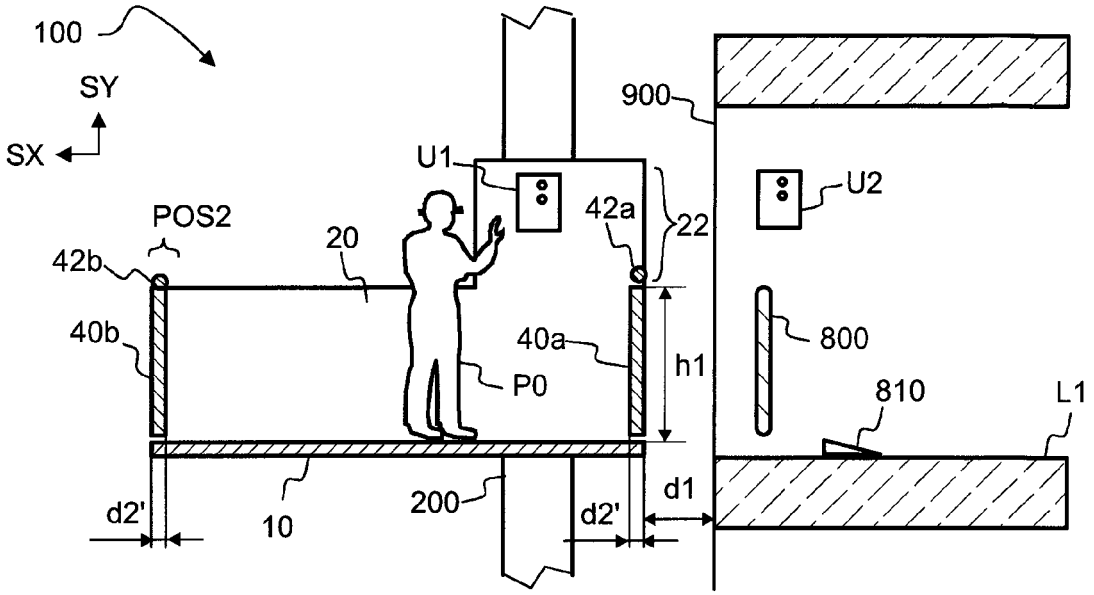
100
SY
SX
POS2
42b
40b
20
U1
42a
22
900
U2
40a
h1
P0
800
810
L1
d2'
10
200
d2'
d1

Fig. 6a

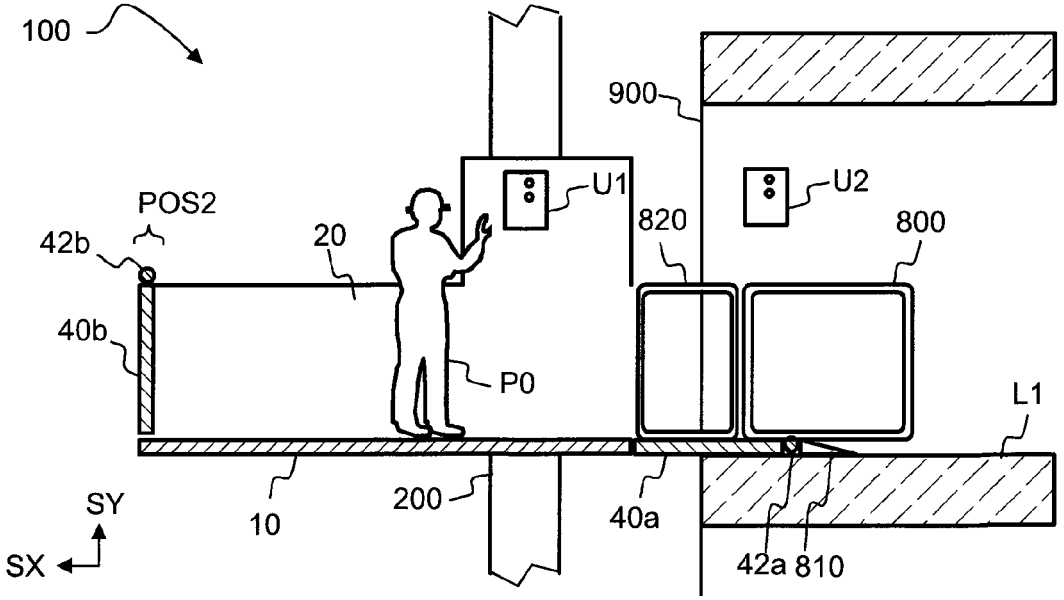
100
POS2
42b
40b
20
U1
820
900
U2
800
P0
L1
SY
SX
10
200
40a
42a
810

Fig. 6b

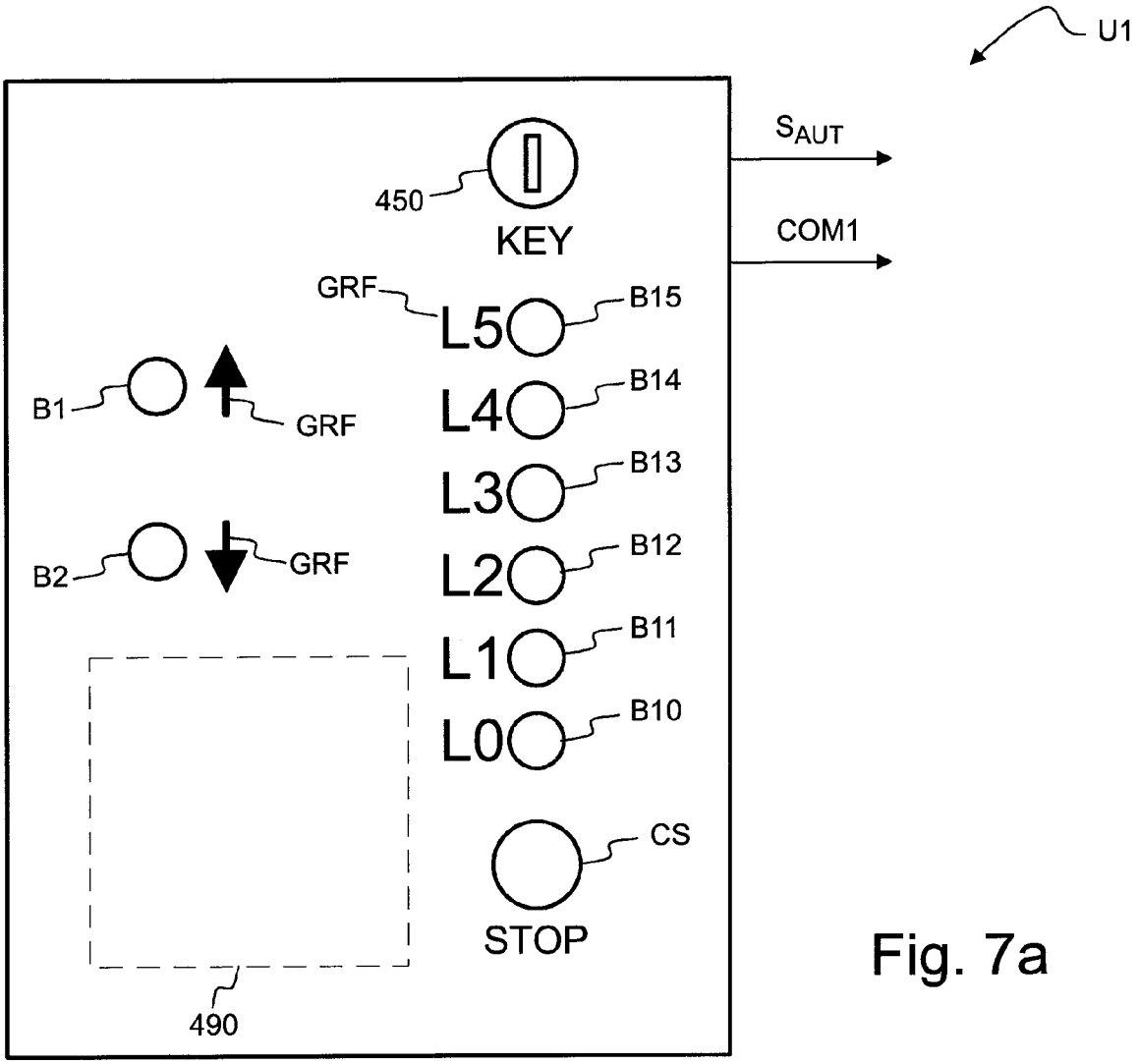
U1
450
KEY
SAUT
COM1
GRF
L5
B15
B1
GRF
L4
B14
L3
B13
B2
GRF
L2
B12
L1
B11
L0
B10
CS
STOP
490

Fig. 7a

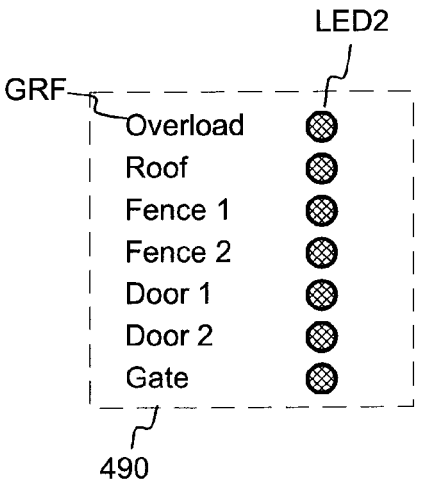
LED2
GRF
Overload
Roof
Fence 1
Fence 2
Door 1
Door 2
Gate
490

Fig. 7b

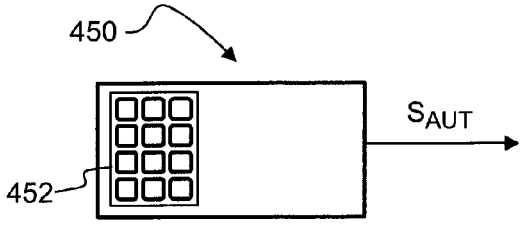

Fig. 8a

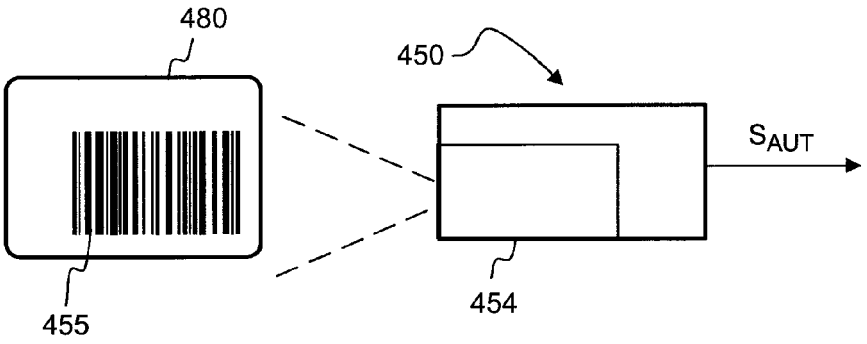

Fig. 8b

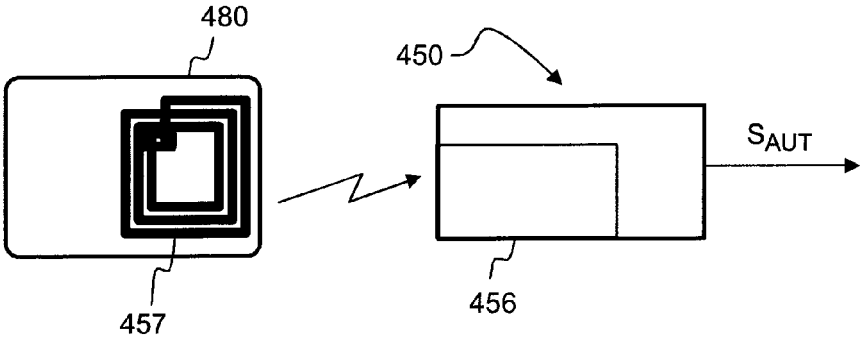

Fig. 8c

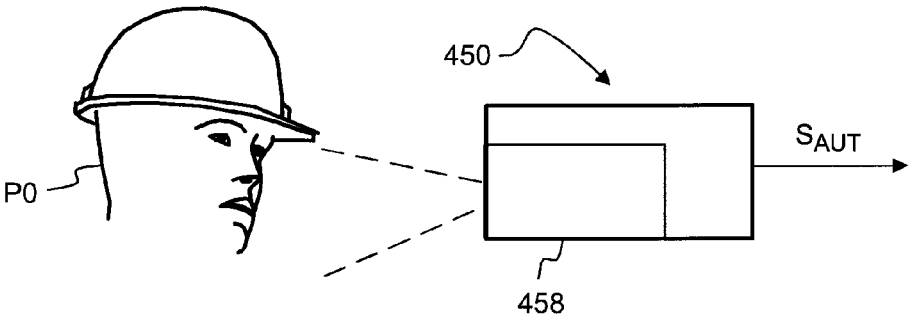

Fig. 8d

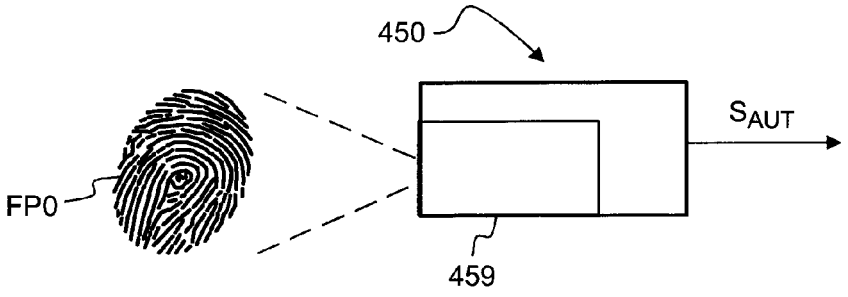

Fig. 8e

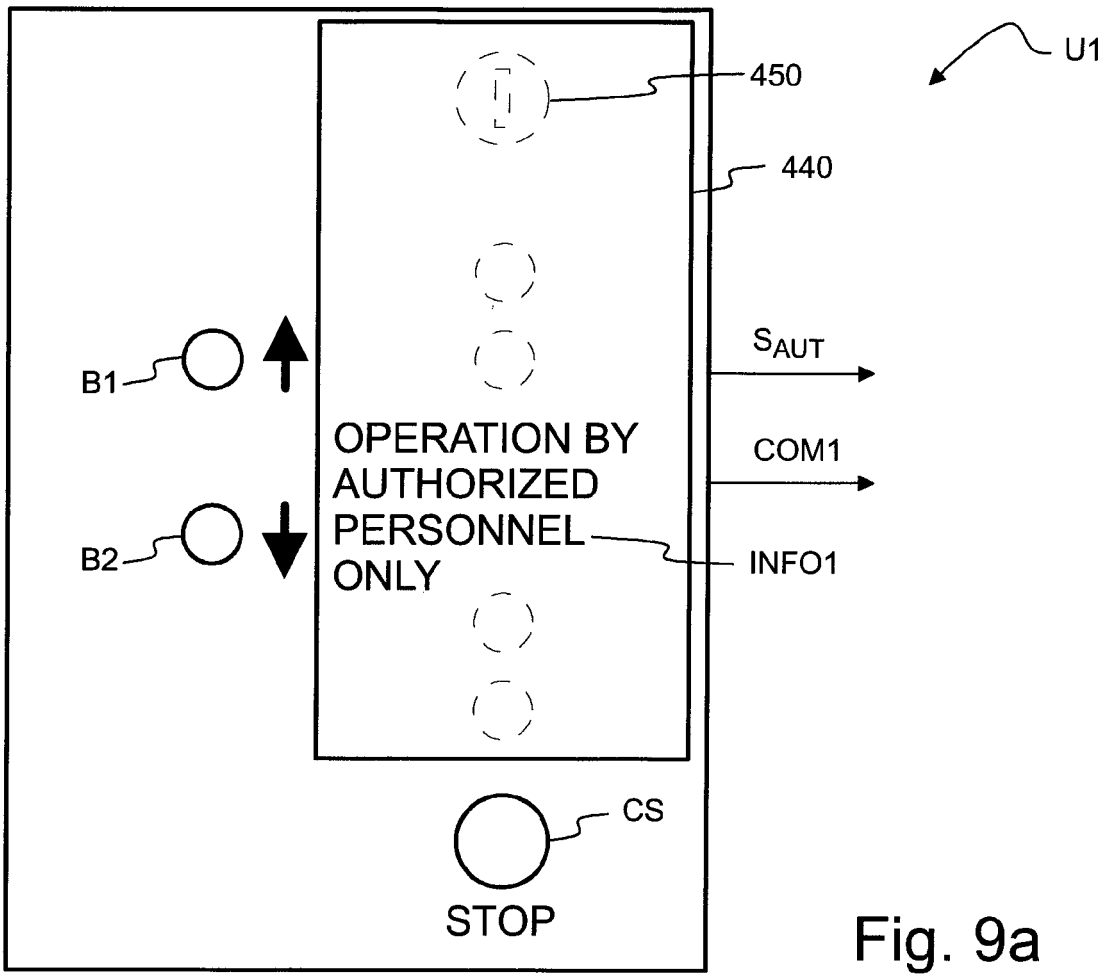
U1
450
440
B1
S_{AUT}
OPERATION BY AUTHORIZED PERSONNEL ONLY
COM1
B2
INFO1
CS
STOP

Fig. 9a


1240 kg
Gate 1 open
OPERATION BY
AUTHORIZED PERSONNEL ONLY
INFO1
490

Fig. 9b

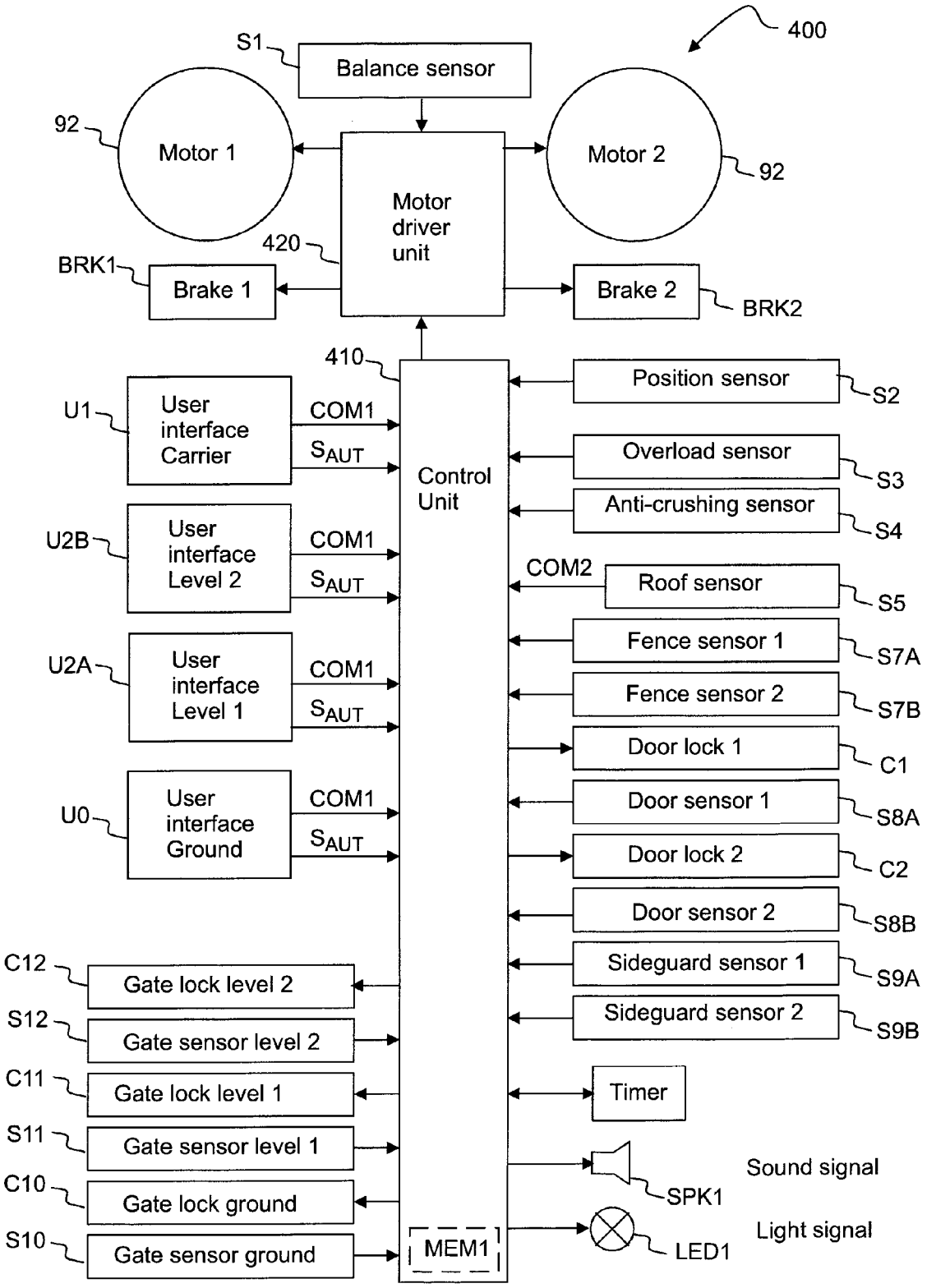
400
S1
Balance sensor
92
Motor 1
Motor 2
92
Motor driver unit
420
BRK1
Brake 1
Brake 2
BRK2
410
Control Unit
U1
User interface Carrier
COM1
SAUT
U2B
User interface Level 2
COM1
SAUT
U2A
User interface Level 1
COM1
SAUT
U0
User interface Ground
COM1
SAUT
Position sensor
S2
Overload sensor
S3
Anti-crushing sensor
S4
COM2
Roof sensor
S5
Fence sensor 1
S7A
Fence sensor 2
S7B
Door lock 1
C1
Door sensor 1
S8A
Door lock 2
C2
Door sensor 2
S8B
Sideguard sensor 1
S9A
Sideguard sensor 2
S9B
C12
Gate lock level 2
S12
Gate sensor level 2
C11
Gate lock level 1
S11
Gate sensor level 1
C10
Gate lock ground
S10
Gate sensor ground
MEM1
Timer
SPK1
Sound signal
LED1
Light signal

Fig. 10

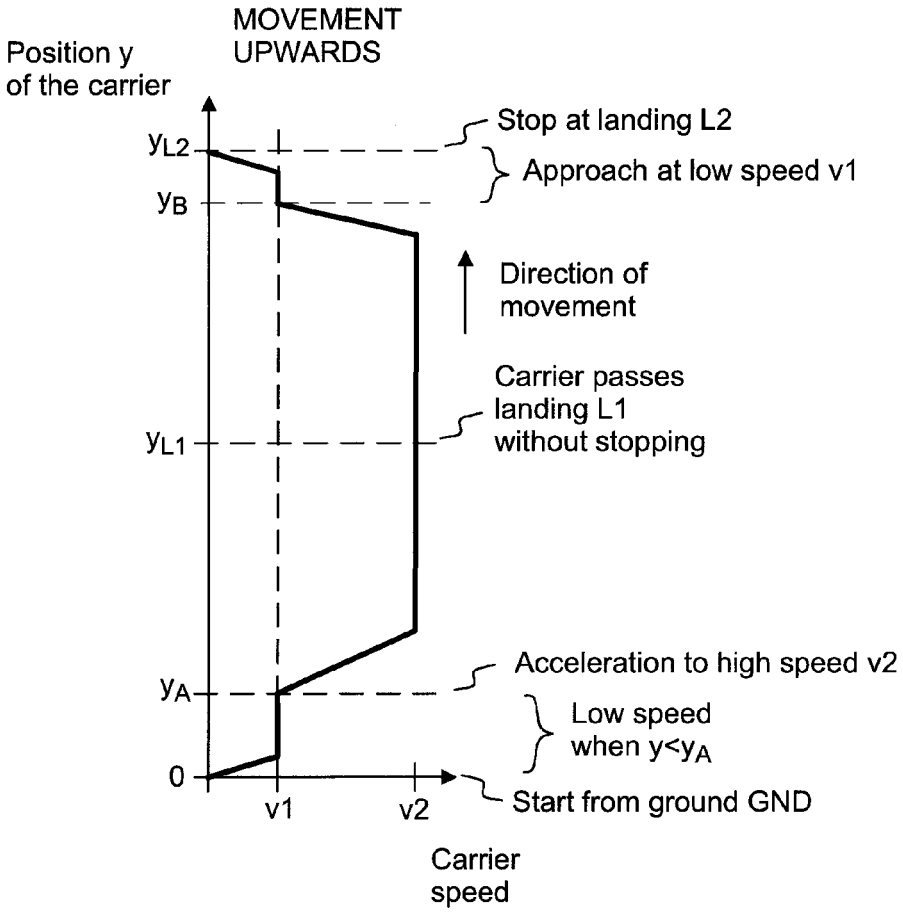

Fig. 11a

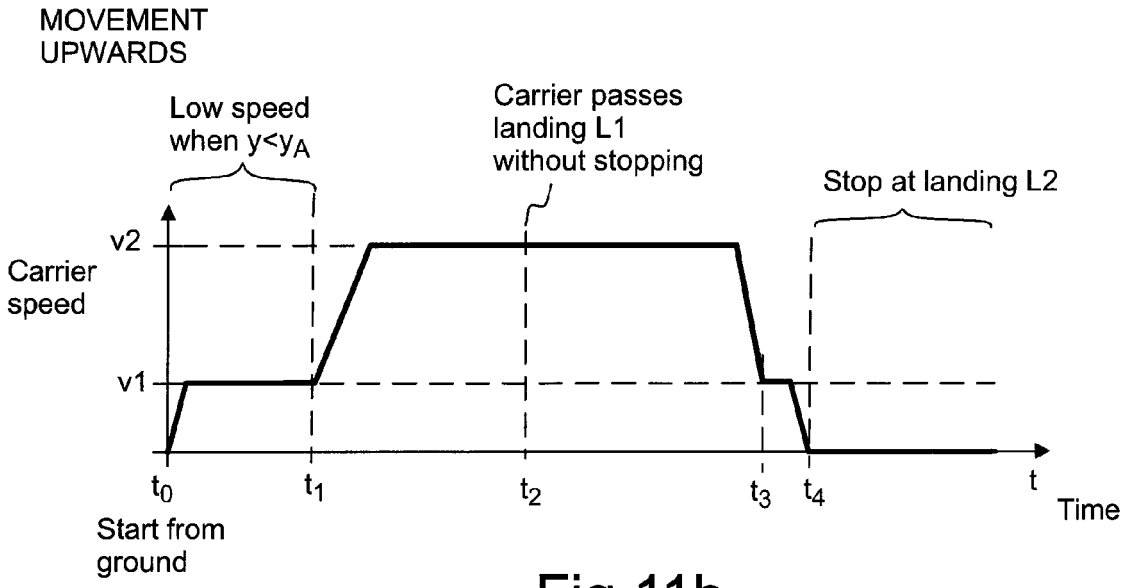

Fig.11b

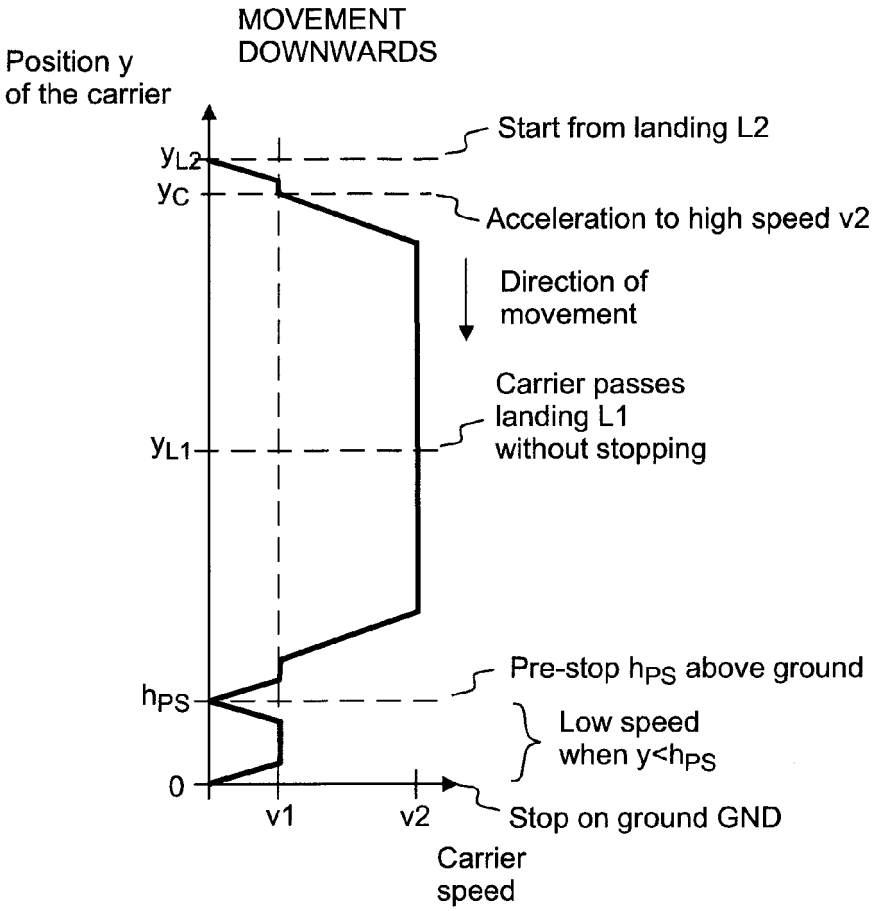

Fig. 11c

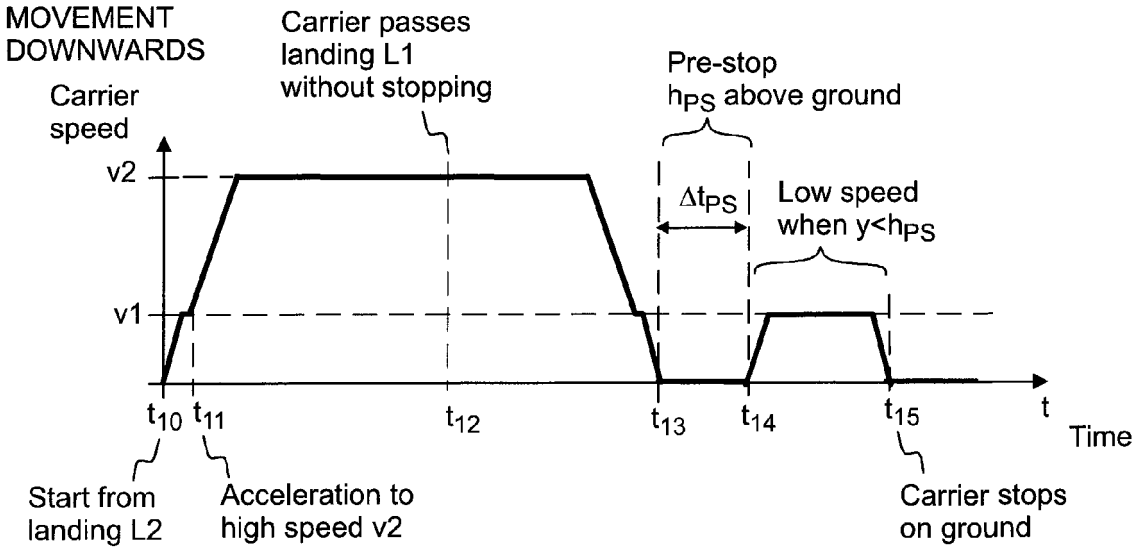

Fig.11d

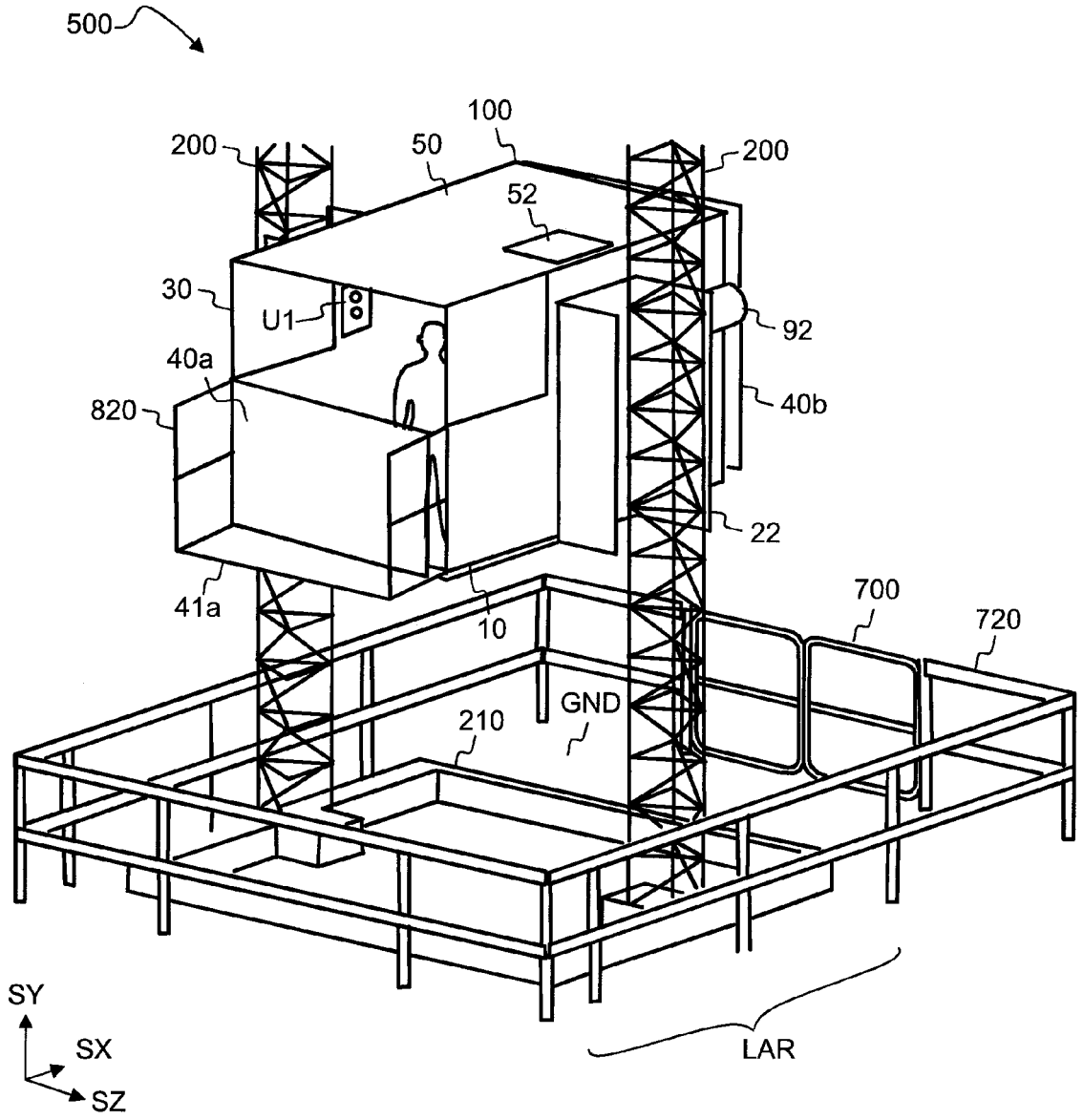
500
100
200
50
200
52
30
U1
92
40a
40b
820
22
41a
10
700
720
GND
210
SY
SX
SZ
LAR

Fig. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 11 39 7504

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B66B
G10L
G07C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 July 2011	Iuliano, Emanuela

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1

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