



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.03.2013 Bulletin 2013/12

(51) Int Cl.:
A61G 3/06 (2006.01)

(21) Application number: **12184592.9**

(22) Date of filing: **14.09.2012**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME

(30) Priority: **15.09.2011 NL 1039038**

(71) Applicant: **Beheers & Beleggingsmaatschappij
Verachtert B.V.**
5334 Le Velddriel (NL)

(72) Inventors:
• **de Bijl, Sjoerd Hendrik**
5334 LE Velddriel (NL)
• **Schouten, Marcel Johannes Hendrikus**
5334 LE Velddriel (NL)

(74) Representative: **Brants, Johan P.E.**
Brantsandpatents bvba
Guldensporenpark 75
9820 Merelbeke (BE)

(54) **Lift device to be used in conjunction with a vehicle**

(57) In a first aspect, the invention provides for a lift, to be used in conjunction with a vehicle containing a floor 6, said lift comprising:
a pair of arms 8, each connected to a four-bar linkage mechanism 5 and at least one of said arms 8 connected to a power actuator system 7;
a platform 9 coupled to said pair of arms 8 and;
a coupling mechanism linking said pair of arms and platform;
characterized in that said pair of arms 8 are one-fold, singular arms.

In a second aspect, the invention provides for a method for employing a lift of the current invention, whereby the method involves using of a velocity profile during the lifting and lowering procedure of the platform of said lift, whereby said velocity profile will vary according to the position of said platform.

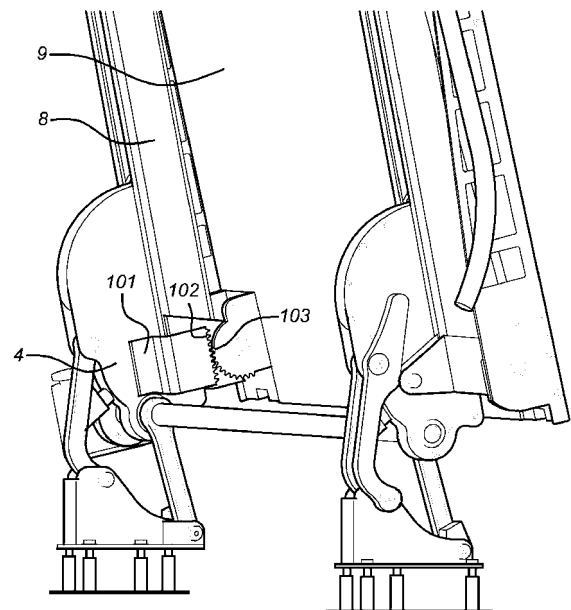


Fig. 7

Description

TECHNICAL FIELD

[0001] The present invention relates to a lift device to be used in conjunction with vehicles, for instance to be used for lifting and lowering wheelchair passengers or goods. In a second aspect, the invention provides for a method for employing a lift according to the current invention.

BACKGROUND

[0002] Vehicular wheelchairs are widely used to assist wheelchair users to enter of leave vehicles. US Pat. No. 6,379,102 issued to the Ricon Corporation on the 30th of April 2002, discloses a powered vehicular lift for persons who are physically challenged or have limited mobility. The lift includes an automatic foldable platform assembly which consists out of two plates hingeably connected along their adjacent transverse edges, where the platform assembly moves from a stowed position inside the vehicle to an entry position at the vehicle opening (and inversely), and moves the platform assembly between the entry level position and a ground level position outside the vehicle (and inversely). The lift has furthermore means for facilitating the unfolding of the platform sections into a horizontal position and coplanar to each other.

[0003] Application WO 03/059685 by the Braun Corporation, discloses a wheelchair access system with a foldable platform for use in conjunction with a vehicle containing a floor. The platform structure includes at least two platform sections, which may be pivotally stacked for storage in a stowed position. A four-bar linkage actuating system moves right- and left-side arms between positions inboard and outboard the vehicle respectively.

[0004] Devices known in prior art require a considerable storage capacity, especially due to the presence of arms comprising at least two parts, e.g. an upper and lower part, which are hingeably connected, hence losing valuable space in a vehicle, and are known to cause obstruction of the door window. It is the object of the current invention to provide a lift which occupies a minimum of space in the vehicle is furthermore and to provide a system that offers adequate stability when moving in- or outboard the vehicle. Furthermore, it is the aim of the invention to assure a confident feeling to the user when handling the lift system whereby the lifting procedure occurs in a smooth movement at a moderate but steady pace. Finally, the lift of the current invention has been designed in an optimal way to ensure the safety of both the operator and the wheelchair passenger.

SUMMARY OF THE INVENTION

[0005] In a first aspect, the present invention provides for a powered vehicular wheelchair according to claim 6 to be used by persons who are physically challenged or

have limited mobility. The lift is to be used in conjunction with a vehicle comprising a floor, and with limited space for storage. The lift furthermore ensures an unhindered view from within the vehicle and provides for a secured and swift lifting movement.

[0006] In one embodiment, the lift comprises a four-bar linkage mechanism, whereby said four-bar linkage mechanism comprises of four linkage structures. The said four-bar linkage mechanism is mounted directly on the vehicle floor, and connected to a pair of one-fold, singular arms adjacent to the lateral vehicle walls.

[0007] In another embodiment, at least one of said one-fold, singular arms is connected to a power actuator system, whereby said power actuator system comprises preferably an electrical motor.

[0008] In yet another embodiment of the current invention, the said arms will form an angle between 80° and 90° with the vehicle floor when in stowed position.

In another embodiment, when the platform of said lift is in an unfolded position, the said arms will form an angle between 55° and 80° with vehicle floor.

[0009] In another embodiment of the current invention, one of the linkage structures of the said the four-bar linkage mechanism is linked to the arms by means of a rack and spur gear mechanism, which permits both a tilted and up-and downwards movement of the arms, in- and outboard of the vehicle.

[0010] In a second aspect, the current invention provides for a method for employing a lift according to claim 1.

[0011] In one embodiment, said method involves using a specific velocity profile during the lifting and lowering procedure of the platform of the lift, whereby the velocity accelerates during the first part of the lifting and lowering procedure, remains constant during the middle part and decreases in the final part of the procedure.

[0012] Although lifts with foldable platforms are known in the prior art to save storage capacity, the amount of space required to install the lift in the vehicle is still considerable. These lifts make use of an actuating system connected to a pair of hinged linking arms, and the space occupied by these structures on the vehicle floor is still considerable. By utilizing a pair of one-fold arms connected to a simple four-bar linkage lifting actuator, mounted on the floor, the present invention provides for a compact lift which can be mounted nearby the entrance door of the vehicle, hence limiting the needed storage space in the vehicle. The present invention provides also for an unhindered view from within the vehicle. Finally, the design of lift according to the current invention ensures an optimal safety for the users.

DESCRIPTION OF FIGURES

[0013]

FIG. 1 is an overview of a lift according to the prior art, whereby the platform of the lift is attached to a

pair of arms, for supporting and moving of the platform, and whereby the arms comprise an upper and lower arm coupled to each other.

FIG. 2a-c show an illustrative overview of the unloading platform to the entry level of the disclosed lift in present invention.

FIG. 3 is an illustrative view of the disclosed lift, whereby the platform is at the ground position.

FIG. 4 is an illustrative overview of the disclosed lift in present invention, whereby the platform is stowed in the back of a vehicle.

FIG. 5a-b give an illustrative view of a four-bar linkage lift mechanism and its linkage structures, which is disclosed in the present invention. The four-bar linkage lifting structure is connected to a arm by a system comprising a rack and spur gears, allowing the arm to move with respect to the four-bar linkage mechanism.

FIG 6. depicts a realistic view of a vehicle installed with the lift according to an embodiment of the current invention.

FIG 7. depicts a preferred embodiment of the four-bar linkage mechanism and the coupling mechanism according to the current invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present invention concerns a foldable lift, to be installed on the floor of a vehicle in a vertical position and which can be used for persons who are physically challenged or have limited abilities. It is the aim of the invention to provide a lift which occupies a minimum of space in the vehicle. The lift therefore is equipped with a specific actuator system comprising a four-bar linkage mechanism and a singular arm linked to both the four-bar linkage mechanism and a platform. The four-bar linkage mechanism will assure the lowering and raising of the arm, thereby bringing the platform either to the ground level or in its stowed position in the vehicle.

Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0015] As used herein, the following terms have the following meanings:

[0016] "A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

[0017] "About" as used herein referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of +/-20% or less, preferably +/-10% or less, more preferably +/-5% or less, even more preferably +/-1% or less, and still more preferably +/-0.1% or less of and from the specified value, in so far such variations are appropriate to perform in the disclosed invention. However, it is to be understood that the value to which the modifier "about" refers is itself also specifically disclosed.

[0018] "Comprise," "comprising," and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

[0019] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

The term "entry level" is to be understood as the level where the platform of the lift is planar to and at the height of the vehicle floor, allowing a wheelchair passenger to either board the vehicle or board the platform of the lift.

[0020] The term "ground level" is to be understood as the level where the platform of the lift is outside the vehicle, planar to and at the height of the ground, allowing a wheelchair passenger to either exit or board the platform.

[0021] The term "one-fold, singular arm" is to be interpreted as an arm or branch which is a single undivided whole.

[0022] The present invention comprises a lift, to be used in conjunction with a vehicle containing a floor 6, the said lift comprising:

- a pair of arms 8, each connected to a four-bar linkage mechanism 5 and at least one of said arms 8 connected to a power actuator system 7;
- a platform 9 coupled to said pair of arms 8 and;
- a coupling mechanism linking said pair of arms and platform.

[0023] Such a lift can be used for lifting or lowering a person in a wheelchair between a transport vehicle floor 6 and an exterior floor, i.e. a floor at ground level.

[0024] In an embodiment, said pair of arms 8 are one-fold, singular arms.

[0025] In an embodiment, said platform 9 comprises an unfolded position for lifting or lowering a person in a wheelchair and a stowed position for transport, and preferably whereby said four-bar linkage mechanisms 5 are in a fixed lift position when said platform is being lifted or lowered between said transport vehicle floor 6 and said exterior floor. In the unfolded position, the platform comprises an essentially horizontal loading plane upon which a wheelchair can be loaded for lifting or lowering. During

lifting or lowering of the platform, possibly loaded with a person in a wheelchair, it is safer if the four-bar mechanisms are blocked. In prior art lifts, a dangerous situation occurred when body members such as legs or arms, or other objects accidentally get introduced in between the four-bar linking mechanism during the lifting or lowering procedure of the lift. As in prior art lifts, the four-bar mechanism was allowed to move, e.g. the linkage structures of the mechanism rotated with respect to each, the body members or objects introduced in between the mechanism could get trapped, resulting in injuries or material damages. The present lift solves this problem by providing four-bar linkage mechanisms 5 which are in a fixed lift position when said platform is being lifted or lowered between said transport vehicle floor 6 and said exterior floor for lifting or lowering a wheelchair.

[0026] In a preferred embodiment, the lift comprises movement controlling means for controlling a velocity profile of said platform 9 at least when said platform is being lifted or lowered between said transport vehicle floor 6 and said exterior floor. The velocity profile of the lift can thus be controlled to improve the safety and comfort of the person in the wheelchair being lifted or lowered.

[0027] In a preferred embodiment, the four-bar linkage mechanisms 5 are in said fixed lift position when said platform 9 is in said unfolded position. This means that no confusion is possible as to when it is safe to use the lift. If the platform is in the unfolded position, it is then safe to use the platform. In a more preferred embodiment, the four-bar linkage mechanisms 5 are in said fixed lift position when said platform 9 is in an intermediate position between the stowed position and the unfolded position, i.e. when the position of the platform is changed from a stowed position to the unfolded position, the four-bar linkage mechanisms obtain said fixed lift position already before the platform is in the unfolded position.

[0028] In a preferred embodiment, each of said four-bar linkage mechanisms comprises four linkage structures 1-4 connected at four rotation points, each comprising a horizontal position, whereby said horizontal positions of said rotation points define a polygonal stability area, whereby said platform 9 and said pair of arms 8 comprise a combined center of mass comprising a horizontal position, whereby said horizontal position of said combined center of mass is located within said stability area when said platform is in said stowed position, and whereby said horizontal position of said combined center of mass is located outside of said stability area when said platform is in said unfolded position. In this embodiment, the change of the platform's position from the stowed position to the unfolded position may occur by changing the horizontal position from the pair of arms and/or the platform, preferably by actuating said power actuator system 7. The four-bar linkage mechanisms can thereby be tipped into the fixed lift position under the influence of gravity, i.e. by changing the horizontal position of the combined center of mass of the arms and platform, the relative orientation of the four-bar linkage structures are

adjusted until they four-bar linkage mechanisms reach the fixed lift position. In a more preferred embodiment, the lift may comprise at least one stopping means for restricting at least one of said four-bar linkage mechanisms to said fixed lift position, i.e. when the platform's position is changed from stowed to unfolded, the four-bar linkage mechanisms are changed, preferably from a fixed stowed position, to a fixed lift position, but not further.

[0029] In one embodiment, the said four-bar linkage mechanism 5 comprises four linkage structures 1-4, which are able to move under a certain angle and with respect to each other. Referring to Figures 4 and 5a-b, there are shown the pair of actuating linkage structures. In a preferred embodiment, one of the said linkage structures 1 of the four-bar linkage mechanism is mounted on the vehicle floor 6. As this rules out the need of any additional mounting plate, as often seen in prior art lifts, less space will be occupied in the vehicle storing the lift. The four-bar linkage mechanism 5 furthermore comprises of a second linkage structure 4, opposite to the said linkage structure 1 mounted on the vehicle floor, and two other linkage structures 2-3, parallel to each other, connected to both the linkage structure 1 mounted on the floor and the structure 4 opposite of the latter. The linkage structures are interconnected by conventional connection means to form a four-bar linkage mechanism 5, all of which said connection means are known in the prior art. The said connection means allow allow a rotational movement around a fixed angle of the linkage structures.

[0030] At least one of said arms 8 will be connected to a power actuator system 7 (ref to Fig. 5a-b) which will actuate the four-bar linkage mechanism. As such, the power actuator system 7 will actuate the movement of the pair of arms 8 and the connected platform 9. The actuator system 7 may be controlled electrically, hydraulically or in any other conventional way known to one skilled in the art. In a preferred embodiment, the said power actuator system comprises an electrical motor. In a preferred embodiment, said electrical motor is capable of providing electrical power of more than 50W, preferably more than 80W, more preferably more than 100W, even more preferably more than 120W, yet more preferably more than 140W, still more preferably more than 160W, still even more preferably more than 180W, yet even more preferably more than 200W, yet still even more preferably more than 220W, most preferably more than 240W.

[0031] An electrical motor further allows for a more precise control over the velocity profile of the platform during a lifting and lowering procedure. It also allows for a smoother velocity profile, i.e. with less shocks or vibrations, than e.g. a hydraulic motor.

[0032] In a preferred embodiment, said electrical motor is a DC motor. In a more preferred embodiment, said electrical motor is a 12V motor, preferably connected to a battery, preferably of said vehicle.

The actuator system 7 is mounted in between two relative

linkage structures and is fixed to the four-bar linkage mechanism mounted on the vehicle's floor by conventional means, all which are well known in the art.

[0033] In a preferred embodiment and with respect to figures 4 and 5a-b, the linkage structure 4 opposite to the linkage structure 1 mounted on the vehicle floor will be connected to an arm 8, which on its turn is attached to the platform of the lift 9 by a coupling mechanism. In a preferred embodiment, said coupling mechanism comprises a rack and spur gear mechanism 10 (see Fig. 5a and 7). The said rack and spur gear mechanism 10 allows the arm 8 to move downwards or upwards with respect to the said linkage structure and the vehicle floor. A protrusion 101 comprising a rack 102, is mounted on the four-bar linkage structure 4 and a spur 103 is fixated on the foldable platform 9. When the arm 8 is lowered, the spur 103 hooks into the teeth of the rack 102 hereby forcing the platform to turn towards an unfolded, essentially horizontal position. When the arm is raised from e.g. the entry level position to the stowed position, and the platform is near the stowed position, the spur 103 grips into the teeth of the rack 102. When the arm 8 is further lifted towards the completely stowed position the spur 103 will roll over the rack 102, hereby rotating the platform 9 attached to it. In a further embodiment, said coupling mechanism furthermore also comprises flexible means 14, such as a cable, that are coupled at a first end 15 to the arm 8 and at an opposite second end 18 to the platform 9. In a preferred embodiment, first end 15 is engaged to a projecting member extending in the inboard direction from arm 8. The cable mechanism controls the unloading of the platform. For example, as platform 9 moves from its stowed position (Figure 2A) towards its entry level position (Figure 2C), said flexible means 14 will pull on platform 9 to maintain the entry level position, planar to the vehicle floor 6. In case a foldable platform is used, said cable mechanisms 14 also assist in maintaining first section 9a and second section 9b in horizontally deployed positions (Figure 2C).

Figures 3 and 4 depict the different end-positions said arms 8 can attain with respect to the four-bar linkage mechanism 5 and vehicle floor 6. Hence, the said arm 8 will move to a lower position outside the vehicle, thereby bringing the platform linked to the arms to a ground level (see Fig. 3). Similarly, the said rack and spur gear mechanism 10 will allow an upward movement of the arm, in order to eventually achieve the stowed position of the lift (as depicted in Fig. 4). In a preferred embodiment, the arm 8 is mounted on the linkage structure 4 under a predetermined angle α (see Fig. 5a). This angle α can be chosen such that the arm 8 makes an angle with the vehicle floor, preferably between 80° and 90°, when the elevator is in a stowed position, and/or preferably between 55° and 80°, when the platform is in an unfolded position and/or the elevator is between an entry level position and a ground level position.

[0034] The said pair of arms 8 connected to both the platform 9 and the four-bar linkage mechanism 5 com-

prises one-fold singular arms. Figure 1 depicts a lift according to the prior art, whereby the arm 11 is a multi-fold arm, comprising at least two parts 11a and 11b, hingeably connected to each other. In order to deploy the platform of said lift, the said hingeably connected parts of the arm will unfold outside of the vehicle. The multi-fold state of the said arm implies that the lift in a stowed position will take up a considerable amount of space in the vehicle.

[0035] The pair of arms connected to the platform in the current invention is of the one-fold type, comprising one upright branch, connected to both the four-bar linkage mechanism 5 and the platform 9. As mentioned above, the arm can move with respect of the four-bar linkage mechanism 5 by means of a rack and spur gears 10. By employing a one-fold arm singular arm as in the current invention, the lift will occupy less space when stowed in the back of a vehicle, contrary to utilizing a lift of the prior art type, as depicted in figure 1. Moreover, the multi-fold arm of the prior art lift has been in the past the cause of severe accidents, as the risk of getting body parts, such as arms or hands, getting stuck between the folding of said multi-fold arms is high. Hence, by deploying a one-fold, singular arm safety issues are improved.

[0036] In one embodiment, the said platform 9 of the lift according of the current invention comprises of one platform section, being a one-piece platform. In another embodiment, said platform is divided in two platform sections 9a and 9b, which are able to fold with respect to each other (see Fig. 2a-c). In yet another, more preferred embodiment, the platform comprises sections which are slideable with respect to each other. This way, the length of the platform can be extended during the lifting procedure, and shortened when in unused, stowed position. Such a platform may comprise a dock bridge or dock-bridge-like set-up with extendable lip, telescopically extendable platform sections, a boom mechanism, etc.

[0037] The platform assembly 9 can be lifted upwardly and downwardly among a stowed position (Fig. 2a), an entry level position (Fig. 2c) and the ground level position by the said actuator system (Fig. 3). Figure 2a depicts the lift installed on a vehicle floor 6, in a fully stowed position. Figures 2b and 2c depict the unloading of the platform to a horizontal position (the entry level), parallel to the ground level. In one embodiment, the platform of the wheelchair may comprise out of at least a first 9a and second 9b platform section. Both platform sections comprise of an upper and lower surface. In the folded configuration (Fig. 2a), the platform sections 9a-b are facing with their lower surfaces towards each other. In unfolded, horizontal position, both platform sections 9a-b are in parallel, with their respective surfaces facing the same direction. In another embodiment, the said platform 9 will comprise a one-piece platform. In a most preferred embodiment, the said platform 9 will comprise slideable sections, which can slide-out with respect to each other when unloaded to the entry and ground level in order to extend the length of said platform. In a stowed position, at least

one of said platform sections will slide underneath or into, e.g. telescopically, the other in order to shorten the length of said platform in stowed position.

[0038] Figure 3 depicts a lift according to the current invention with the platform on ground level whereby the arms 8 connected to the platform 9 are at their lowest position with respect to the ground level. In this position, the four-bar linkage mechanism 5 with the linkage structures 1-4 is pivoted/tilted towards the outside of the vehicle.

[0039] Figure 4 on the other hand depicts a preferred embodiment of the lift according to the current invention in its stowed position. In this position, the arms 8 connected to the platform 9 and the four-bar linkage mechanism 5 are at their highest position with respect to the ground level by deformation of the four-bar linkage lifting structure 5.

[0040] When in said stowed position, the said arms 8 will have an essentially vertical position, whereby said essentially vertical is to be understood that said arms will form an angle with the vehicle floor 6 between 80° and 90°. When said lift is actuated to move from a stowed position to ground level position, the said arms 8 will be slightly tilted with respect to the vehicle floor 6 due to the action of the four-bar linkage mechanism 5. In an embodiment, the maximum tilting angle between said arm 8 and said vehicle floor 6 is smaller than 80° and larger than 55°, more preferably smaller than 75° and larger than 65°, more preferably 70°. Said tilting of the arm 8 occurs preferably before lowering the arm to the ground position. As is depicted in figure 2c, in a preferred embodiment, the arm achieves its maximal tilted position when the lift being at the entry level position, that is with the platform 9 being planar to and at the height of the vehicle floor 6. The subsequent movement of the arms will mostly involve the lowering of said arms 8 and connected platform 9 to the ground level, without said tilting angle being changed. When the lift has to move in the opposite direction, from said ground level, to entry position and finally to a stowed configuration, the motion of the arms 8 will equally be reversed. Said arms 8 will equally perform a reversed movement, meaning that said arms will go from a tilted to an essentially vertical position with respect to the vehicle floor, due to the actions of said four-bar linkage mechanism 5.

[0041] The present invention also comprises a method for employing a lift for lifting or lowering a person in a wheelchair between a transport vehicle floor 6 and an exterior floor, said lift comprising a platform 9, said method comprising the steps of:

- lifting or lowering said platform 9 along a linear trajectory between said transport vehicle floor 6 and said exterior floor;
- using a velocity profile during said lifting or lowering procedure, whereby said velocity profile will vary according to the position of said platform 9.

Preferably a lift is used as described in this document, and preferably said linear trajectory is defined by the fixed lift position of the four-bar linkage mechanisms of the lift as further explained in this document.

[0042] Preferably said method comprises the step of:

- changing the position of the platform from a stowed position to an unfolded position; and/or
- changing the position of the platform from an unfolded position to a stowed position;

whereby preferably said platform position changing steps are performed by changing the position of the four-bar linkage mechanisms of the lift as further explained in this document from a fixed stowed position to a fixed lift position or from a fixed lift position to a fixed stowed position respectively.

[0043] Prior art methods usually lifted wheelchair passengers along a non-linear trajectory, mostly due to the platform being directly attached to a four-bar linkage mechanism, or to the platform being attached to a pair of arms at a specific position, whereby the pair of arms are directly attached to a four-bar linkage mechanism as in fig. 1. Furthermore, the present method offers an improved safety and comfort for the wheelchair passenger during the lifting/lowering procedure, due to a velocity profile during said lifting or lowering procedure. Such velocity profile may be adapted to specific needs, but in a preferred embodiment, said velocity profile will vary according to the position of the platform, e.g. with respect to the transport vehicle floor and/or the exterior floor.

[0044] In an embodiment, during both the lifting and lowering procedure of the wheelchair and its passenger, the lift will move along a well-defined velocity profile. In one embodiment, said utilized velocity profile will be constant, and not change during the entire procedure. In a more preferred embodiment, said velocity profile will vary according to the position of the platform. In a first step of the lifting and lowering procedure, said procedure will start at a low to moderate speed, whereby said speed will accelerate to a defined threshold in a first part of the procedure, after which said speed will remain constant during the middle part of the procedure, and eventually will slow down when entering the final part of the procedure. More preferably, said first and final part of the procedure is to be understood as the first and final percentages of the distance that is to be bridged. In a most preferred embodiment, said first and final percentages are to be interpreted as not more than the first and final 20% of said distance to bridge, most preferably the first and final 10% of said distance. In a preferred embodiment, the maximal speed employed during the lifting or lowering procedure is 0.15 m/s. In a more preferred embodiment, the speed employed during the first and final part of the procedure will be less than 0.15 m/s. By employing a velocity profile that accelerates to achieve a constant speed during the first part of the procedure, and finally decreases again in the last part of said procedure, the

stability of the lifting and lowering procedure is improved, hence equally improving the safety thereof. Moreover, by not utilizing a constant speed throughout the whole procedure, but rather start at a moderate speed and accelerate throughout the course of the procedure, the latter will create a better safety feeling for passenger.

[0045] In one embodiment, said (un)stowing and lifting/lowering procedure can be initiated by an operator by pressing a button or switch present in the vehicle comprising the lift. In a preferred embodiment, said separate buttons or switches are provided for the unstowing/lowering procedure and the lifting/stowing procedure. In a more preferred embodiment, said both procedures will come automatically to a halt when the platform 9 of the lift has reached the entry level, said the level planar to and at the height of the vehicle floor 6 (see Fig. 2c). The latter ensures protection of a potential passenger on the lift, and prevents for instance that the lift would proceed to the stowed position, while the passenger is still present on the platform. Similarly, as such the system will prevent movement of the platform while a passenger inside the vehicle is still boarding the platform. In general, overall safety of the lowering and lifting procedure is improved. In a preferred embodiment, continuation of the procedure (when the wheelchair passenger has safely boarded the platform or the vehicle) will only occur when the operator pushes the correspondent button or switch for a second time. By doing so, the operator indicates that the circumstances allow proceeding with the subsequent steps of the procedure, e.g. stowing away the lift or descending to ground level.

[0046] Figure 6 depicts the preferred embodiment of the lift according to the current invention, installed in the back of a vehicle. In one embodiment, the lift comprises a foldable platform 9, comprising two sections 9a-b. In another preferred embodiment, the platform may comprise out of one platform section, being a one-piece platform. In case of the presence of a foldable platform, the platform section includes a first platform section 9b and a second platform section 9b. The first and second platform sections 9a-b are pivotally connected along their transverse adjacent edges. In the stowed position, the two sections 9a-b are collapsed transversely across each other and folded against each other such that their undersides abut against each other, and oriented in a substantially vertical low profile arrangement relative to the vehicle doorway. In a preferred embodiment, the sections are linked with means for interlinking 12 the said platform sections. In one embodiment, these means comprise a gear assembly which comprises of a pair of parallel spur gears, interlinking both sections of the platform, and thereby regulating the movement of the second platform section 9a as it is folded and unfolded with respect to the first platform section 9b. In another embodiment, these said means 12 for interlinking the platform sections may comprise spring means which are respectively connected to the side panels 13a-b of said outer 9b and inner plate 9a for assisting in unfolding and folding of the two

plates. The interlinking means 12 may furthermore comprise a plate having a first end pivotally connected to side panel 13a and another end pivotally coupled to side panel 13b. The platform sections are foldable relative to one another about interlinking means 12 between the folded and unfolded positions with respect to the first platform section as the actuator moves the right-side and left-side arms 8 between positions inboard and outboard the vehicle, respectively. The second platform section 9a is coupled for movement with the actuator.

[0047] In a preferred embodiment, the platform may comprise side panels. Presence of these side panels can prevent the wheelchair from rolling of the sides of the platform.

[0048] In a preferred embodiment, the lift may be provided with handrails 16 extending horizontally from arms 8 when the platform is deployed in a horizontal position as shown in Figs. 2C, 3 and 6.

[0049] Handrails 16 fold vertically relative to arms 8 so as to extend along arms 8 when platform 9 is in its vertically stowed position of Figs. 2A and 4. The platform also includes a spring-loaded rollstop 17 pivotally connected to the outboard end of platform 22 that is normally spring-biased to a raised safety barrier position as shown in Fig. 6.

[0050] The present invention is not intended to be restricted to any particular form or arrangement, or any specific embodiment disclosed herein, or any specific use, since the same may be modified in various particulars or relations without departing from the scope of the claimed invention hereinabove shown and described of which the apparatus shown is intended only for illustration and for disclosure of an operative embodiment and not to show all of the various forms or modifications in which the present invention might be embodied or operated.

The present invention has been described in considerable detail in order to comply with the patent laws by providing full public disclosure of at least one of its forms.

[0051] However, such detailed description is not intended in any way to limit the broad features or principles of the present invention, or the scope of patent monopoly to be granted.

[0052] Therefore, the present invention provides, but is not limited to:

1. A lift, to be used in conjunction with a vehicle containing a floor 6, said lift comprising:

a pair of arms 8, each connected to a four-bar linkage mechanism 5 and at least one of said arms connected to a power actuator system 7; a platform 9 coupled to said pair of arms 8 and; a coupling mechanism linking said pair of arms and platform;

characterized in that said pair of arms 8 are one-fold, singular arms.

2. The lift of point 1 with said four-bar linkage mechanism 5 comprising four linkage structures 1-4 whereby said one linkage structure 1 is mounted on- to the vehicle floor 6 and a second linkage structure 4 is attached to said pair of arms 8.

3. The lift according to point 2, whereby said pair of arms 8 form an angle between 80° and 90° with the vehicle floor 6, when said lift is in stowed position.

4. The lift according to point 3, whereby said pair of arms form an angle between 55° and 80° with the vehicle floor 6, when the platform of said lift is in an unfolded position.

5. The lift according to point 4, whereby said linkage structure 4 of the four-bar linkage mechanism 5 is linked to the arms 8 by a rack and spur gear mechanism 10, to control a downwards and upwards movement of the arms with respect to the vehicle floor.

6. The lift according to point 5, whereby said power actuator system 7 actuates the movement of said arms 8 and platform 9.

7. The lift according to point 6, whereby said power actuating system 7 comprises an electrical motor.

8. A method for employing a lift according to any of the claims 1 to 7, whereby the method involves using of a velocity profile during the lifting and lowering procedure of the platform 9 of said lift, whereby said velocity profile will vary according to the position of said platform 9.

9. A method according to point 8, whereby said velocity accelerates during the first part of said lifting and lowering procedure, remains constant during the middle part of said procedure and decreases in the final part of said procedure.

10. A method according to point 9, whereby said first part of lifting and lowering procedure comprises not more than 20% of the maximal distance to bridge by said lift.

11. A method according to point 9, whereby said final part of lifting and lowering procedure comprises not more than 20% of the maximal distance to bridge by said lift.

12. A method according to point 10, whereby said first part of lifting and lowering procedure comprises of 10% of said maximal distance to bridge by said lift.

13. A method according to point 11, whereby said final part of lifting and lowering procedure comprises of 10% of said maximal distance to bridge by said lift.

Claims

1. Method for employing a lift for lifting or lowering a person in a wheelchair between a transport vehicle floor 6 and an exterior floor, said lift comprising a platform 9, said method comprising the steps of:

- lifting or lowering said platform 9 along a linear

trajectory between said transport vehicle floor 6 and said exterior floor;

- using a velocity profile during said lifting or lowering procedure, whereby said velocity profile will vary according to the position of said platform 9.

2. Method according to claim 1, whereby said velocity profile will vary according to the position of said platform 9.

3. A method according to any of the claims 1 to 2, whereby said velocity accelerates during the first part of said lifting and lowering procedure, remains constant during the middle part of said procedure and decreases in the final part of said procedure.

4. A method according to any of the claims 1 to 3, whereby said first part of lifting and lowering procedure comprises not more than 20% of the maximal distance to bridge by said lift and/or whereby said final part of lifting and lowering procedure comprises not more than 20% of the maximal distance to bridge by said lift.

5. A method according to claim 4, whereby said first part of lifting and lowering procedure comprises of 10% of said maximal distance to bridge by said lift and/or whereby said final part of lifting and lowering procedure comprises of 10% of said maximal distance to bridge by said lift.

6. A lift for lifting or lowering a person in a wheelchair between a transport vehicle floor 6 and an exterior floor, comprising

- a pair of arms 8, each connected to a four-bar linkage mechanism 5 and at least one of said arms connected to a power actuator system 7;
- a platform 9 coupled to said pair of arms 8; and
- a coupling mechanism linking said pair of arms and platform 9;

whereby said platform 9 comprises an unfolded position for lifting or lowering a person in a wheelchair and a stowed position for transport; whereby said four-bar linkage mechanisms 5 are in a fixed lift position when said platform is being lifted or lowered between said transport vehicle floor 6 and said exterior floor.

7. A lift according to claim 6, comprising movement controlling means for controlling a velocity profile of said platform 9 at least when said platform is being lifted or lowered between said transport vehicle floor 6 and said exterior floor.

8. A lift according to any of the claims 6 to 7, whereby said four-bar linkage mechanisms 5 are in said fixed

lift position when said platform 9 is in said unfolded position.

9. The lift according to any of the claims 6 to 8, whereby said power actuating system 7 comprises an electrical motor. 5

10. A lift according to any of the claims 6 to 9, whereby each of said four-bar linkage mechanisms comprises four linkage structures 1-4 connected at four rotation points, each comprising a horizontal position, whereby said horizontal positions of said rotation points define a polygonal stability area, whereby said platform 9 and said pair of arms 8 comprise a combined center of mass comprising a horizontal position, whereby said horizontal position of said combined center of mass is located within said stability area when said platform is in said stowed position, and whereby said horizontal position of said combined center of mass is located outside of said stability area when said platform is in said unfolded position. 10
15
20

11. A lift according to any of the claims 6 to 10, comprising at least one stopping means for restricting at least one of said four-bar linkage mechanisms to said fixed lift position. 25

12. A lift according to any of the claims 6 to 11, whereby said pair of arms 8 are one-fold, singular arms. 30

13. A lift according to any of the claims 6 to 12, whereby said four-bar linkage mechanism 5 comprise four linkage structures 1-4 whereby said one linkage structure 1 is mounted onto the vehicle floor 6 and a second linkage structure 4 is attached to said pair of arms 8. 35

14. The lift according to claim 13, whereby said linkage structure 4 of the four-bar linkage mechanism 5 is linked to the arms 8 by a rack and spur gear mechanism 10, to control a downwards and upwards movement of the arms with respect to the vehicle floor. 40

15. The lift according to any of the claims 6 to 14, whereby said pair of arms 8 form an angle between 80° and 90° with the vehicle floor 6, when said lift is in stowed position, and whereby said pair of arms form an angle between 55° and 80° with the vehicle floor 6, when the platform of said lift is in an unfolded position. 45
50

55

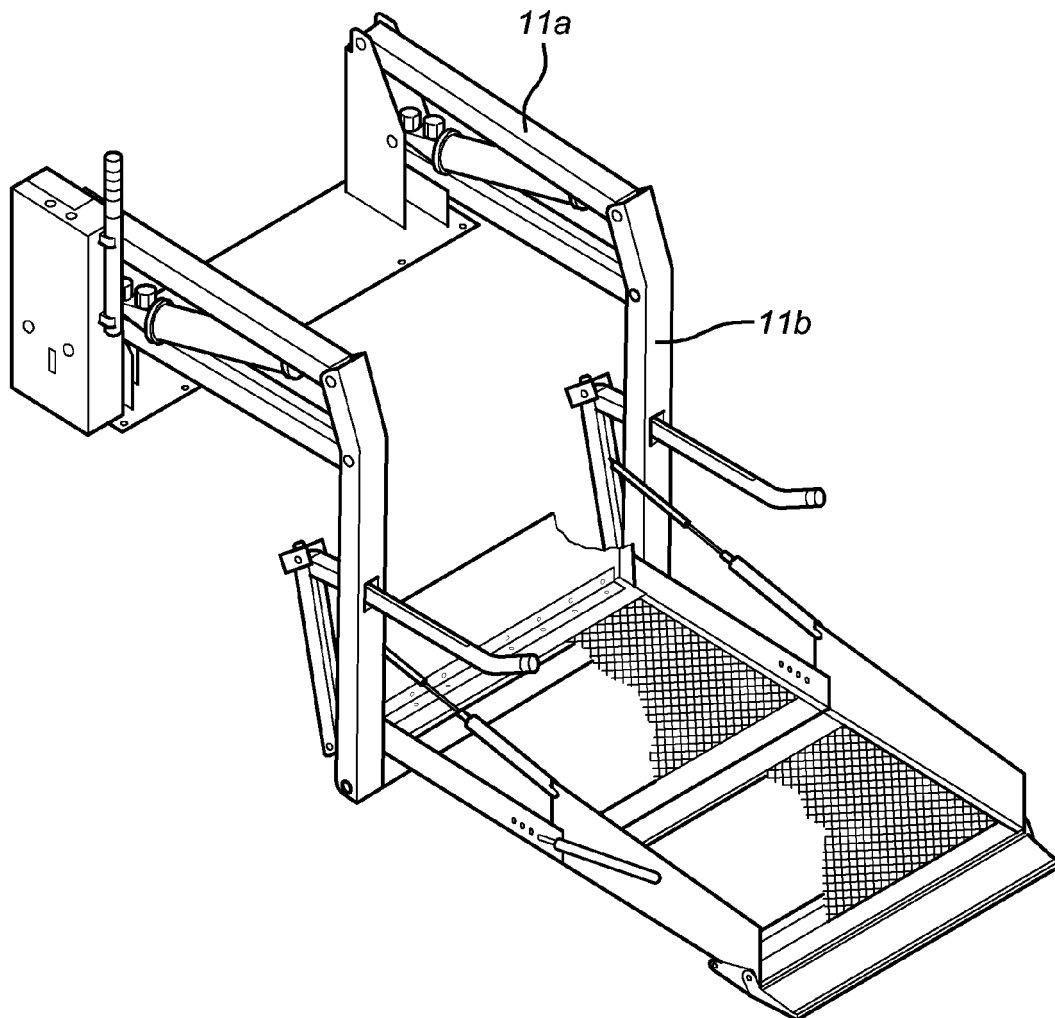


Fig. 1

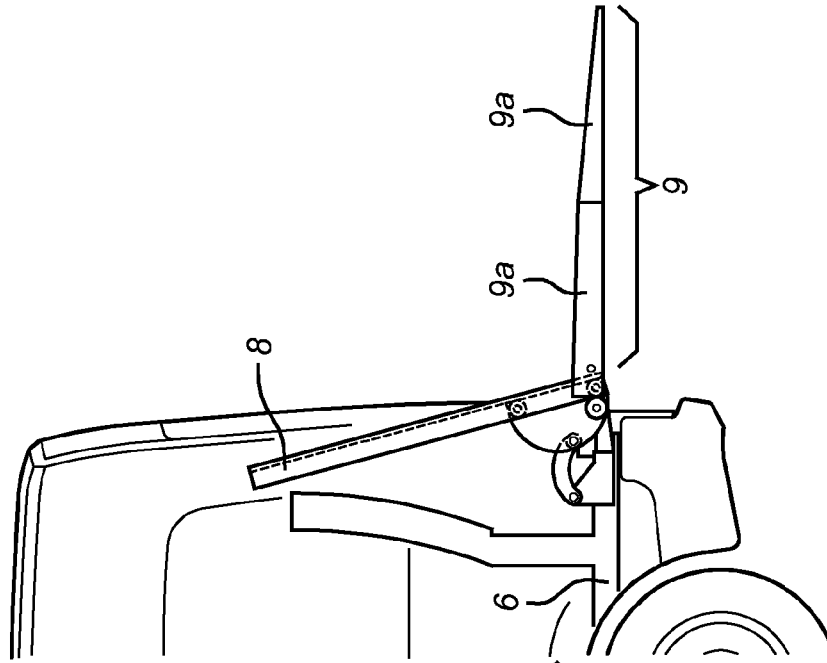


Fig. 2c

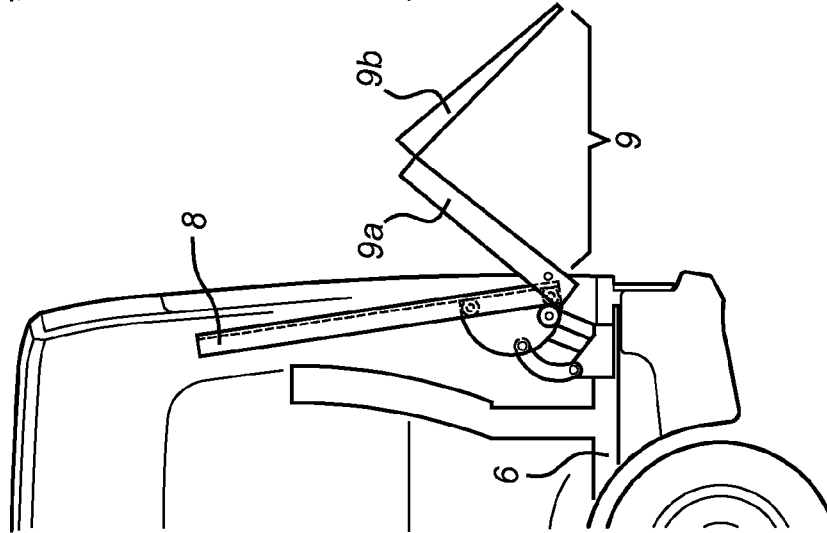


Fig. 2b

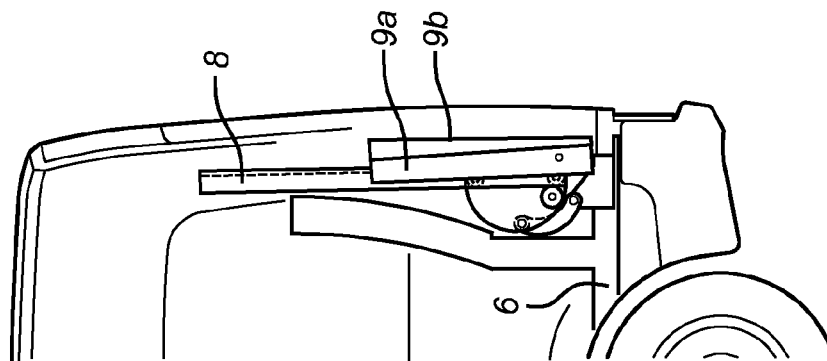


Fig. 2a

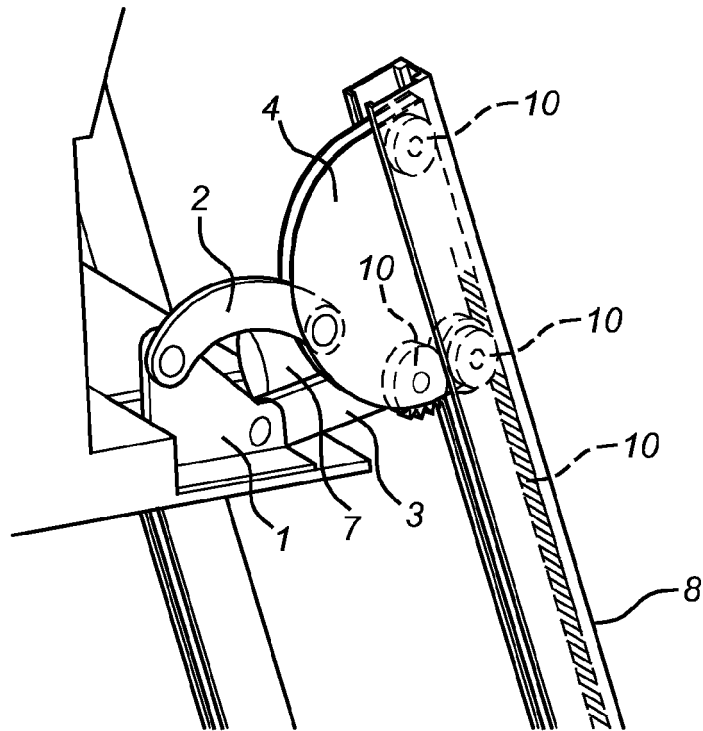


Fig. 5a

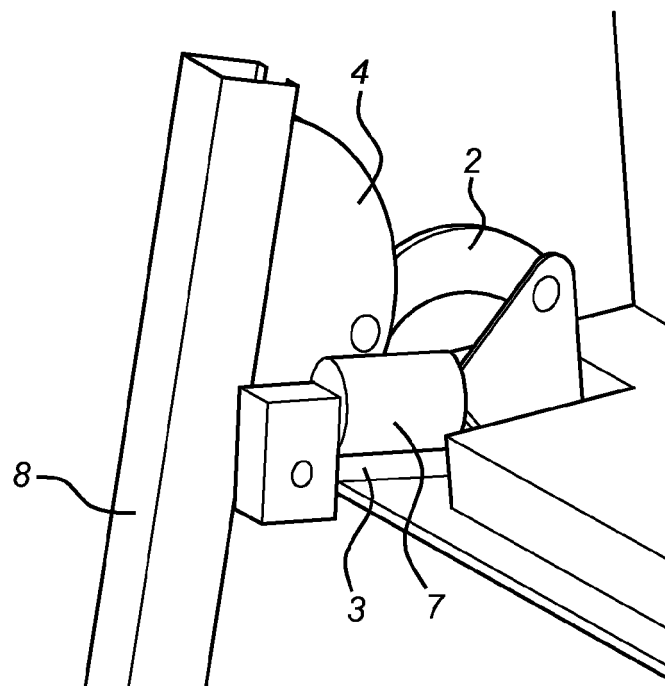


Fig. 5b

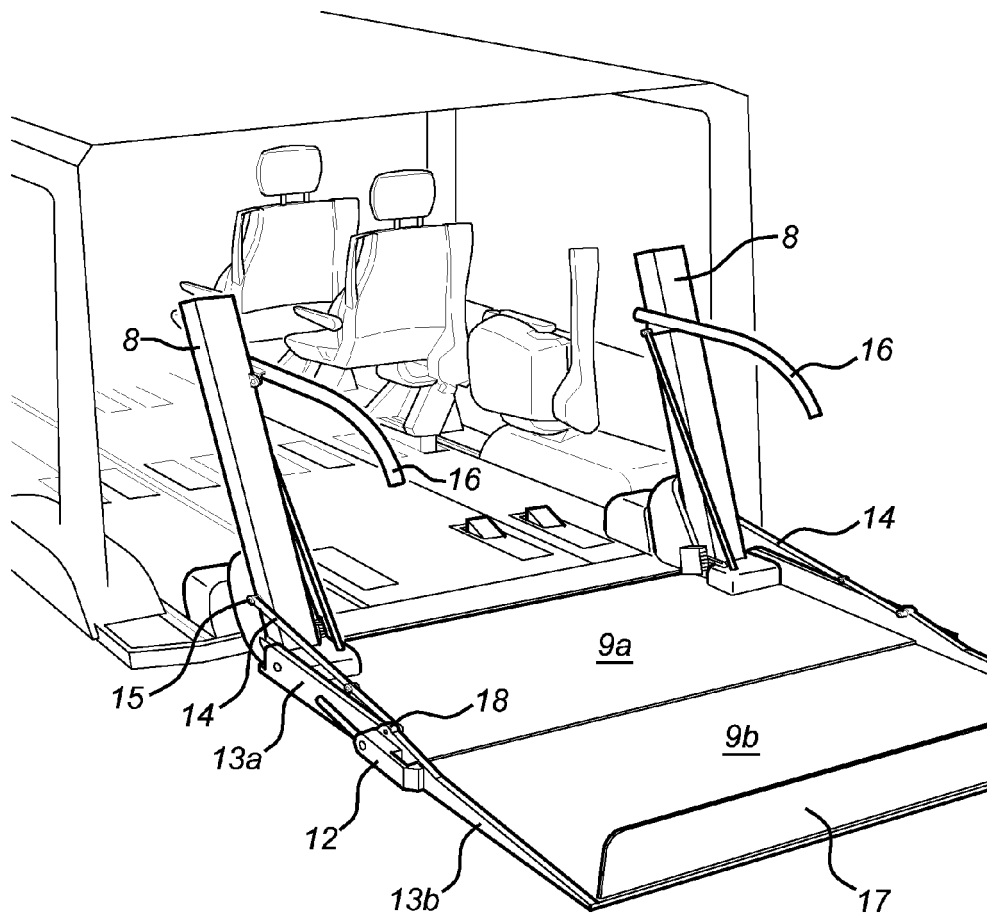


Fig. 6

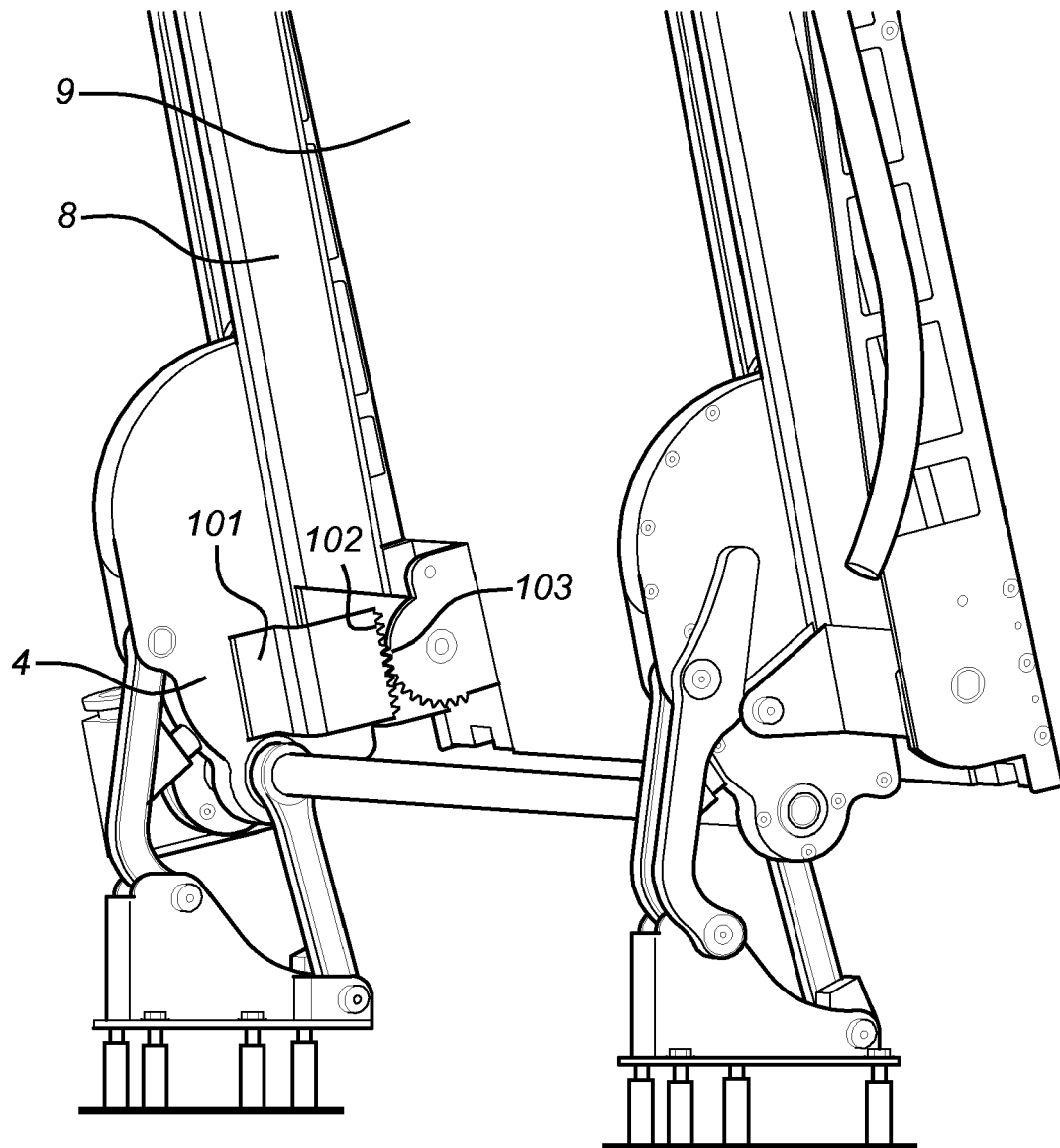


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 12 18 4592

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 4 474 527 A (RISNER MELVIN G [US] ET AL) 2 October 1984 (1984-10-02)	1-13,15	INV. A61G3/06
Y	* column 2, line 45 - column 5, line 51; figures 3,5,6 *	14	
X	US 5 052 879 A (WOLFE CLIFFORD L [CA]) 1 October 1991 (1991-10-01)	1-9, 11-13,15	
A	* page 2, line 52 - page 3, line 46; figures 6,8,11 *	10	
T	GB 2 415 681 A (GLIDE RITE PRODUCTS LTD [GB]) 4 January 2006 (2006-01-04)	1-5	
Y	US 2010/028115 A1 (ABLABUTYAN KARAPET [US] ET AL) 4 February 2010 (2010-02-04)	14	
A	WO 2011/036984 A1 (TOYOTA AUTO BODY CO LTD [JP]; INAGUMA YUKIO [JP]; HORIGUCHI KENJI [JP]) 31 March 2011 (2011-03-31)	14	TECHNICAL FIELDS SEARCHED (IPC)
	* abstract; figures 3,7 *		A61G
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 November 2012	Examiner Kroeders, Marleen
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 18 4592

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-11-2012

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4474527	A	02-10-1984	NONE	

US 5052879	A	01-10-1991	CA 1265090 A1	30-01-1990
			US 5052879 A	01-10-1991

GB 2415681	A	04-01-2006	GB 2415681 A	04-01-2006
			WO 2006003385 A1	12-01-2006

US 2010028115	A1	04-02-2010	US 2007224025 A1	27-09-2007
			US 2009000876 A1	01-01-2009
			US 2010028115 A1	04-02-2010
			WO 2007109351 A2	27-09-2007

WO 2011036984	A1	31-03-2011	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 6379102 B [0002]
- WO 03059685 A [0003]