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(54) AN ELECTRIC STAIR-CLIMBING WHEELCHAIR WITH A HYBRID LOCOMOTION SYSTEM

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SYSTÈME DE LOCOMOTION HYBRIDE

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of systems to assist the movement of people with disabilities or reduced mobility, in particular it refers to stair-climbing wheelchairs.

[0002] The present invention refers more specifically to a stair-climbing wheelchair provided with a hybrid locomotion system according to the preamble of Claim 1.

STATE OF ART

[0003] Today, enabling people with disabilities, or with reduced mobility, to climb architectural barriers safely and in a complete independent way is a felt concern. With respect to known solutions, such as for example fixed or movable stairlifts, there are alternative solutions aimed to solve such problem, as for example stair-climbing wheelchairs. The latter allow to combine in a single device both the ability to climb an obstacle and the functionality of a traditional electric wheelchair. Actually, such devices to climb obstacles such as single steps, side-walks, stairs, even when there are no fixed structures intended to climb barriers and, compared to the traditional stairlifts, they usually allow the user to move about independently without requiring the presence of an assistant.

[0004] A widespread type of these stair-climbing wheelchairs is disclosed for example from Chinese patent document CN204072538U and from the wheelchair named with the tradename "TopChair", which provides a first locomotion system with motor-driven wheels for flat ground motion, and a second locomotion system with a motor-driven track for climbing on stairs.

[0005] The main disadvantage of this constructive solution is to require a double motorization system that, added to the implementation systems necessary to reconfigure the wheelchair, leads to problems of heavy weight and large dimensions. In addition, the track solution results poorly effective in managing the phases of entrance and exit from the stairs.

[0006] A solution aimed to solve such drawbacks is disclosed from European Patent Application EP1516797A2 and from the stair-climbing wheelchair named with the tradename "Scoiattolo". Such solution provides for a locomotion system with a cluster of wheels, more manageable during the phases of entrance and exit from the stairs, less cumbersome compared to current track solutions, and that can be used both for flat ground motion and climbing on stairs, without requiring a double motorization.

[0007] However, this solution is not equipped with motors for flat ground motion and has the disadvantage of allowing climbing architectural barriers only with the help of an assistant who keeps the wheelchair balanced. Actually, the wheelchair without an external aid does not

show any condition of static balance, since in general the projection of its centre of gravity falls outside the area comprised between the wheel-stairs contact points, and almost always this area is reduced to an ideal segment between the contact points of the wheels, to the right and to the left, in contact with a single step.

[0008] A solution aimed at overcoming this drawback is disclosed in the Italian Patent IT1402989B1, which provides for a wheelchair with a locomotion system with a cluster of wheels both at the front and at the rear to ensure the static balance. However, this solution has some criticality, particularly due to the movement of the clusters of wheels during the climbing of the stairs, since each cluster of wheels travels along a trajectory similar to a cycloid, generating continuous oscillations, scarcely comfortable for the user.

[0009] To limit these drawbacks, the publication "G. Quaglia, W. Franco, M. Nisi, "Evolution of Wheelchair, a Stair-climbing Wheelchair", Proceeding of the 14th World Congress in Mechanism and Machine Science, 2015, Taipei, Taiwan" discloses a hybrid locomotion system, with a motorized rear cluster of wheels and a non-motorized front track.

[0010] Despite the non-motorized front track allows to have a wheelchair which is substantially stable, lighter, less bulky and subject to less oscillations with respect to previously described wheelchairs, such solution does not ensure a correct distribution of contact forces in its front and rear support points, causing possible traction and grip problems of the wheelchair, in particular during the stair-climbing motion. Also, it is not able to generate a straight translational motion of the user of the wheelchair during the climbing of stair flights.

[0011] A further example of stair-climbing wheelchair is disclosed in CN 204 233 314 U, which relates to an anti-skid device for an electric stair-climbing wheelchair.

[0012] In particular, a pentacle wheel used for stair climbing is mounted on a power spindle and an air cylinder is arranged on a wheel chassis.

[0013] The bottom end of an ejector rod of the air cylinder is fixed to a track frame body and the track frame body is positioned below the wheel chassis.

[0014] A driving wheel and a driven wheel are mounted on the track frame body, respectively positioned at the two ends of the inner side of a track and meshed with the track.

[0015] A driving chain wheel is further mounted on the power spindle and a driven chain wheel is fixed on the wheel axle of the driving wheel.

[0016] According to the anti-skid device of this solution, driving power is provided by the power spindle of the existing electric wheelchair, so that the power device is not required to be additionally arranged and the structural design is reasonable.

OBJECTS AND SUMMARY OF THE INVENTION

[0017] The object of the present invention is to over-

come the drawbacks of the known art. In particular, it is an object of the present invention to provide a stair-climbing wheelchair with a hybrid locomotion system having characteristics of high safety and comfort for the user, and also a higher power autonomy.

[0018] Also, it is an object of the present invention to provide a stair-climbing wheelchair with a hybrid locomotion system having a simple and compact structure.

[0019] These and other objects of the present invention are achieved by a stair-climbing wheelchair incorporating the features of the appended claims, which form an integral part of the present description.

[0020] The basic idea of the present invention envisages to realize a stair-climbing wheelchair comprising a frame provided with a seat intended to accommodate a user to be transported, and a locomotion unit comprising a couple of clusters of wheels. Further, the wheelchair comprises passive supporting means that are movable between a stowed position wherein they are raised from the ground and an extracted position wherein they are in contact with the ground.

[0021] More in detail, the passive supporting means comprise a track configured in such a way that, in its extracted position, the frame rests at the front on the locomotion unit and at the rear on the track, and the stair-climbing wheelchair further comprises at least one mechanical device linked between the locomotion unit and the seat, adapted to cooperate with the track for compensating the oscillations of the seat generated by the movement of the couple of clusters of wheels, and configured in such a way as to allow a substantially translational motion of the seat during a stair-climbing motion of the stair-climbing wheelchair.

[0022] The choice of providing a front-wheel drive, by the locomotion unit with clusters of wheels and a rear support system on the track, allows a more regular and safer motion of the wheelchair during the stair-climbing motion, improving its static stability. Actually, this architecture allows, during the stair-climbing motion, to obtain a correct distribution of the contact forces at the rear and front support points of the wheelchair, loading more the locomotion unit to confer more grip during the traction stage and to avoid the occurrence of possible slipping.

[0023] It should be noted that in this description, the term "front/at the front" is used to indicate the side of the wheelchair, and each individual component thereof, that a user has in front of him/herself, while the term "rear/at the rear" is used to indicate the side of the wheelchair, and each individual component thereof, that a user has behind him/herself.

[0024] In addition, the idea of providing passive supporting means - i.e. non-motorized - reduces the number of sensors and actuators required for the wheelchair operation, giving greater compactness and structural simplicity to the structure. Advantageously, at least one mechanical device of the wheelchair adapted to allow a translational motion of the seat during its motion comprises a cam-follower mechanism, wherein the cam is

coupled to a connecting shaft connected to the couple of clusters of wheels, and wherein the follower is hinged to a supporting element integral with the seat.

[0025] Such solution increases the comfort for the user since it allows to compensate the oscillations of the seat generated by the cycloid trajectory of the geometric centre of the cluster of wheels during the stair-climbing stage. Also, the use of a cam-follower system, therefore a non-actuated system, allows to simplify the control system of the wheelchair and to reduce the power consumption required for its operation, thus improving the autonomy during the flat ground motion.

[0026] Further advantageous features of the present invention will become more apparent from the description that follows and from the appended claims, which form an integral part of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The invention will be described hereinbelow with reference to non-limiting examples, provided for the purposes of explanation, and not limiting, in the accompanying drawings. These drawings illustrate different aspects and embodiments of the present invention and, where appropriate, reference numbers illustrating components, materials and/ or similar elements in different figures are denoted by similar reference numerals.

Figures 1 and 2 illustrate an overall view respectively in flat ground motion and stair-climbing motion of a stair-climbing wheelchair according to the invention; figures 3a, 3b and 3c illustrate respectively a front section view, a side section view and an enlarged detail of the side section view of a first constructive detail - the locomotion unit - of the stair-climbing wheelchair according to the invention; figures 4a and 4b illustrate an overall view of a first and a second embodiment of a second constructive detail - the transmission assembly - of the stair-climbing wheelchair according to the invention; figures 5a, 5b and 5c illustrate an overall view in a first operating position, a side view in a first operating position and an overall view in a second operating position of a detail of a third constructive detail - the frame - the stair-climbing wheelchair according to the invention; figures 6 and 7 illustrate a simplified side view and a schematic view of an enlarged detail of the stair-climbing wheelchair according to the invention; figures 8 and 9 illustrate an overall view of two different operative configurations of a fourth constructive detail - the track - of the stair-climbing wheelchair according to the invention; figure 10 shows an overall view of a preferred embodiment of a fifth constructive detail - the track moving means - of the stair-climbing wheelchair according to the invention; figures 11a, 11b and 11c each illustrate a side view

of the constructive detail of figure 10 in three different operating positions;
 figures 12a and 12b illustrate an overall view and an enlarged detail of an alternative embodiment of the track moving means of the stair-climbing wheelchair according to the invention;
 figures 13a, 13b, 13c and 14 illustrate an overall view of a first, a second and a third embodiment of a sixth constructive detail - the mechanical device compensating the oscillations of the seat - of the stair-climbing wheelchair according to the invention;
 figures 15 and 16, respectively, illustrate a first and a second embodiment of a seventh constructive detail - the seat - of the stair-climbing wheelchair according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0028] While the invention is susceptible to various modifications and alternative constructions, some non-limiting embodiments, provided for explanatory purposes, are described in detail hereinbelow.

[0029] However, it should be understood that there is no intention to limit the invention to the specific illustrated embodiments, but, on the contrary, the invention is intended to cover all modifications, alternative constructions, and equivalents which fall within the scope of the invention as defined in the claims.

[0030] In the following description, therefore, the use of "for example", "etc.", "or", "either" indicates not exclusive alternatives without any limitation, unless otherwise indicated; the use of "also" means "including, but not limited to" unless otherwise indicated; the use of "includes / comprises" means "includes / comprises but not limited to" unless otherwise indicated.

[0031] Figures 1 and 2 illustrate overall views of a stair-climbing wheelchair 1 according to the invention. In particular, figure 1 shows the wheelchair 1 in flat ground motion conditions and figure 2 shows the wheelchair in stair-climbing motion conditions.

[0032] In general terms, the stair-climbing wheelchair 1 comprises a frame 2, provided with a seat 3 intended to accommodate a user 100, in particular a user with disabilities or reduced mobility, and a locomotion unit 4 to allow the movement of the wheelchairs 1.

[0033] The stair-climbing wheelchair 1 is an electric wheelchair, i.e. which is provided with an electric motor assembly adapted to transmit a torque to operate a transmission assembly connected to the locomotion unit 4, and which will be discussed in more detail thereafter.

[0034] The wheelchair 1 further comprises passive supporting means (5, 6), idle or in any case non-motorized, connected to the frame 2, and movable between a stowed position wherein they are raised from the ground 1a, and an extracted position wherein they are in contact with the ground 1a.

[0035] In particular, the supporting means comprise a track 6 and a pair of pivoting wheels 5. In use, and in a

condition of flat ground motion of the wheelchair 1 - as illustrated in figure 1 - it corresponds to a stowed position of the track 6 and to an extracted position of the pivoting wheels 5, in such a way that the track 6 is accommodated inside the volume occupied by the wheelchair 1, and the pivoting wheels 5 are in contact with the ground 1a.

[0036] On the contrary, during the stair-climbing motion of the wheelchair 1 - and as it can be seen in figure 2 - the track 6 is in the extracted position and is in contact with the stairs, and the pivoting wheels 5 are in stowed position, raised along the side of the frame 2.

[0037] Although in all embodiments which will be described in the present invention the pivoting wheels 5 of the wheelchair 1 are illustrated in such a way that during its flat ground motion, i.e. in their extracted position, i.e. in contact with the ground 1a, they are positioned at the rear of locomotion unit 4, the pivoting wheels 5 can also be arranged at the front of the locomotion unit 4, when they are in their extracted position, simply entailing a slight modification of the framework structure of the wheelchair 1 with respect to the illustrated examples.

[0038] With reference to figures 3a, 3b and 3c, the locomotion unit 4 comprises a couple of identical clusters of wheels 40 - of which only one is illustrated in the figures - positioned at the front of opposite sides of the frame 2 and mutually in axis.

[0039] Advantageously, the couple of clusters of wheels 40 is mounted at a distance such as to minimize the overall dimension of the wheelchair 1 and to confer the necessary mobility even in confined spaces (e.g., to allow an easy passage through the internal doors in buildings).

[0040] Each clusters of wheels preferably comprises three wheels 41, connected to a box-like body constituted by a supporting structure 42 - or planet carrier - and by a cover.

[0041] However, alternative embodiments of the wheelchair 1 may provide for the use of a different number of wheels, such as for example two or four wheels, according to the design choices aimed at further reduced dimensions and weights of the wheelchair 1. In more detail, the planet carrier 42 comprises a central portion from which three supporting arms 43 extend, each for a respective wheel 41 and angularly equidistant from one another, and is provided with a housing 44 for accommodating a gear train therein.

[0042] In a preferred embodiment, the gear train is of the epicyclic type and comprises a sun gear 45, positioned centrally in the housing 44, integral with a drive shaft 45a and that meshes with three planet wheels 46, each positioned on a respective arm 43. Preferably, the sun wheel 45 and the related drive shaft 45a are hollow in order to enclose a shaft 42a integral with the planet carrier 42.

[0043] Each planet wheel 46 is hinged to the planet carrier 42 and allows to obtain the same direction of rotation between the sun wheel 45 and a second assembly of gears, in this case three gears 47. Each gear 47 of the

second group of gears is arranged on a respective arm 43 and each meshes with a corresponding satellite wheel 46.

[0044] In addition, each gear 47 of the second group of gears is hinged to the planet carrier 42 and integral to a shaft 47a on which the wheel 41, preferably in rubber, is rigidly mounted, destined to come into contact with the ground 1a.

[0045] Therefore, each clusters of wheels 40 of the locomotion unit 4 has two degrees of freedom: the rotation of the sun gear 45 and the rotation of the planet carrier 42 respectively controlled by the drive shaft 45a and by the shaft 42a.

[0046] Figure 4a shows a first embodiment of the transmission assembly of the wheelchair 1 that, in order to simplify its structure and to ensure synchronous rotation of both cluster of wheels 40, provides a connecting shaft 48 that connects the shafts 42a controlling the rotation of the respective planet carriers 42.

[0047] Doing so, the couple of clusters of wheels 40 generally has three degrees of freedom since the rotations of both planet carriers 42 result coupled.

[0048] To control the three degrees of freedom of the locomotion unit 4, an electric motor assembly is provided, comprising three gear motors, indicated in figure 4a with the references 7a, 7b and 7c. Two of the three gear motors 7a and 7b are coupled to a respective drive shaft 45a connected to the sun wheel 45 of a corresponding planet carrier 42, while the remaining gear motor 7c is coupled to the connecting shaft 48 and is adapted to manage the rotation of both planet carriers 42 of the couple of clusters of wheels 40.

[0049] The gear motors (7a, 7b), i.e. those relating to the sun gears 45 of the planet carriers 42, can be both reversible and irreversible. In the case of reversibility of the gear motors 7a, 7b, the addition of a brake on the respective output shaft can be considered. The gear motor 7c coupled to the connecting shaft 48 is configured to ensure an irreversibility of the rotational motion, in such a way as to maintain the wheelchair 1 in position also when the motor assembly is not powered.

[0050] In an alternative embodiment illustrated in figure 4b, the connecting shaft, indicated with the reference 48a, connects the planet carriers of each cluster of wheels 40 and is mounted in a non-coaxial way with respect to the spin axis of the drive shafts 45a connected to the sun gears 45.

[0051] In this configuration two supporting elements 49 are provided integral with the frame 2, each disposed in the vicinity of the two planet carriers 42 and adapted to support the connecting shaft 48a.

[0052] Each supporting element 49 supports at one end a coaxial hinge to a respective drive shaft 45a of the sun gears 45, and at the other end a coaxial hinge to the connecting shaft 48a.

[0053] The connecting shaft 48a is coupled to the gear motor 7c adapted to control the motion of the two planet carriers 42, and to each of its ends a gear is keyed, which

meshes with a corresponding gear mounted integral with a respective planet carrier 42 of the cluster of wheels 40. At the ends of the drive shafts 45a of the two sun gears 45, the gear motors 7a, 7b are mounted, adapted to control the rotation of the latter. In this case, preferably, the gear ratio between the gears mounted on the end of the connecting shaft 48a and the gears mounted integral with a respective planet carrier 42 is 3:1, so as to couple a complete rotation of the connecting shaft 48 with a 120° rotation of the cluster of wheels 40 during the stair-climbing motion, which corresponds to climbing a step.

[0054] Advantageously, such configuration allows to limit the overall dimension of the transmission assembly, and facilitates and simplifies the assembly thereof in the stair-climbing wheelchair 1, since it does not require the presence of shafts and coaxial motors entailing a greater constructive complexity, such as hollow shafts and multiple hinges, for example.

[0055] With reference to figures 5a, 5b, 5c, the frame 2 of the wheelchair 1 is shown. The frame 2 is constituted by a first and a second sub-frame mutually hinged by means of a couple of hinges (20a, 20b). Such coupling corresponds to hinge C in the diagram of figure 7. The first sub-frame comprises a structure provided with a first rod 2a and a second rod 2b, intended to connect reciprocally the other components of the wheelchair 1.

[0056] The two rods 2a, 2b are integral and parallel one another, i.e. they constitute a single rigid body that does not allow their relative rotation.

[0057] With reference to figures 6 and 7, each rod (2a, 2b) corresponds to segment PC. In particular, two drive shafts 45a of the respective sun gears 45 and two shafts 42a rotating the planet carriers 42 connected to the connecting shaft 48 are hinged in the point of the frame 2 indicated with P. The second sub-frame is constituted by a supporting element 30 integral with the seat 3 of the wheelchair 1, which corresponds to segment RC represented in figure 7.

[0058] Returning to figures 5a, 5b and 5c, and as previously stated, during the flat ground motion, the wheelchair 1 rests on two pivoting wheels 5, each mounted on one end of a movable rod 51, in such a way that, when the wheels are in contact with the ground 1a, they support the wheelchair 1 during the flat ground motion.

[0059] In the illustrated embodiment, each bar is hinged to the frame 2 at the opposite end of the end provided for the pivoting wheels 5. However, different embodiments can provide bars 51 hinged to the supporting element 30 of the seat 3.

[0060] Furthermore, although in the illustrated examples the movable bars 51 are hinged at one end of the frame 2 and, in particular, in correspondence of the planet carrier 42 of the cluster of wheels 40, they can be hinged at any other point belonging to the two bodies, provided that it allows the pivoting wheels 5 to move between the extracted position, in which they rest on the ground 1a - as illustrated in figures 5a, 5b, and the stowed position, in which they are raised from the ground 1a - as shown

in figure 5c. The movement of the two movable bars 51 and of the relevant pivoting wheels 5 connected thereto occurs by the actuation of a linear or rotary actuator (not represented in the figures).

[0061] When climbing stairs, and in particular after having passed the transitory stage of entrance on the stairs and before of the transitory stage of exit, the motion of the wheelchair 1 is controlled by the coordinated action of the two reduction gears 7a, 7b coupled to the drive shafts 45a of the solar gears 45, and of the gear motor 7c coupled to the connecting shaft 48 moving the planet carriers 42.

[0062] In this condition of motion, the planet carriers 42 of each cluster of wheels 40 rotate synchronously in the motion of climbing each step, and the point indicated with P, which corresponds substantially to the geometric centre of each cluster of wheels 40, i.e. where the drive shaft 45a meshes, moves along a substantially cycloidal trajectory.

[0063] With reference to figures 6, 7, 8 and 9, the track 6, which comprises the hinge indicated with reference S, moves with a translational motion along a straight line, parallel to the plane lying on the edges of the steps of the stair.

[0064] Due to the cycloidal trajectory motion of P, the frame 2 - indicated schematically with the segment PC in figure 7 - oscillates and consequently also the supporting element 30 of seat 3 - indicated schematically in figure 7 with the segment RC - would oscillate if the two bodies were integral.

[0065] In order to obtain a translational motion for the supporting element 30 of the seat 3, the latter is hinged to the track 6 in correspondence of the hinge S, and the distance between the point R belonging to the supporting member 30 of the seat 3 and the point P belonging to the planet carrier 42 of the cluster of wheels 40, is controlled in such a manner as to compensate for the motion of P with respect to R.

[0066] Thus, the wheelchair 1 comprises at least one mechanical device linked between the locomotion unit 4 and the seat 3, adapted to cooperate with the track (6) for compensating the oscillations of the seat 3 generated by the movement of the couple of clusters of wheels 40, and configured in such a way as to allow a substantially translational motion of the seat 3 during the motion of the stair-climbing wheelchair 1.

[0067] In particular, such mechanical device comprises a first mechanism that allows to connect the supporting element 30 of the seat 3 to the track 6, and a second mechanism that manages the distance between P and R as a function of the rotation of the cluster of wheels 40. The first mechanism can move the track 6 between the stowed position for flat ground motion (in which the track 6 is raised and is not in contact with the ground 1a) and the extracted position in which the track 6 rests on the stair during the climbing motion.

[0068] The track 6 is idle, i.e. non-motorized, and at its maximum extension it preferably has a length greater

than twice the maximum pitch between the steps of stairs that the wheelchair must climb (where pitch means the pitch is the hypotenuse of the triangle which has as catheti the riser and the tread of the step).

[0069] In order to reduce the overall dimension of the structure of the track 6, the wheelchair 1 preferably provides a telescopic track. The telescopic track of the embodiment illustrated in the figures comprises a first portion 6a on which the previously described hinge S is positioned, having a substantially rectangular structure, each opposite long side thereof is wound by a belt 61 and are connected at one end by a cross member 62.

[0070] Alternative embodiments may comprise a non-telescopic track, provided with a single belt (or for example with a rubber track), or a plurality of belts. In any case, the track 6 comprises one or more parts, connected to one another so as to be movable and such as to allow a retracted configuration in which the track 6 occupies a minimum volume, and an extended configuration of the latter in which it occupies a maximum volume.

[0071] Internally, the opposite long sides are provided with a linear guide 63 which constrains the sliding of a second telescopic portion 6b of the track 6.

[0072] The second telescopic portion 6b slides parallel inside the first fixed portion 6a, and it is also provided with belts 61 intended to come into contact with the plane of the stairs.

[0073] An actuator (not represented in the figures) allows to pass from the retracted configuration (figure 8) to the extended configuration (figure 9) of the telescopic track, and vice versa. The retracted configuration minimizes the overall dimension of the track 6 inside the volume occupied by the wheelchair 1 during the flat ground motion, while the extended configuration ensures a sufficient length of track 6 during the stair-climbing motion. Moreover, in the extended configuration of the track 6, the second telescopic portion 6b results extracted in such a way as to expand the track 6 in a direction which extends at the rear of the wheelchair 1.

[0074] The track 6 is shifted into the retracted or extended position by means of a mechanism connected to the supporting element 30 of the seat 3, which will be discussed in more detail shortly. With respect to such mechanism, the track 6 is further free to rotate about an axis perpendicular to the sagittal plane of the wheelchair 1 by means of a hinge 64, indicated with reference S in figure 7.

[0075] In the embodiment illustrated in the figures, both the fixed portion 6a and the telescopic portion 6b of the track 6 provide distinct contact surfaces by means of belts (i.e. two parallel and spaced apart half-rollers), however not illustrated alternative embodiments, and as previously mentioned, may provide a single contact surface for the fixed portion 6a and for the telescopic portion 6b, for example.

[0076] With reference to figures 10, 11a, 11b and 11c, the mechanism allowing to shift the track 6 between the stowed position during the flat ground motion and the

extracted position during the stair-climbing motion is shown. Such mechanism allows, moreover, to manage with continuity the distance of the frame 2 (especially that of the hinge indicated with letter C in figure 7) from the plane of the stairs during the different operative stages.

[0077] In a first alternative embodiment, not shown in figures, the mechanism provides a bar connecting the hinge S integral to the fixed portion 6a of the track 6 to a hinge connected to the supporting element 30 of the seat 3. Thanks to this mechanism, the hinge is moved in the plane leaving free the rotation of the fixed portion 6a of the track 6 with respect to the supporting element 30. This solution is similar to the example shown in figure 10, but deprived of the rods indicated by references 32 and 33.

[0078] A different alternative embodiment of such mechanism, illustrated in figure 10, provides two equal and parallel articulated parallelograms moving at the two sides of the track 6. Each articulated parallelogram is constituted by the supporting element 30 of the seat 3, which is hinged to the ends of two rods (31, 32), the latter in turn hinged to the opposite ends of a connecting rod 33, hinged to the fixed portion 6a of the track 6.

[0079] In this configuration, the two rods (31, 32) have the same length and the connecting rod 33 has a length equal to the distance between the hinges 34a and 34b provided on the supporting element 30 of the seat 3.

[0080] The articulated parallelogram mechanism thus realized allows to move in the plane the hinge S of the fixed portion 6a of the track 6, while also translating the connecting rod 33, which is always parallel to the segment joining the hinges (34a, 34b) provided on the supporting element 30 of the seat 3.

[0081] This solution allows to introduce limitations to the rotation of the fixed portion 6a of the track 6 with respect to the connecting rod 33, for example by adding contact surfaces on the latter, and allowing to improve the mobility control of the track 6, without introducing further actuation systems.

[0082] Figures 11a, 11b and 11c show the track 6 provided with the articulated quadrangle mechanism in three different operating configurations that maintain its inclination constant with respect to the connecting rod 33.

[0083] Alternatively, a possible embodiment for the mechanism can provide the use of a single articulated parallelogram.

[0084] Preferably, and with reference to figures 12a and 12b, the articulated quadrangle mechanism provides a hook 36 integral with the telescopic portion 6b of the track 6 adapted to engage, in a closed track configuration, a pin 37 integral with the connecting rod 33. This solution makes the fixed portion 6a of the track 6 integral with the connecting rod 33 in the closed track configuration.

[0085] The motion system of the track 6 with respect to the supporting element 30 may also be implemented by mechanisms having two or three degrees of freedom actuated independently, that manage the relative position between the two elements. Returning to figures 6

and 7, and as stated above, in order to obtain a substantially translational motion of the seat 3 during the stair-climbing motion of the wheelchair, this latter provides not only the mechanism just described that allows to connect the supporting element 30 of the seat 3 to the track 6, but also a second mechanism to manage the distance between the point R belonging to the supporting member 30 of the seat 3 and the point P belonging to the planet carrier 42 of the clusters of wheels 40, in such a way as to compensate for the motion of P with respect to R.

[0086] A first embodiment of this second mechanism, illustrated in figure 13a, provides a system with a cam and a follower. The cam 80 is integral with the connecting shaft 48 that connects the shafts 42a controlling the rotation of the planet carriers 42 of the clusters of wheels 40, then rotates together with the clusters of wheels; the follower 81 is for example a roller tappet, and it is hinged to the supporting element 30 of the seat 3.

[0087] In this way, by appropriately shaping the profile of the cam, the mechanism can control the distance between P and R - see figure 7 - so as to compensate the movement of point P during the rotation of the clusters of wheels 40 and can ensure a translational motion of the seat. This solution also allows to control the distance PR in a passive manner, i.e. by operating without the aid of control and actuated systems, but by exploiting the gear motors (7a, 7b, 7c) of the clusters of wheels 40, to the advantage of the constructive simplification of wheelchair 1.

[0088] Although the trajectory of the point P varies as the type of stairs to climb varies, and therefore different shapes of the cam profiles should be provided in function of these types, such variations are in any case reduced. Therefore, it is sufficient using a single cam profile, designed to compensate for most of the oscillations.

[0089] In figures 13b and 13c, and with further reference to figure 4b, the positioning of the cam 80a is elucidated, in the alternative embodiment of the transmission assembly of the wheelchair 1, in which the connecting shaft 48a connects the planet carriers of each cluster of wheels 40, and is mounted in a non-coaxial way with respect to the spin axis of the drive shafts 45a connected to the sun gear 45.

[0090] As mentioned previously, in this case, on each end of the connecting shaft 48a a gear wheel is keyed, which meshes with a corresponding gear mounted integral with a respective planet carrier 42 of the cluster of wheels 40.

[0091] Since such pair of gears preferably have a gear ratio of 3:1, such configuration allows to couple a complete rotation of the connecting shaft 48a with a 120° of rotation of the cluster of wheels 40, rotation corresponding to the climbing of a step during the stair-climbing motion of the wheelchair 1.

[0092] The cam 80a is integral with the connecting shaft 48a rotating together with the clusters of wheels, and is coupled to the follower 81a, the latter hinged to the supporting element 30 of the seat 3.

[0093] Advantageously, in this way a cam of reduced dimensions is obtained. Actually, the same displacement of the follower, with respect to the previously described solution, is obtained by a rotation of the cam of 360°, instead of 120°. This allows to have less stringent constraints on pressure angles of the mechanism, and therefore allows to obtain a smaller and less bulky cam.

[0094] On the other hand, the choice of using a mechanism with such configuration, entailing an architecture with basically larger volumes, and providing two pairs of additional gears, needs appropriate evaluations and comparisons in the executive design phase with respect to the embodiment illustrated in figure 13a.

[0095] An alternative embodiment, illustrated in figure 14, provides that the mechanism of motion compensation of P with respect to R is implemented by an active control by means of an actuator 9.

[0096] In this case, the actuator 9 is hinged at one end to the connecting shaft 48 of the planet carriers 42, and at the other end to the supporting element 30 of the seat 3.

[0097] Such type of coupling is only a constructive example since, in general, in case of an active control of the distance between the point P and the point R, it is sufficient that one end of the actuator is connected to any point of the first sub-frame (2a, 2b) and the other end of the actuator to any point of the supporting element 30 of the seat.

[0098] In a third alternative embodiment, not illustrated in the figures, the motion compensation mechanism of P with respect to R provides a combined use of the cam-follower mechanism and of the control system by means of the actuator, which were previously described.

[0099] The wheelchair 1 can also have different types of seat 3 installed, illustrated in figures 15 and 16, attached to the relevant supporting element 30, allowing to obtain a same structure of the wheelchair 1.

[0100] In a preferred embodiment, illustrated in figure 15, the seat 3 is fixed and rigidly connected to the relevant supporting element 30 by means of a generic link represented by the element indicated by the reference 35, such as for example a connecting bar.

[0101] Alternatively, and as shown in figure 16, a controlled degree of freedom can be added, regarding the positioning of the seat 3 with respect to the relevant supporting element 30.

[0102] In the example in the figure, this measure has been implemented by providing a hinge 36 for coupling the supporting element 30 and the seat 3, positioned in a generic point of the latter.

[0103] In alternative to the hinge 36, any other mechanism with a single degree of freedom could be used. In particular, a possible alternative solution could be the use of an articulated quadrangle. The introduction of a further degree of freedom requires, on the one hand, the introduction of an additional actuator 37, but allows to obtain an adjustment of the posture of the user 100 on the wheelchair, and the possibility to control and manage the centre of gravity position.

[0104] From the description above it is apparent how the described device allows to achieve the intended objects.

[0105] Therefore, it is apparent to a person skilled in the art that it is possible to make modifications and variants to the solution described with reference to the figures indicated above, without departing from the scope of protection of the present patent, as defined by the appended claims.

[0106] For example, further solutions not shown in the figures may relate to the use of passive articulated mechanisms, or other types of mechanisms, that control the distance PR in a way similar to that described regarding the cam, but using a different constructive embodiment of the mechanism.

Claims

1. Stair-climbing wheelchair (1) comprising

- a frame (2) provided with a seat (3) intended to accommodate a user (100) to be transported,
- a locomotion unit (4) comprising a couple of clusters of wheels (40),
- passive supporting means movable between a stowed position wherein they are raised from the ground (1a) and an extracted position wherein they are in contact with the ground (1a),

characterized in that

the passive supporting means comprise a track (6) configured in such a way that in said extracted position the frame (2) rests at the front on the locomotion unit (4) and at the rear on said track (6), the stair-climbing wheelchair (1) further comprises at least one mechanical device linked between the locomotion unit (4) and the seat (3) and adapted to cooperate with the track (6) for compensating the oscillations of the seat (3) generated by the movement of the couple of clusters of wheels (40), said at least one mechanical device being configured in such a way as to allow a translational motion of the seat (3) during a stair-climbing motion of the stair-climbing wheelchair (1).

2. Stair-climbing wheelchair (1) according to claim 1, wherein said at least one mechanical device comprises a cam-follower mechanism, wherein the cam (80, 80a) is coupled to a connecting shaft (48, 48a) connected to the couple of clusters of wheels (40) and wherein the follower (81, 81a) is hinged to a supporting element (30) integral with the seat (3).
3. Stair-climbing wheelchair (1) according to claim 2, wherein said cam (80) is integral with the rotation of a connecting shaft (48) connecting the geometrical centers of the couple of clusters of wheels (40).

4. Stair-climbing wheelchair (1) according to claim 2, wherein said cam (80a) is integral with the rotation of a connecting shaft (48a) mounted in a non-coaxial and parallel way with respect to an axis passing through the geometric centers of each cluster of wheels (40), wherein said connecting shaft (48a) is coupled with each cluster of wheels through a gear transmission. 5
5. Stair-climbing wheelchair (1) according to claim 4, wherein said gear transmission is adapted to allow a rotation of 360° of said connecting shaft (48a) for every 120° rotation of the clusters of wheels (40). 10
6. Stair-climbing wheelchair (1) according to claim 4, wherein said gear transmission is adapted to allow a rotation of 360° of said connecting shaft (48a) for every 360° rotation of the clusters of wheels (40). 15
7. Stair-climbing wheelchair (1) according to any one of the preceding claims, wherein said at least one mechanical device comprises an actuator (9) connected between a first sub-frame (2a, 2b) of said frame (2) and a supporting element (30) integral with the seat (3) in such a way as to control the relative angular position between the frame (2) and the seat (3). 20 25
8. Stair-climbing wheelchair (1) according to any one of the preceding claims, wherein the passive supporting means further comprise a couple of pivoting wheels (5), wherein during a flat ground motion of the wheelchair the couple of pivoting wheels (5) are in the extracted position and the track (6) is in the stowed position, and wherein during a stair-climbing motion of the wheelchair the couple of pivoting wheels (5) are in the stowed position and the track (6) is in the extracted position. 30 35
9. Stair-climbing wheelchair (1) according to claim 8, wherein said couple of pivoting wheels (5) are fixed to the frame (2) in such a way that in said extracted position are disposed at the front or at the rear of said locomotion unit (4). 40
10. Stair-climbing wheelchair (1) according to any one of the preceding claims, wherein said track (6) comprises a first portion (6a) and a second portion (6b), wherein the second portion (6b) is movable relative to the first portion (6a), wherein the first portion (6a) is equipped with a hinge (S) coupled to one end of a bar (31), said bar (31) being hinged at the other end with said supporting element (30) integral with the seat (3). 45 50
11. Stair-climbing wheelchair (1) according to any one of the claims from 1 to 9, wherein said track (6) comprises a first portion (6a) and a second portion (6b), wherein the second portion (6b) is movable relative to the first portion (6a), wherein the first portion (6a) is equipped with a hinge (S) coupled to a first member (33) of an articulated parallelogram and wherein a second member of the articulated parallelogram opposite to said first member (33) is made in one piece with the supporting element (30) of the seat (3) in such a way that, during the stair-climbing motion of the wheelchair (1), the track (6) translates along a line parallel to the plane lying on the edges of the steps of the stair. 55
12. Stair-climbing wheelchair (1) according to claim 11, wherein the articulated parallelogram comprises a connecting rod (33) hinged in said first portion (6a), said connecting rod (33) being provided with contact surfaces adapted to limit a movement of said track (6) around the hinge (S).
13. Stair-climbing wheelchair (1) according to any one of the claims from 1 to 9, wherein said track (6) is moved between said extracted position and said stowed position, and vice versa, through a mechanism with two or three degrees of freedom, wherein each of said two or three degrees of freedom is actuated independently.
14. Stair-climbing wheelchair (1) according to any one of the claims from 10 to 13, wherein said second portion (6b) of the track (6) is movable with respect to said first portion (6a) between an extended configuration in which the track (6) has length at least greater than twice the pitch between two consecutive steps of a stair, wherein the pitch is the hypotenuse of the triangle which has as catheti the riser and the tread of the step, and a retracted configuration wherein the track (6) has a length not exceeding the greater length between the lengths of the first (6a) and second (6b) portion.
15. Stair-climbing wheelchair (1) according to any one of the claims from 10 to 13, wherein the first portion (6a) comprises a linear guide (63) adapted to allow a sliding movement of the second portion (6b) between a retracted configuration of the track (6) wherein the second portion (6b) is internal to the first portion (6a), and an extended configuration of the track (6) wherein the second portion (6b) is external to the first portion (6a) and the track (6) has a length greater than twice the pitch between two consecutive steps of a stair, wherein the pitch is the hypotenuse of the triangle which has as catheti the riser and the tread of the step.
16. Stair-climbing wheelchair (1) according to any one of the claims from 10 to 15, wherein the track (6) further comprises a hook (36) integral with said movable portion (6b) and configured so as to engage, in

the retracted configuration of the track, a pin (37) integral with a member (33) hinged in said hinge (S).

17. Stair-climbing wheelchair (1) according to any one of the preceding claims, wherein said track (6) comprises one or more contact surfaces with the ground, wherein said one or more contact surfaces comprise skids or rubber belts. 5
18. Stair-climbing wheelchair (1) according to any one of the preceding claims, wherein each cluster of wheels (40) comprises a planet carrier (42) provided with an epicyclical gear train driven by an electric motor assembly adapted to put in rotation the connecting shaft (48, 48a), said connecting shaft (48, 48a) being adapted to transmit a rotational motion to each planet carrier (42). 10 15
19. Stair-climbing wheelchair (1) according to claim 18, wherein the electric motor assembly comprises three gear motors (7a, 7b, 7c), wherein two (7a, 7b) of the three gear motors are coupled to a respective drive shaft (45a) connected to a sun gear (45) of a corresponding planet carrier (42), and wherein the remaining gear motor (7c) is coupled to the connecting shaft (48), each drive shaft (45a) being hollow and coaxial with the connecting shaft (48), said connecting shaft (48) being adapted to control the rotation of both planet carriers (42) of the two clusters of wheels (40). 20 25 30
20. Stair-climbing wheelchair (1) according to claim 18, wherein the electric motor assembly comprises three gear motors (7a, 7b, 7c), wherein two (7a, 7b) of the three gear motors are coupled to a respective drive shaft (45a) connected to a sun gear (45) of a corresponding planet carrier (42), wherein the connecting shaft (48a) is hinged at the ends to a respective supporting element (49) and extends parallel to an axis passing through the geometric centers of the two clusters of wheels (40), each supporting element (49) being hinged at the opposite end to a respective drive shaft (45a), and wherein on each end of the connecting shaft (48a) is coupled a gear which meshes with a corresponding gear rigidly mounted on a respective planet carrier (42) of the cluster of wheels (40), and wherein the remaining gear motor (7c) is coupled to the connecting shaft (48a) to control the rotation of both planet carriers (42) of the two clusters of wheels (40). 35 40 45 50

Patentansprüche

1. Treppensteigrollstuhl (1) bestehend aus 55
 - einem Rahmen (2), der mit einem Sitz (3) versehen ist, der derart vorgesehen ist, um einen

zu transportierenden Benutzer (100) aufzunehmen,

- einer Bewegungseinheit (4), die ein Paar Radgruppen (40) umfasst,
- passiven Stützmitteln, die zwischen einer verstaute Position, in der sie vom Boden (1a) angehoben sind, und einer herausgezogenen Position, in der sie mit dem Boden (1a), in Kontakt stehen (1a), beweglich sind;

dadurch gekennzeichnet, dass

die passiven Stützmittel umfassen eine Schiene (6), die derart konfiguriert ist, dass in der herausgezogenen Position der Rahmen (2) vorne auf der Bewegungseinheit (4) und hinten auf der Schiene (6) anliegt. Der Treppensteigrollstuhl (1) umfasst ferner mindestens eine mechanische Vorrichtung, die zwischen der Bewegungseinheit (4) und dem Sitz (3) verbunden ist und ist geeignet zur Zusammenarbeit mit der Schiene (6) zur Kompensation der Schwingungen des Sitzes (3), die durch die Bewegung des Paares Radgruppen (40) erzeugt werden, wobei mindestens eine mechanische Vorrichtung derart konfiguriert ist, dass sie eine Translationsbewegung des Sitzes (3) während einer Treppensteigbewegung des Treppensteigrollstuhls (1) gestattet.

2. Treppensteigrollstuhl (1) nach Anspruch 1, wobei die mindestens eine mechanische Vorrichtung einen Nockenfolger-Mechanismus umfasst, wobei der Nocken (80, 80a) mit einer Verbindungswelle (48, 48a) gekoppelt ist, die mit dem Paar Radgruppen (40), wobei der Mitnehmer (81, 81a) an einem Stützelement (30) angelenkt ist, das mit dem Sitz (3) integral ist.
3. Treppensteigrollstuhl (1) nach Anspruch 2, wobei der Nocken (80) integral mit der Drehung einer Verbindungswelle (48) ist, die die geometrischen Zentren des Paares Radgruppen (40) verbindet.
4. Treppensteigrollstuhl (1) nach Anspruch 2, wobei der Nocken (80a) integral mit der Drehung einer Verbindungswelle (48a) ist, die in nicht koaxialer und paralleler Weise in Bezug auf eine durch die geometrischen Zentren verlaufende Achse jeder Radgruppe (40) montiert ist, wobei die Verbindungswelle (48a) mit jeder Radgruppe über ein Getriebe verbunden ist.
5. Treppensteigrollstuhl (1) nach Anspruch 4, wobei das Getriebe ist derart ausgelegt ist, dass es eine Drehung der Verbindungswelle (48a) um 360° für jede 120°-Drehung der Radgruppen (40) gestattet.
6. Treppensteigrollstuhl (1) nach Anspruch 4, wobei das Getriebe derart ausgelegt ist, dass es eine Drehung der Verbindungswelle (48a) um 360° für jede

360°-Drehung der Radgruppen (40) gestattet.

7. Treppensteigrollstuhl (1) nach einem der vorhergehenden Ansprüche, wobei die mindestens eine mechanische Vorrichtung einen Aktuator (9) umfasst, der zwischen einem ersten Hilfsrahmen (2a, 2b) des Rahmens (2) und einem Stützelement (30) verbunden ist, das mit dem Sitz (3) derart integral ist, dass die relative Winkelposition zwischen dem Rahmen (2) und dem Sitz (3) gesteuert wird. 5
8. Treppensteigrollstuhl (1) nach einem der vorhergehenden Ansprüche, wobei das passive Stützmittel ferner ein Paar Schwenkräder (5) umfasst, wobei während einer flachen Bodenbewegung des Rollstuhls das Paar Schwenkräder (5) sich in der herausgezogenen Position befindet und die Schiene (6) sich in der verstaute Position befindet, wobei sich während einer Treppensteigbewegung des Rollstuhls die beiden Schwenkräder (5) sich in der verstaute Position befinden und sich die Schiene (6) in der verstaute Position in der extrahierten Position befindet. 10
9. Treppensteigrollstuhl (1) nach Anspruch 8, wobei die beiden Schwenkräder (5) derart am Rahmen (2) befestigt sind, dass sie in der herausgezogenen Position vorne oder hinten mit Bezug auf die Bewegungseinheit (4), angeordnet sind. 15
10. Treppensteigrollstuhl (1) nach einem der vorhergehenden Ansprüche, wobei die Schiene (6) ein erstes Teil (6a) und ein zweites Teil (6b) umfasst, wobei das zweite Teil (6b) relativ zum ersten Teil (6a) beweglich ist, wobei das erste Teil (6a) mit einem Scharnier (S) ausgestattet ist, das mit einem Ende einer Stange (31) gekoppelt ist, wobei die Stange (31) am anderen Ende mit dem Stützelement (30) angelenkt ist, das integraler Bestandteil des Sitzes (3) ist. 20
11. Treppensteigrollstuhl (1) nach einem der Ansprüche 1 bis 9, wobei die Schiene (6) ein erstes Teil (6a) und ein zweites Teil (6b) umfasst, wobei das zweite Teil (6b) ist beweglich relativ zu dem ersten Teil (6a), wobei das erste Teil (6a) mit einem Scharnier (S) ausgestattet ist, das mit einem ersten Element (33) eines Gelenkparallelogramms gekoppelt ist, und wobei ein zweites Element des Gelenkparallelogramms dem ersten Element (33) gegenüberliegt (33), das aus einem Stück mit dem Stützelement (30) des Sitzes (3) besteht, so dass sich die Schiene (6) während der Treppensteigbewegung des Rollstuhls (1) entlang einer Linie parallel zu der Ebene bewegt, die an den Rändern der Stufen der Treppe liegt. 25
12. Treppensteigrollstuhl (1) nach Anspruch 11, wobei das Gelenkparallelogramm eine Verbindungsstange (33) umfasst, die in dem ersten Teil (6a) angelenkt ist, wobei die Verbindungsstange (33) mit Kontaktflächen versehen ist, die zur Begrenzung einer Bewegung der Schiene (6) um das Scharnier (S) geeignet sind. 30
13. Treppensteigrollstuhl (1) nach einem der Ansprüche von 1 bis 9, wobei die Schiene (6) bewegt wird zwischen der herausgezogenen Position und der verstaute Position und umgekehrt durch einen Mechanismus mit zwei oder drei Freiheitsgraden, wobei jeder der zwei oder drei Freiheitsgrade unabhängig betätigt wird. 35
14. Treppensteigrollstuhl (1) nach einem der Ansprüche 10 bis 13, wobei das zweite Teil (6b) der Schiene (6) in Bezug auf das erste Teil (6a) beweglich ist, zwischen einer erweiterten Konfiguration in der die Schiene (6) eine Länge hat, die mindestens größer als die doppelte Steigung zwischen zwei aufeinanderfolgenden Stufen einer Treppe ist, wobei die Steigung die Hypotenuse des Dreiecks ist, das als Kathete den Steigteil und das Profil der Stufe aufweist, und einer zurückgezogenen Konfiguration, wobei die Schiene (6) eine Länge aufweist, die nicht die größte Länge zwischen den Längen des ersten (6a) und des zweiten (6b) Teils nicht überschreitet. 40
15. Treppensteigrollstuhl (1) nach einem der Ansprüche 10 bis 13, wobei das erste Teil (6a) eine Linearführung (63) umfasst, die derart ausgelegt ist, dass sie eine Gleitbewegung des zweiten Teils (6b) zwischen einer zurückgezogenen Konfiguration der Schiene (6), in der das zweite Teil (6b) innerhalb des ersten Teils (6a) liegt, und einer erweiterten Konfiguration der Schiene (6), gestattet, wobei das zweite Teil (6b) außerhalb des ersten Teils (6a) liegt und die Schiene (6) hat eine Länge, die größer als die doppelte Steigung zwischen zwei aufeinanderfolgenden Stufen einer Treppe ist, wobei die Steigung die Hypotenuse des Dreiecks ist, das als Kathete das Steigteil und das Profil der Stufe aufweist. 45
16. Treppensteigrollstuhl (1) nach einem der Ansprüche von 10 bis 15, wobei die Schiene (6) ferner einen Haken (36) umfasst, der in das bewegliche Teil (6b) integriert und derart konfiguriert ist, dass er sich in der zurückgezogenen Konfiguration der Schiene in einen Stift (37) einrastet, der in ein Element (33) integriert ist, das in dem Scharnier (S) angelenkt ist. 50
17. Treppensteigrollstuhl (1) nach einem der vorhergehenden Ansprüche, wobei die Schiene (6) eine oder mehrere Kontaktflächen mit dem Boden umfasst, wobei die einen oder mehreren Kontaktflächen Kufen oder Gummibänder umfassen. 55
18. Treppensteigrollstuhl (1) nach einem der vorherge-

henden Ansprüche, wobei jede Gruppe von Rädern (40) einen Planetenträger (42) umfasst, der mit einem Planetengetriebe ausgestattet ist, das von einer Elektromotoranordnung angetrieben wird, die zum Drehen der Verbindungswelle (48, 48a) ausgelegt ist, wobei die Verbindungswelle (48, 48a) derart angepasst ist, um eine Drehbewegung auf jeden Planetenträger (42) zu übertragen.

19. Treppensteigrollstuhl (1) nach Anspruch 18, wobei die Elektromotoranordnung drei Getriebemotoren (7a, 7b, 7c) umfasst, wobei zwei (7a, 7b) der drei Getriebemotoren mit einer jeweiligen Antriebswelle (45a) gekoppelt sind, die mit einem Sonnenrad (45) eines entsprechenden Planetenträgers (42) verbunden sind, und wobei der weitere Getriebemotor (7c) mit der Verbindungswelle (48) gekoppelt ist, wobei jede Antriebswelle (45a) hohl und koaxial mit der Verbindungswelle (48) ist, wobei die Verbindungswelle (48) derart angepasst ist, um die Drehung beider Planetenträger (42) der beiden Radgruppen (40) zu steuern.
20. Treppensteigrollstuhl (1) nach Anspruch 18, wobei die Elektromotoranordnung drei Getriebemotoren (7a, 7b, 7c) umfasst, wobei zwei (7a, 7b) der drei Getriebemotoren mit einer jeweiligen Antriebswelle (45a) gekoppelt sind, die mit einem Sonnenrad (45) eines entsprechenden Planetenträgers (42) verbunden ist, wobei die Verbindungswelle (48a) an den Enden an einem jeweiligen Stützelement (49) angelenkt ist und sich parallel zu einer durch die geometrischen Zentren der beiden Radgruppen (40) verlaufenden Achse erstreckt, wobei jedes Stützelement (49) am gegenüberliegenden Ende einer jeweiligen Antriebswelle (45a) angelenkt ist und an jedem Ende der Verbindungswelle (48a) ein Zahnrad angebracht ist, das mit einem entsprechenden Zahnrad eingreift, das starr auf einem jeweiligen Planetenträger (42) der Radgruppe (40) montiert ist, und wobei der weitere Getriebemotor (7c) mit der Verbindungswelle (48a) gekoppelt ist, um die Drehung beider Planetenträger (42) der beiden Radgruppen (40) zu steuern.

Revendications

1. Fauteuil roulant monte-escaliers (1) comprenant
 - un châssis (2) muni d'un siège (3) destiné à accueillir un utilisateur (100) à transporter,
 - une unité de locomotion (4) comprenant un couple de groupes de roues (40),
 - des moyens de support passifs mobiles entre une position repliée dans laquelle ils sont soulevés du sol (1a) et une position extraite dans laquelle ils sont en contact avec le sol (1a),

caractérisé en ce que

les moyens de support passifs comprennent une piste (6) configurée de telle sorte que dans ladite position extraite le châssis (2) repose à l'avant sur l'unité de locomotion (4) et à l'arrière sur ladite piste (6), le fauteuil roulant monte-escalier (1) comprend en outre au moins un dispositif mécanique lié entre l'unité de locomotion (4) et le siège (3) et adapté pour coopérer avec la piste (6) pour compenser les oscillations du siège (3) générées par le mouvement du couple de groupes de roues (40), ledit au moins un dispositif mécanique étant configuré de manière à permettre un mouvement de translation du siège (3) pendant un mouvement de montée d'escalier du fauteuil roulant monte-escalier (1).

2. Fauteuil roulant monte-escalier (1) selon la revendication 1, dans lequel ledit au moins un dispositif mécanique comprend un mécanisme suiveur de came, dans lequel la came (80, 80a) est couplée à un arbre de liaison (48, 48a) relié au couple des groupes de roues (40) et dans lequel le suiveur (81, 81a) est articulé sur un élément de support (30) solidaire du siège (3).
3. Fauteuil roulant monte-escalier (1) selon la revendication 2, dans lequel ladite came (80) est solidaire de la rotation d'un arbre de liaison (48) reliant les centres géométriques du couple de groupes de roues (40).
4. Fauteuil roulant monte-escalier (1) selon la revendication 2, dans lequel ladite came (80a) est solidaire de la rotation d'un arbre de liaison (48a) monté de manière non coaxiale et parallèle par rapport à un axe passant par les centres géométriques de chaque groupe de roues (40), dans lequel ledit arbre de liaison (48a) est couplé à chaque groupe de roues par l'intermédiaire d'une transmission à engrenages.
5. Fauteuil roulant monte-escalier (1) selon la revendication 4, dans lequel ladite transmission à engrenages est adaptée pour permettre une rotation de 360° dudit arbre de liaison (48a) pour chaque rotation de 120° des groupes de roues (40).
6. Fauteuil roulant monte-escalier (1) selon la revendication 4, dans lequel ladite transmission à engrenages est adaptée pour permettre une rotation de 360° dudit arbre de liaison (48a) pour chaque rotation de 360° des groupes de roues (40).
7. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications précédentes, dans lequel ledit au moins un dispositif mécanique comprend un actionneur (9) connecté entre un premier sous-châssis (2a, 2b) dudit châssis (2) et un élément de support (30) qui est solidaire du siège (3) de ma-

nière à contrôler la position angulaire relative entre le châssis (2) et le siège (3).

8. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications précédentes, dans lequel les moyens de support passifs comprennent en outre un couple de roues pivotantes (5), dans lequel pendant un mouvement plan sur le sol du fauteuil roulant le couple de roues pivotantes (5) sont en position extraite et la piste (6) est en position repliée, et dans lequel pendant un mouvement de montée d'escalier du fauteuil roulant, le couple de roues pivotantes (5) est en position repliée et la piste (6) est dans la position extraite. 5
9. Fauteuil roulant monte-escalier (1) selon la revendication 8, dans lequel ledit couple de roues pivotantes (5) est fixé au châssis (2) de telle sorte que dans ladite position extraite il sont disposés à l'avant ou à l'arrière de ladite unité de locomotion (4). 10
10. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications précédentes, dans lequel ladite piste (6) comprend une première partie (6a) et une deuxième partie (6b), dans laquelle la deuxième partie (6b) est mobile par rapport à la première partie (6a), dans laquelle la première partie (6a) est équipée d'une charnière (S) couplée à une extrémité d'une barre (31), ladite barre (31) étant articulée à l'autre extrémité avec ledit élément de support (30) solidaire du siège (3). 15
11. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications 1 à 9, dans lequel ladite piste (6) comprend une première partie (6a) et une deuxième partie (6b), dans laquelle la deuxième partie (6b) est mobile par rapport à la première partie (6a), dans laquelle la première partie (6a) est équipée d'une charnière (S) couplée à un premier élément (33) d'un parallélogramme articulé et dans laquelle un deuxième élément du parallélogramme articulé opposé audit premier élément (33) est réalisé d'une seule pièce avec l'élément de support (30) du siège (3) de telle sorte que, pendant le mouvement de montée des escaliers du fauteuil roulant (1), la piste (6) se déplace le long d'une ligne parallèle au plan s'appuyant sur les bords des marches de l'escalier. 20
12. Fauteuil roulant monte-escalier (1) selon la revendication 11, dans lequel le parallélogramme articulé comprend une tige (33) articulée dans ladite première partie (6a), ladite tige (33) étant pourvue de surfaces de contact adaptées pour limiter un mouvement de ladite piste (6) autour de la charnière (S). 25
13. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications 1 à 9, dans lequel ladite 30

piste (6) est déplacée entre ladite position extraite et ladite position repliée, et vice versa, à travers un mécanisme à deux ou trois degrés de liberté, chacun desdits deux ou trois degrés de liberté étant actionné indépendamment.

14. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications 10 à 13, dans lequel ladite deuxième partie (6b) de la piste (6) est mobile par rapport à ladite première partie (6a) entre une configuration étendue où la piste (6) a une longueur au moins supérieure au double du pas entre deux marches consécutives d'un escalier, où le pas est l'hypoténuse du triangle qui a pour cathets la contremarche et la base de la marche, et une configuration rétractée dans laquelle la piste (6) a une longueur ne dépassant pas la plus grande longueur entre les longueurs de la première (6a) et de la deuxième partie (6b). 35
15. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications 10 à 13, dans lequel la première partie (6a) comprend un guide linéaire (63) adapté pour permettre un mouvement de coulissement de la deuxième partie (6b) entre une configuration rétractée de la piste (6) dans laquelle la deuxième partie (6b) est interne à la première partie (6a), et une configuration étendue de la piste (6) dans laquelle la deuxième partie (6b) est externe à la première partie (6a) et la piste (6) a une longueur supérieure au double du pas entre deux marches consécutives d'un escalier, le pas étant l'hypoténuse du triangle qui a pour cathets la contremarche et la base de la marche. 40
16. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications 10 à 15, dans lequel la piste (6) comprend en outre un crochet (36) solidaire de ladite partie mobile (6b) et configuré pour s'engager, dans la configuration rétractée de la piste, une goupille (37) solidaire d'un élément (33) articulé dans ladite charnière (S). 45
17. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications précédentes, dans lequel ladite piste (6) comprend une ou plusieurs surfaces de contact avec le sol, dans laquelle lesdites une ou plusieurs surfaces de contact comprennent des patins ou des courroies en caoutchouc. 50
18. Fauteuil roulant monte-escalier (1) selon l'une quelconque des revendications précédentes, dans lequel chaque groupe de roues (40) comprend un porte-satellites (42) muni d'un train épicycloïdal d'engrenages entraîné par un ensemble de moteur électrique adapté pour mettre en rotation l'arbre de liaison (48, 48a), ledit arbre de liaison (48, 48a) étant adapté pour transmettre un mouvement de rotation 55

à chaque porte-satellites (42) .

19. Fauteuil roulant monte-escalier (1) selon la revendication 18, dans lequel l'ensemble du moteur électrique comprend trois motoréducteurs (7a, 7b, 7c), dans lequel deux (7a, 7b) des trois motoréducteurs sont couplés à un arbre d'entraînement respectif (45a) connecté à un engrenage solaire (45) d'un porte-satellites correspondant (42), et dans lequel l'autre moteur à engrenages (7c) est couplé à l'arbre de connexion (48), chaque arbre d'entraînement (45a) étant creux et coaxial avec l'arbre de liaison (48), ledit arbre de liaison (48) étant adapté pour commander la rotation des deux porte-satellites (42) des deux groupes de roues (40).
20. Fauteuil roulant monte-escalier (1) selon la revendication 18, dans lequel l'ensemble du moteur électrique comprend trois motoréducteurs (7a, 7b, 7c), dans lequel deux (7a, 7b) des trois motoréducteurs sont couplés à un arbre d'entraînement respectif (45a) connecté à un engrenage solaire (45) d'un porte-satellites correspondant (42), dans lequel l'arbre de connexion (48a) est articulé aux extrémités sur un élément de support respectif (49) et s'étend parallèlement à un axe passant par les centres géométriques des deux groupes de roues (40), chaque élément de support (49) étant articulé à l'extrémité opposée à un arbre d'entraînement respectif (45a), et dans lequel à chaque extrémité de l'arbre de liaison (48a) est couplé un engrenage qui engrène avec un engrenage correspondant monté rigidement sur un porte-satellites respectif (42) du groupe de roues (40), et dans lequel l'autre motoréducteur (7c) est couplé à l'arbre de connexion (48a) pour commander la rotation des deux porte-satellites (42) des deux groupes de roues (40).

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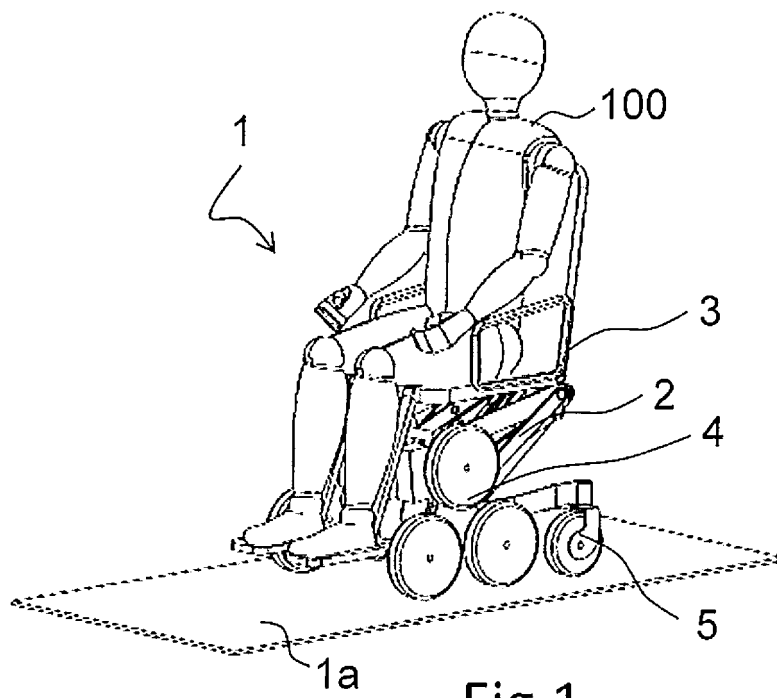


Fig.1

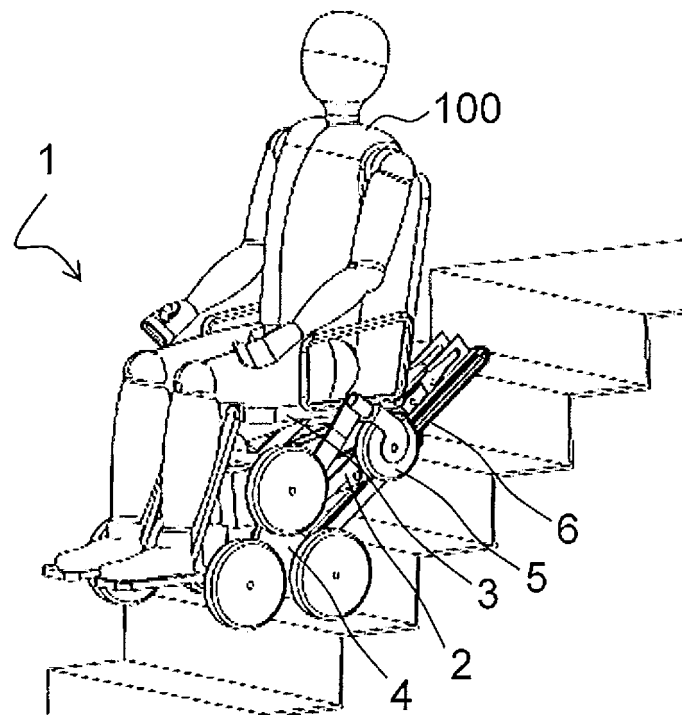


Fig.2

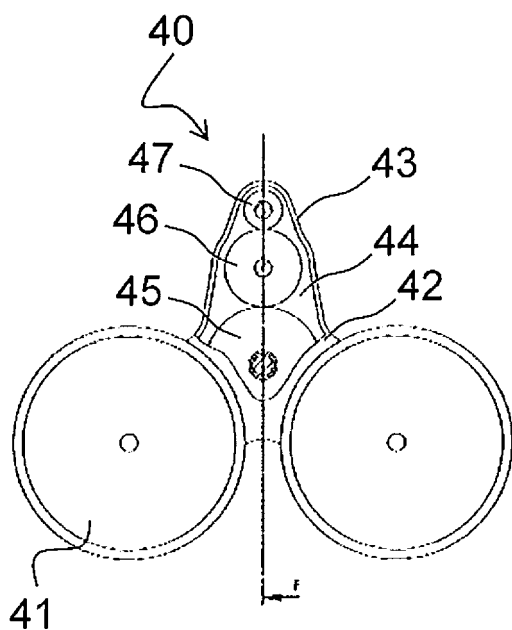


Fig. 3a

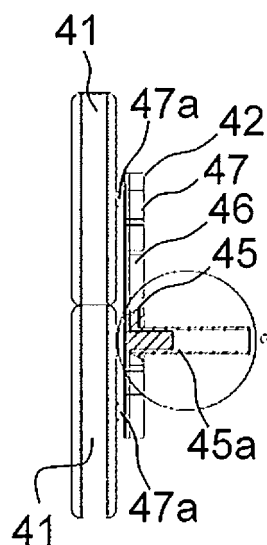


Fig. 3b

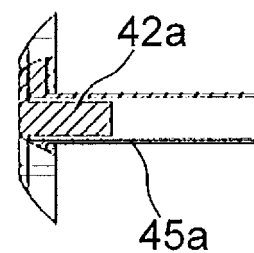


Fig. 3c

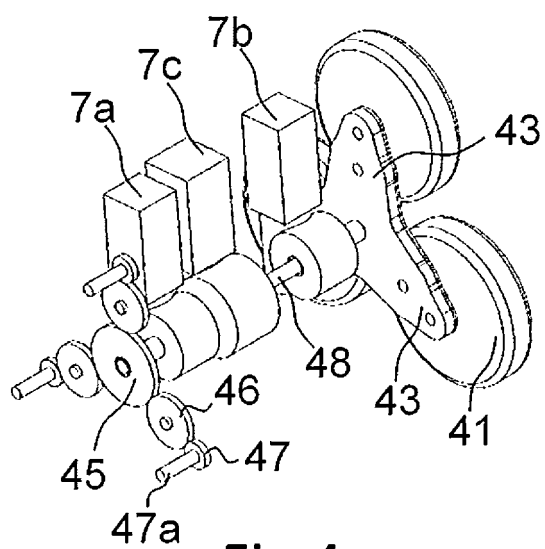


Fig. 4a

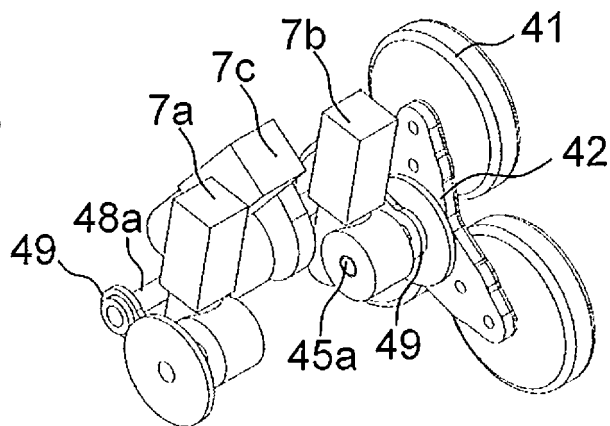
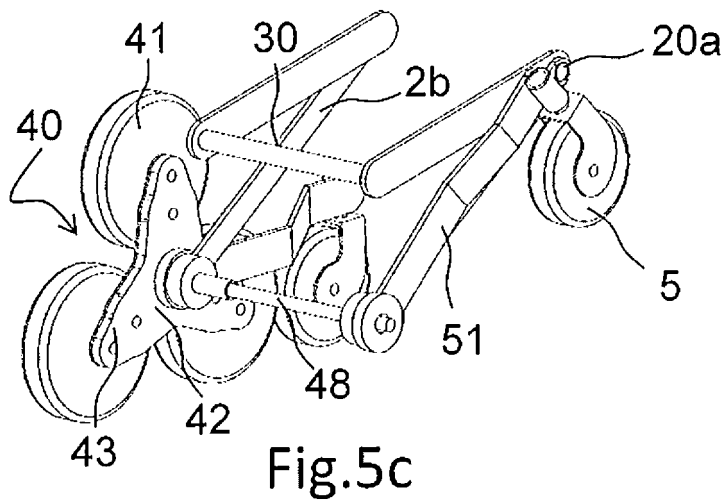
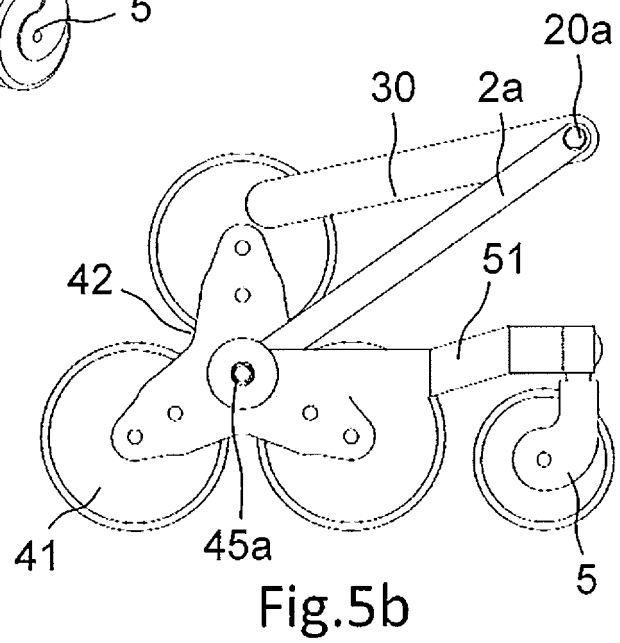
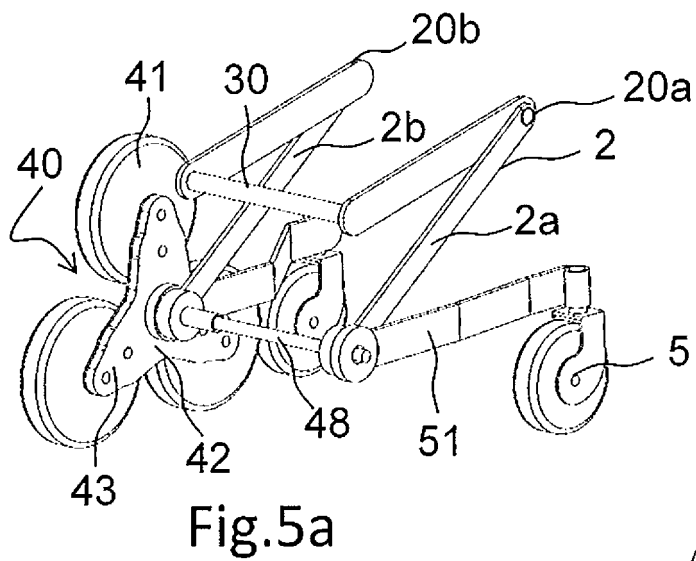


Fig. 4b



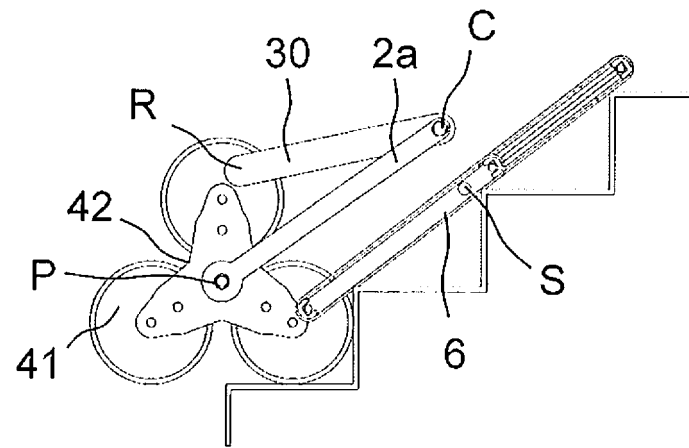


Fig. 6

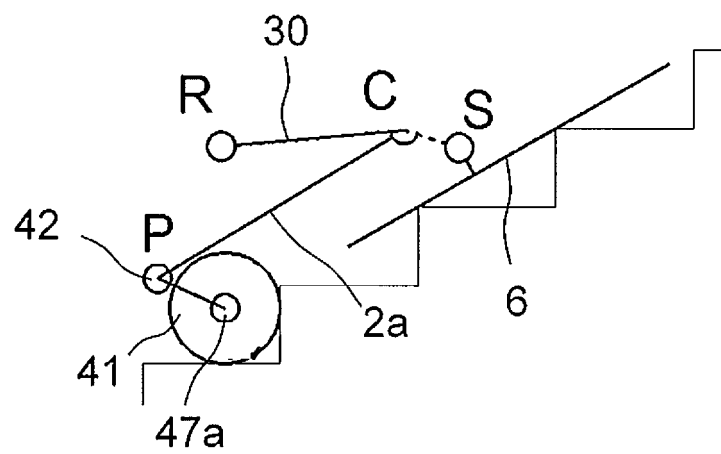


Fig. 7

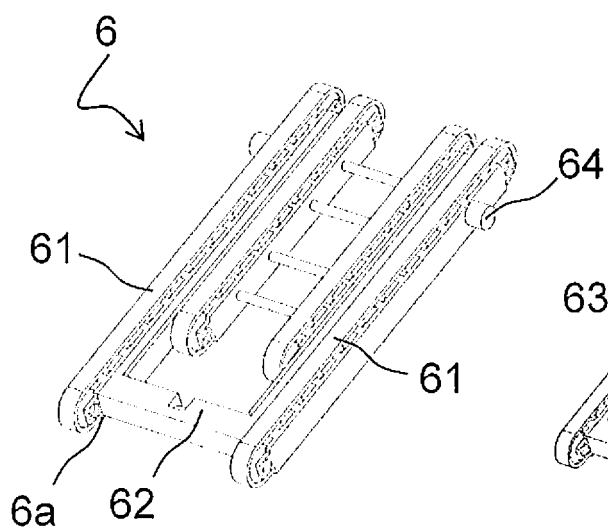


Fig. 8

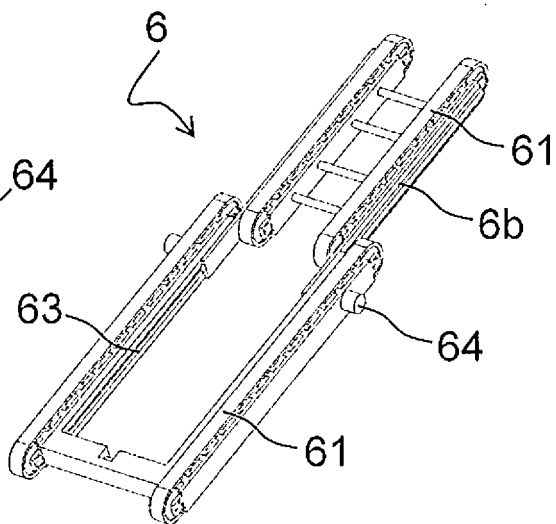


Fig. 9

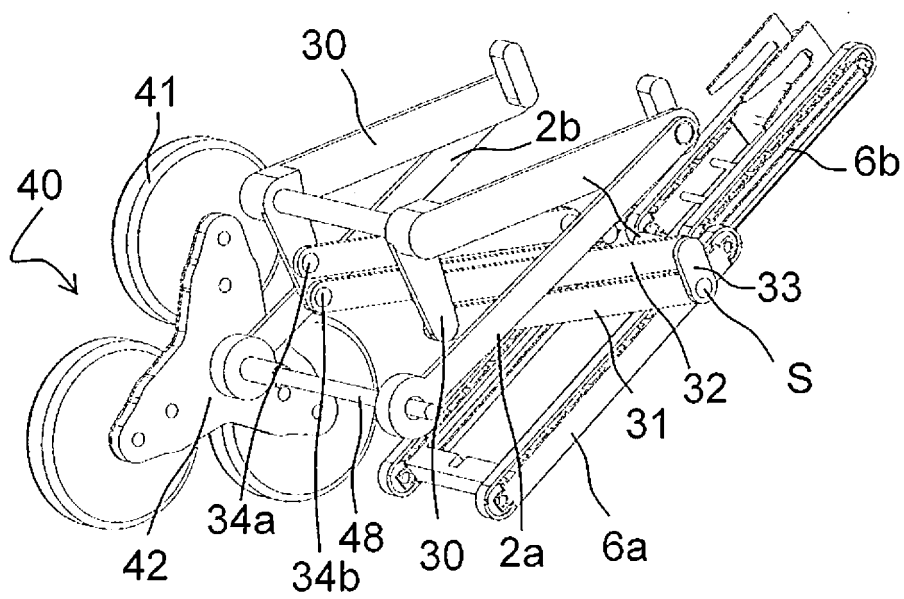


Fig. 10

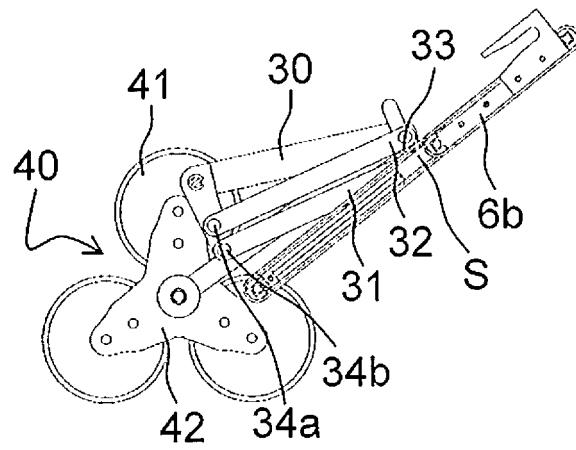


Fig.11a

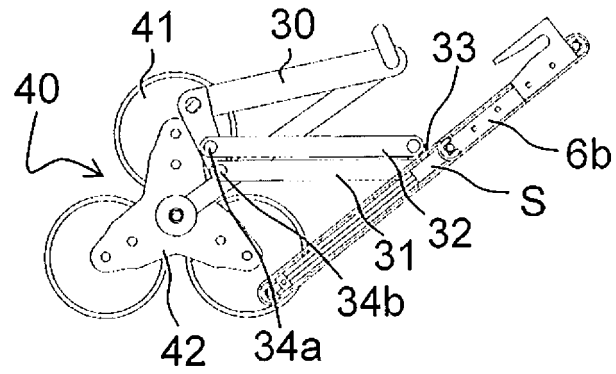


Fig.11b

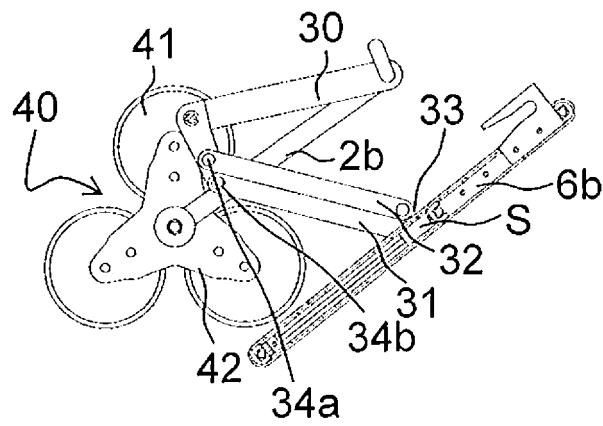


Fig.11c

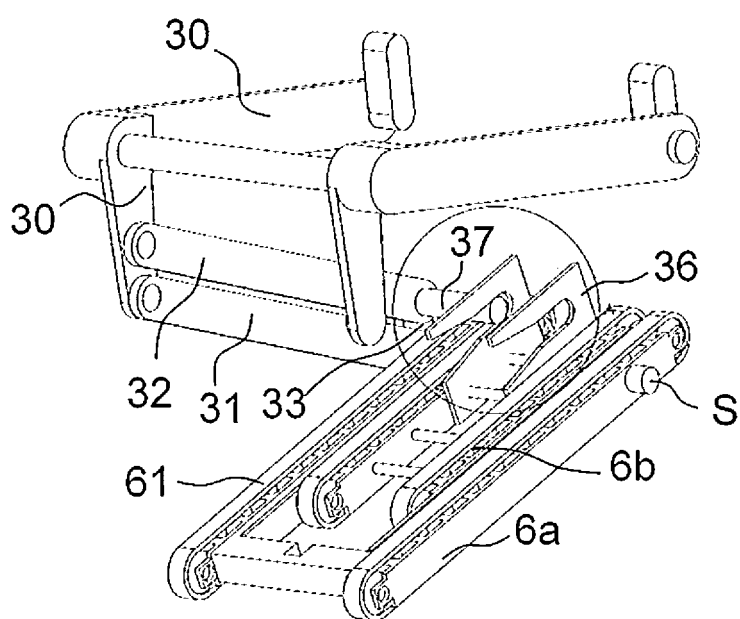


Fig. 12a

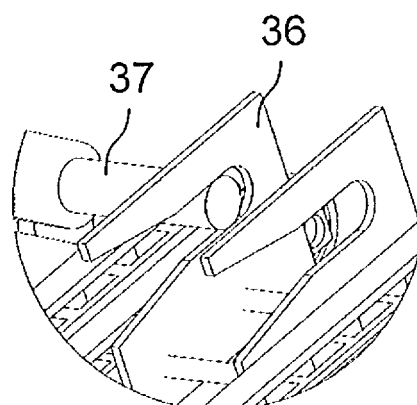


Fig. 12b

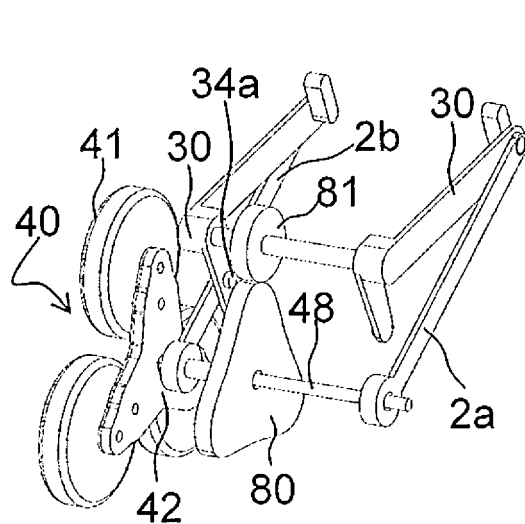


Fig. 13a

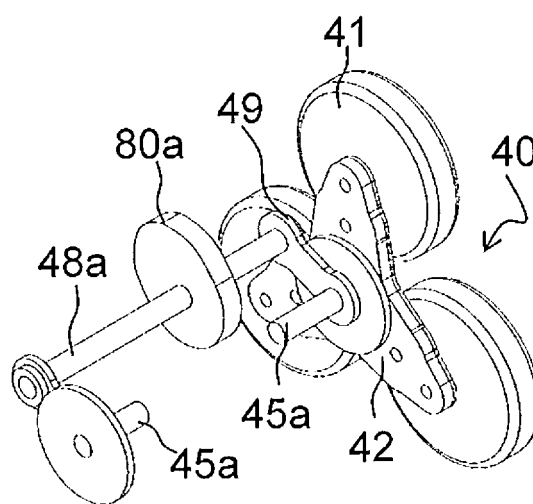


Fig. 13b

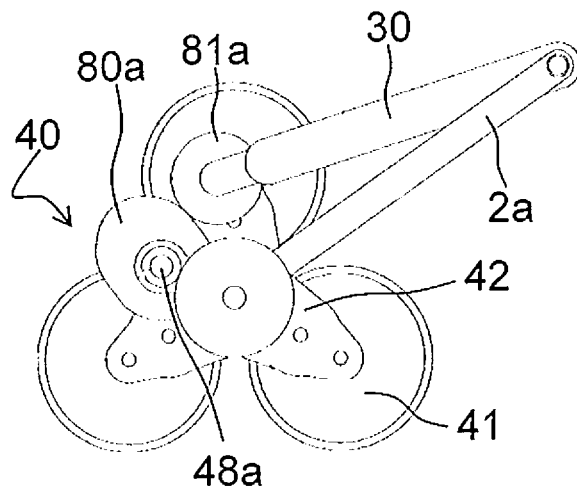


Fig.13c

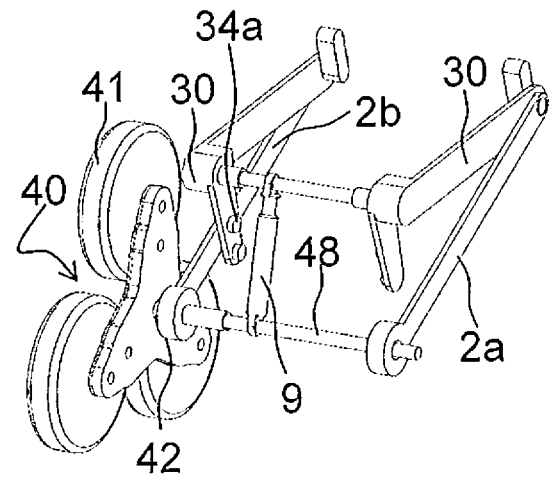


Fig.14

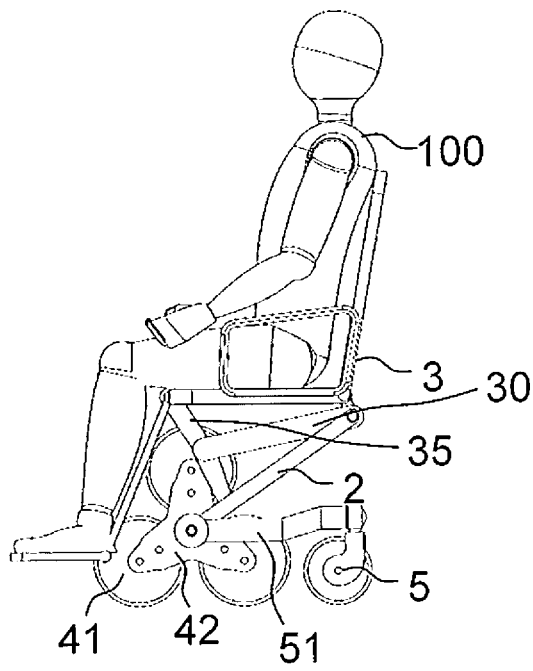


Fig.15

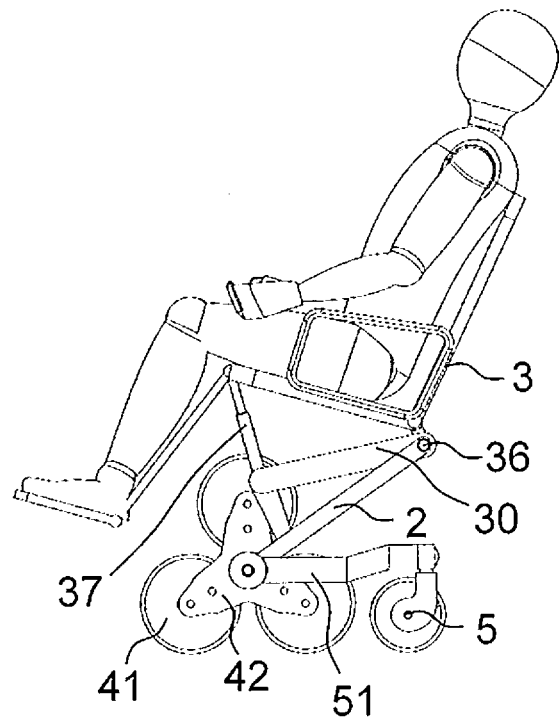


Fig.16

REFERENCES CITED IN THE DESCRIPTION

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