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(54) FOLDABLE WHEELCHAIR

(57) The present invention relates to a foldable wheelchair (10) comprising:
- a chair assembly (20) comprising a seat assembly (22), in which a seat frame (22b) defines a plane P1, and a backrest assembly (21), in which a backrest frame (21b) defines a plane P2,
- a wheel assembly (40) comprising a rear wheel assembly (41) including at least two rear wheels (41a, 41b) in rotation around or defining a first rotation axis AR1, a front wheel assembly (42) including at least two front wheels (42a, 42b) in rotation around or defining a second rotation axis AR2, and a folding frame (43) connected to the rear and front wheel assemblies (41, 42), wherein said folding frame (43) is foldable along a longitudinal direction between an unfolded position and a folded position, said first rotation axis AR1 and said second rotation axis AR2 being closer in said folded position than in said unfolded position, characterized in that, when the folding frame (43) moves from its unfolded position to its folded position, the second rotation axis AR2 moves rearward relative to the chair assembly (20) and the first rotation axis AR1 does not move relative to the chair assembly (20) and in that the folding frame (43) comprises at least two parallel first rear arms, respectively left and right first rear arms (431a, 431b; 431'a, 431'b), and at least two parallel first front arms, respectively left and right first front arms (432a, 432b; 432'a, 432'b), said first rear arms, respectively said first front arms, being pivotally connected at one of their ends to a vertical rear tube (433) connected to the rear wheel assembly (41), respectively to a vertical front tube (434) connected to the front wheel assembly (42), and at their other end to a vertical central tube (435).

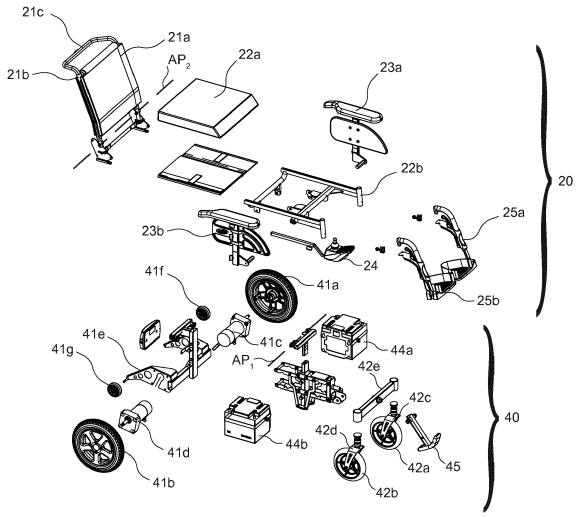

Figure 1c

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Description

Technical Field

[0001] The present invention relates in general to foldable wheelchairs. More particularly, the present invention relates to a foldable power wheelchair.

Prior Art and the Problem Underlying the Invention

[0002] Foldable wheelchairs have been known for some time, and the advantages are numerous with respect to managing the wheelchair when it is not in use, or for transportation of the chair. Mostly this feature has been provided for relatively light-weight, manual wheelchair. However, the same feature is an advantage for power wheelchair users who need to transport, and even occasionally to store their wheelchair.

[0003] Traditionally, foldable wheelchairs are provided with X-shaped cross-bracing frame assemblies that fold or scissor to allow the side frames of the wheelchair to be folded along a longitudinal direction between a spaced apart deployed position for use and a folded position for storage or transport. In general, such foldable wheelchairs are provided with a flexible seat connected to the side frames. Indeed, such a flexible seat permits the folding operation of the wheelchair. However, many users prefer or even require rigid seating. Thus, a first objective of the present invention is to provide a foldable wheelchair which will comprise a foldable frame structure that can be used to support a rigid seat assembly. The current invention is suitable for use on a power wheelchair; however, it is envisioned that it could be used on a foldable manual wheelchair.

[0004] A second objective of the present invention is to provide a foldable wheelchair that can be easily and quickly folded.

[0005] A third objective of the present invention is to provide a foldable wheelchair in which the seat assembly can be easily tilted relative to the frame structure and/or can be easily replaced by another one.

[0006] A fourth objective of the present invention is to provide a removable battery support frame accommodating a battery that can be easily connected to a wheelchair frame.

[0007] A fifth objective of the present invention is to provide a seat assembly that can be easily separated from the frame structure.

Summary of Invention

[0008] In an aspect, the present invention provides a foldable wheelchair comprising:

- a chair assembly comprising a seat assembly, in which a seat defines a plane P1, and a backrest assembly, in which a backrest defines a plane P2,
- a wheel assembly comprising a rear wheel assembly including at least two rear wheels in rotation around or defining a first rotation axis, a front wheel assembly including at least two front wheels in rotation around or defining a second rotation axis, and a folding frame connected to the rear and front wheel assemblies, wherein said folding frame is foldable along a longitudinal direction between an unfolded position and a folded position, said first rotation axis and said second rotation axis being closer in said folded position than in said unfolded position, such that, when the folding frame moves from its unfolded position to its folded position, the second rotation axis moves rearward relative to the chair assembly and the first rotation axis does not move relative to the chair assembly, the folding frame comprising at least two parallel first rear arms, respectively left and right first rear arms, and at least two parallel first front arms, respectively left and right first front arms, said first rear arms, respectively said first front arms, being pivotally connected at one of their ends to a vertical rear tube connected to the rear wheel assembly, respectively to a vertical front tube connected to the front wheel assembly, and at their other end to a vertical central tube.

[0009] The folding frame may be configured such that the second rotation axis moves along an horizontal direction when the folding frame moves from its unfolded position to its folded position.

[0010] The wheelchair may comprise locking means so as to lock the folding frame in its unfolded position, wherein said locking means may comprise at least two cylindrical elements protruding respectively from the vertical rear tube and the vertical central tube, or from the vertical front tube and the vertical central tube, or from the vertical rear tube and the vertical front tube, said cylindrical elements extending in the same horizontal plane in parallel lateral directions and being spaced apart in a longitudinal direction when the folding frame is in its unfolded position, each cylindrical element comprising a circumferential groove adapted to receive a locking plate provided with two at least partially hemi-circular openings and/or recesses, the hemi-circular portion of said openings or recesses having approximately the same radius as the circumferential groove of said cylindrical elements and the distance between said two openings or recesses being equal to the distance between said two cylindrical elements when the folding frame is in its unfolded position and wherein the locking plate may be an integral part of a removable battery support frame accommodating a battery.

[0011] The chair assembly may be pivotally connected to the wheel assembly around a first pivot axis AP1 such that the chair assembly is moveable between a lower position, in which the plane P1 is approximately horizontal or slightly tilted relative to the horizontal, the angle α_0 between the plane P1 and the horizontal lying preferably between -15° and +15°, and an upper position, in which

the plane P1 is approximately vertical or slightly tilted relative to the vertical, the angle α between the plane P1 and the horizontal lying preferably between +75° and +105°, wherein the chair assembly may be provided with at least one first connecting hole and the wheel assembly may be provided with at least one corresponding first connecting hole such that the chair assembly is locked in its lower position when a quick release pin is positioned both into said first connecting hole and said corresponding first connecting hole, and, wherein the chair assembly may be provided with at least one second connecting hole and the wheel assembly may be provided with at least one corresponding second connecting hole such that the chair assembly is locked in its upper position when a quick release pin is positioned both into said second connecting hole and said corresponding second connecting hole.

[0012] The chair assembly may be provided with two first connecting holes and the wheel assembly may be provided with two corresponding first connecting holes such that the chair assembly is locked in its lower position when quick release pins are positioned both into said two first connecting holes and said two corresponding first connecting holes, wherein said two corresponding first connecting holes of the wheel assembly are disposed at each end of an upper rod of a T-shape bracket, said upper rod extending in a lateral direction, perpendicularly to a lower rod of said T-shape bracket, said lower rod being telescopically received in the central tube of the folding frame and being connected at its lower end to left and right, first rear and first front arms by left and right, rear and front struts respectively, said left and right, rear and front struts being pivotally connected at one of their ends to said lower rod and at their other end to left and right, first rear and first front arms respectively. The lower rod of the T-shape bracket may be adjustable in length so as to adjust the position in height of the two first connecting holes of the wheel assembly and so as to adjust the angle α_0 between the plane P1 and the horizontal in the lower position of the chair assembly. The lower rod of the T-shape bracket may comprise an inner section and an outer section, said inner section being telescopically received in said outer section and being provided with a plurality of threaded holes so that the position of said inner section with regard to said outer section is adjustable by modifying the screwing positions of fixing screws adapted to be received inside said threaded holes and corresponding through-holes of said outer section. The front wheel assembly may comprise a pair of front wheels, each front wheel being rotatably coupled to a fork structure pivotally connected to a front swing arm, said front swing arm being pivotally connected to the folding frame.

[0013] A curb rider may be pivotally connected to the folding frame so as to be moveable between an extended position, in which said curb rider is positioned forward the front wheels, and a collapsed position, in which said curb rider is positioned between the front wheels.

[0014] The backrest assembly may be pivotally connected to the seat assembly around a second pivot axis AP2 between a normal position, in which the plane P2 is inclined relative to the plane P1, and a service or transport position, in which the plane P2 is parallel or approximately parallel to the plane P1, wherein the backrest assembly may comprise a U-shape cross bar disposed at least partially above and rearward the backrest frame when the plane P2 is vertical or slightly tilted relative to the vertical, for example when the angle between the plane P2 and the vertical lying between -15° and +15°, such that said U-shape cross bar can be easily seized by a user with one of his hands.

[0015] Thus configured, the foldable wheelchair of the present invention provides several advantages. Firstly, such a configuration permits to fold the wheelchair without modifying the relative position of the chair assembly with respect to the rear wheel assembly. Accordingly, the folding operation is simplified compared to the traditionally folding wheelchairs wherein the seat and/or the backrest move during the folding operation of the wheelchair. Secondly, such a configuration permits to easily separate the chair assembly from the wheel assembly. This makes the handling of the wheelchair much easier when the chair assembly and the wheel assembly are separated. This also permits to replace the chair assembly by another one having different seat and/or backrest sizes, different functionality and/or different accessories.

[0016] Furthermore, this permits to reduce the manufacturing cost of the wheelchair, the wheel assembly remaining the same whatever the chair assembly is chosen.

Brief Description of the Drawings

[0017] The wheelchair of the present invention will be described in further detail further below, when useful with reference to the attached drawings, which show an exemplary wheelchair according to the invention.

Figure 1a is a side view of a motorized wheelchair according to an embodiment of the present invention, said wheelchair being in its normal position of use.

Figure 1b is a perspective view of the wheelchair as shown in Figure 1a.

Figure 1c is an exploded perspective view of the wheelchair as shown in Figure 1a.

Figure 1d is a perspective view of the seat frame of the wheelchair as shown in Figure 1a.

Figure 2a is a side view of the folding frame of the wheelchair of Figure 1a when connected to the rear and front wheelchair assemblies, in its unfolded position.

Figure 2b is a perspective view of the folding frame as shown in Figure 2a.

Figure 2c is an exploded perspective view of the folding frame as shown in Figure 2a.

Figure 3a is a side view of the folding frame of the wheelchair of Figure 2a, in its folded position.

Figure 3b is a perspective view of the folding frame as shown in Figure 3a.

Figure 4a is a perspective view of an embodiment of a battery assembly that can be connected to the folding frame of Figure 2a.

Figure 4b is an exploded perspective view of the battery assembly of Figure 4a.

Figure 4c is a side view of the battery assembly of Figure 4a.

Figure 5a is a side view of the wheelchair as shown in Figure 1a, in a first service position.

Figure 5b is a side view of the wheelchair as shown in Figure 1a, in a second service position.

Figure 5c is a side view of the wheelchair as shown in Figure 1a, in a third service position.

Figure 5d is a side view of the wheelchair as shown in Figure 1a, in a fourth service position.

Figure 5e is a side view of the wheelchair as shown in Figure 1a, in a fifth service position.

Detailed Description of the Preferred Embodiments

[0018] For the purpose of the present specification, situations and directions of elements of the wheelchair of the present invention are determined by the perspective of a user seated in the wheelchair. Accordingly, the left side of the wheelchair corresponds to the right upper side of Figure 1b. The situations or directions "up" or "top" and "down" or "bottom", "rear" or "back" and "front", "behind" and "in front", "distal" and "proximal", "lateral" and "central" follow the same rule. A longitudinal direction corresponds to a back-to-front direction and a lateral direction corresponds to a left-to-right direction. The horizontal corresponds to the plane tangential to the rear and front wheels and positioned under said wheels when the wheelchair is its normal position of use. A horizontal plane corresponds to a plane parallel to the horizontal. The vertical, or a vertical plane, corresponds to a plane perpendicular to the horizontal.

[0019] Figures 1a, 1b and 1c show a foldable wheelchair according to the present invention. This wheelchair may be a dismountable wheelchair, meaning that at least a part of the wheelchair can be reversibly removed from the wheelchair. In this way, it is possible to remove at least one part, for example for the purpose of repairing the part or in order to arrange the wheelchair in a more space-saving manner, for example for storage and/or transport of the wheelchair. Thus, any one selected from the seat, the backrest, the armrest, the legrest and/or the battery assemblies may be demountable and remountable. The wheelchair 10 of Figures 1a, 1b and 1c comprises a chair assembly 20 and a wheel assembly 40.

[0020] The chair assembly 20 comprises a backrest assembly 21 and a seat assembly 22. The backrest assembly 21 comprises a backrest cushion 21a connected to a backrest frame 21b and the seat assembly 22 comprises a seat cushion 22a connected to a seat frame 22b. The backrest frame 21b defines approximately a plane P2 and the seat frame 22b defines approximately a plane P1. In the normal position of use, the plane P2 is inclined relative to the plane P1, the angle between the planes P1 and P2 being preferably comprised between 85° and 100°, and more preferably close to 90°. As better explained in the following paragraphs, in particular in relation with Figure 5a, the backrest assembly 21 is advantageously pivotally connected to the seat assembly 22 around a pivot axis AP2 so that the backrest assembly 21 can be moved between a normal position as shown in Figure 1a and a service or transport position as shown in Figure 5a, in which the plane P2 is parallel or approximately parallel to the plane P1. A U-shape cross bar 21 c connected at its two ends to the backrest frame 21 b is advantageously disposed at least partially above and rearward the backrest frame 21b when the wheelchair is in its normal position of use. Thus, said U-shape cross bar 21c can be easily seized by a user with one of its hands so as to push or pull the wheelchair 10. As shown in detail in Figure 1d, the seat frame 22b comprises two left and right longitudinal bars 221a and 221b, said bars being linked by a pair of rear and front lateral crosspieces 221c and 221d. Each end of the front crosspiece 221d can be removably connected to a left armrest assembly 23a, respectively a right armrest assembly 23b, and the front end 222a, respectively 222b, of the left longitudinal bar 221 a, respectively the right longitudinal bar 221 b, can be removably connected to a left legrest assembly 25a, respectively a right legrest assembly 25b. A control joystick 24 can also be removably connected to the right armrest assembly 23b and/or the left armrest assembly 23a.

[0021] The wheel assembly 40 comprises a rear wheel assembly 41 and a front wheel assembly 42. The rear wheel assembly 41 comprises a left rear wheel 41a and a right rear wheel 41b. A pair of left and right power drive assemblies 41c and 41d, each assembly comprising a motor and a gear box assembly, are provided in order to propel the left and right rear wheels 41a and 41b, respectively. Of course, such power drive assemblies are not necessary if the wheelchair is not power driven. Thus,

the rear wheels 41a, 41b are rotatably coupled to the gearbox assembly of the power drive assemblies 41c, 41d, respectively, so as to rotate around a rotation axis AR1. The power drive assemblies 41c, 41d are supported by a motor sub-frame 41e. As shown in detail in Figures 2a, 2b and 2c, the motor sub-frame 41e comprises a pair of left and right longitudinal plates 411a and 411b linked together by a lateral strut 411c which is fixedly connected or integral with a vertical rear tube 433. A left anti-tip wheel 41f, respectively a right anti-tip wheel 41g, can be rotatably connected to a rear end of said left longitudinal plate 411 a, respectively said right longitudinal plate 411 b, so as to rotate around a rotation axis AR3 and such that the plane enclosing the rotation axes AR1 and AR3 are inclined relative to the horizontal in the normal position of use of the wheelchair 10. The front wheel assembly 42 comprises a left front wheel 42a and a right front wheel 42b, which are rotatably connected to a fork structure 42c and 42d, respectively. In the embodiment shown, the fork structures 42c, 42d are pivotally connected to a front swing arm 42e. In this case, the front wheels 42a, 42b do not rotate in general around the same rotation axis due to the fact that each front wheel 42a, 42b has its own orientation with regard to the back-to-front direction. Thus, to simplify our explanation, we will consider in the following paragraphs that the front wheels 42a, 42b are defined by the same rotation axis AR2 which corresponds to the axis enclosing both centers of said front wheels 42a and 42b. This rotation axis AR2 corresponds to the real rotation axes of said front wheels 42a and 42b when the fork structures 42c, 42d are fixedly connected to the front swing arm 42e. Same reasoning would apply to the rotation axis AR1 if the orientation of the left and right rear wheels 41a, 41b was different with regard to the back-to-front direction. As shown in detail in Figures 2a, 2b and 2c, the front swing arm 42e is pivotally connected to a vertical front tube 434. This configuration allows the front wheels 42a, 42b to follow the curvature of the ground and to act like a suspension.

[0022] The wheel assembly 40 comprises also a folding frame 43 linking together the rear wheel assembly 41 and the front wheel assembly 42. As shown in detail in Figures 2a, 2b, 2c, said folding frame 43 comprises said above mentioned vertical rear tube 433, said above mentioned vertical front tube 434 and a vertical central tube 435 aligned with and disposed between said rear and front tubes 433, 434 along a longitudinal direction, said tubes 433, 434 and 435 being spaced-apart along said longitudinal direction in the unfolded position of the folding frame 43 as shown in Figures 1a and 2a. Said tubes 433, 434 and 435 will have preferably the same cross-section profile, said profile being advantageously rectangular. However, other cross-section profile may be chosen, in particular a circular or elliptic profile. The central tube 435 is connected to the rear tube 433 through a pair of parallel left and right first rear arms 431a and 431b in its upper part and through a pair of parallel left and right second rear arms 431'a and 431'b in its lower part and to the front tube 434 through a pair of parallel left and right first front arms 432a and 432b in its upper part and through a pair of parallel left and right second front arms 432'a and 432'b in its lower part. Said left and right first and second rear arms, respectively said left and right first and second front arms, are pivotally connected at one of their ends to the vertical rear tube 433, respectively to the vertical front tube 434, and at their other end to the vertical central tube 435. Thus configured, the folding frame 43 is foldable between the unfolded position shown in Figures 2a, 2b and a folded position shown in Figures 3a, 3b. In the folded position of the folding frame 43, the central tube 435 is disposed rearwards and upwards with regard to its position in the unfolded position of the folding frame 43. Thus, the longitudinal distances between the central tube 435 and the rear and front tubes 433 and 434, respectively, are much shorter in the folded position of the folding frame 43 than in its unfolded position. This permits to greatly reduce the longitudinal dimensions of the folding frame 43.

[0023] The wheelchair 10 may also comprise locking means so as to lock the folding frame 43 in its unfolded position. Such locking means may be configured so as to prevent the rearward and upward displacement of the central tube 435 when the folding frame 43 moves from its unfolded position to its folding position. In the embodiment shown in Figures 2a-2c, such locking means comprise two left and right first rear cylindrical elements 433a, 433b protruding from the vertical rear tube 433, respectively at its left side and at its right side, in its upper part, two left and right second rear cylindrical elements 433'a, 433'b protruding from the vertical rear tube 433, respectively at its left side and at its right side, in its lower part, two left and right first front cylindrical elements 435a, 435b protruding from the vertical central tube 435, respectively at its left side and at its right side, in its upper part and two left and right second front cylindrical elements 435'a, 435'b protruding from the vertical central tube 435, respectively at its left side and its right side, in its lower part. Said first, respectively said second, left, respectively right, cylindrical elements 433a and 435a, respectively 433b and 435b, respectively 433'a and 435'a, respectively 433'b and 435'b, advantageously extend in the same horizontal plane in parallel lateral directions and are spaced apart in a longitudinal direction when the folding frame 43 is in its unfolded position. Each cylindrical element 433a, 433b, 433'a, 433'b, 435a, 435b, 435'a, 435'b comprises a circumferential groove g adapted to receive a locking plate 471 as shown in Figure 4a provided with two upper at least partially hemi-circular openings 471c, 471d and two lower at least partially hemi-circular recesses 471'c, 471'd, the hemi-circular portion of said openings 471c, 471d and recesses 471'c, 471'd having approximately the same radius as said circumferential grooves g and the distance d2 between said openings 471c, 471d and said recesses 471'c, 471'd being equal to the distance d1 between said first left cylindrical elements 433a and 435a, respectively said first

right cylindrical elements 433b and 435b, respectively said second left cylindrical elements 433'a and 435'a, respectively said second right cylindrical elements 433'b and 435'b, when the folding frame 43 is in its unfolded position. When the wheelchair 10 is power driven, said locking plate 471 will be advantageously an integral part of a removable battery support frame 47 accommodating a battery 46.

[0024] In the embodiment shown in Figures 4a, 4b and 4c, such a battery support frame 47 comprises a left part 47a removably connected to a right part 47b. When linked together, the left part 47a and the right part 47b define an internal space corresponding approximately to the external dimensions of the battery 46. Thus, when the battery 46 has an approximately parallelepiped form, the left and right parts 47a and 47b will define a parallelepiped cage inside which the battery can be lodged. In the specific embodiment shown, the left part 47a is a U-shape element dimensioned so that the left side 46a, the rear side 46c and the front side 46d of the battery 46 fit therein and the right part 47b comprises an approximately rectangular plate 471 having approximately the same dimension as the right side 46b of the battery 46 and four tongues 472, 473, 474 and 474 extending perpendicularly from each side of said rectangular plate 471 so that the rear side 46c, the front side 46d, the upper side 46e and the lower side 46f of the battery 46 fit therein. As shown in Figure 4c, a small spacing may advantageously exist between the plate 471 and the right side 46b of the battery 46 when the battery 46 is lodged inside the battery support frame 47 so that the end of the cylindrical elements, 433a, 435a, 433'a, 435'a when the battery support frame 47 is removably connected to the left side of the folding frame 43, or 433b, 435b, 433'b, 435'b when the battery support frame 47 is removably connected to the right side of the folding frame 47, can be lodged inside said spacing when the plate 471 is positioned inside the grooves g of said cylindrical elements, the openings 471c, 471d and the recesses 471'c, 471'd of said plate 471 being substantially aligned with said cylindrical elements. Of course, it is clear that other configuration and geometry could be chosen for the battery 46 and the battery support frame 47. It is also clear that the battery support frame 47 could be removably connected to the folding frame 43 through only the openings 471c and 471d or the recesses 471'c and 471'd, or through additional openings and/or recesses. Furthermore, the battery support frame 47 shown in Figures 4a, 4b and 4c may also be used inside a non-folding wheelchair. In this case, the frame of such a non-folding wheelchair will comprise similar cylindrical elements so as to permit the connection of the battery support frame 47 to the wheelchair frame.

[0025] The locking means used so as to lock the folding frame 43 in its unfolding position may also differ from those shown in Figures 2a-2c and 4a-4c. In particular, in further embodiments of the present invention (not shown), the cylindrical elements may protrude respectively from the vertical front tube 434 and the vertical central tube 435, or from the vertical rear tube 433 and the vertical front tube 434.

[0026] The wheelchair 10 may also comprise a curb rider 45 pivotally connected at its upper end to the folding frame 43 so as to be moveable between an extended position, as shown in Figure 1a, in which it is positioned forward the front wheels 42a and 42b, and a collapsed position, as shown in Figure 5d, in which it is positioned between the front wheels 42a and 42b. In the embodiment shown in Figures 1c and 2c, the connecting points around which pivots said curb rider 45 may for instance be formed inside the longitudinal flanges 434a and 434b of a fork element integral with or fixedly connected to the vertical front tube 434. Such a curb rider 45 is an accessory helping the wheelchair's user to climb curbs higher than 5-6 cm.

[0027] In the preferred embodiment shown in Figures 1c and 2c, the chair assembly 20 is pivotally connected to the wheel assembly 40 around a pivot axis AP1. Such a pivot axis AP1 is defined by a lateral branch of T-bracket 438 integral with or fixedly connected to the vertical rear tube 433 at its bottom end, the left, respectively the right, end of said lateral branch having a protruding element 438a, respectively 438b, forming an axle adapted to be pivotally received inside a corresponding hole formed inside a vertical flange 225'a, respectively 225'b, integral with or fixedly connected to the rear lateral crosspiece 221c of the seat frame 22b. Thus configured, the chair assembly 20 is moveable between a lower position, as shown in Figure 5a, in which the plane P1 is horizontal or approximately horizontal, to an upper position, as shown in Figure 5b, in which the plane P1 is approximately vertical or slightly tilted relative to the vertical, the angle α between the plane P1 and an horizontal plane H' lying preferably between +75° and +105°. In said upper position, and when the plane P2 is parallel or substantially parallel to the plane P1, the U-shape cross bar 21c of the backrest assembly 21 is positioned at least partially above and rearward the backrest frame 21b, as shown in Figure 5b, such that said U-shape cross bar 21c can be easily seized by a user with one of his hands, as shown in Figure 5e. Thus, the user can easily move the wheelchair 10 by simply pulling on the U-shape cross bar 21c, said wheelchair 10 rolling on its anti-tip wheels 41g, as shown in Figure 5e, or on its rear wheels 41b, when the wheelchair 10 does not have anti-tip wheels.

[0028] The chair assembly 20 may advantageously be locked in its lower position when a quick release pin is positioned both into at least one first connecting hole provided in the chair assembly 20 and into at least one corresponding first connecting hole provided in the wheel assembly 40. In the preferred embodiment shown in Figures 1d, 2b and 2c, said at least one first connecting hole corresponds to a hole 223a and/or 223b formed inside a longitudinal flange 225a, respectively 225b, integral with or fixedly connected to the front lateral crosspiece 221d of the seat frame 22b and said at least one corresponding

first connecting hole corresponds to a hole 437a and/or 437b formed inside a longitudinal flange 436a, respectively 436b, extending at the left, respectively the right, end of an upper rod 436i of a T-shape bracket 436 connected to the folding frame 43. In the embodiment shown, said T-shape bracket 436 is slidably received inside the central tube 435 of the folding frame 43. However, in a further embodiment of the present invention (not shown), said T-shape bracket may also be integral with or fixedly connected to the front tube 434 of the folding frame 43. The upper rod 436i of the T-shape bracket 436 shown in Figures 2a-2c extends in a lateral direction, perpendicularly to a lower rod 436j, 436k of said T-shape bracket 436, said lower rod being telescopically received in the central tube 435 of the folding frame 43 and being connected at its lower end to left and right first rear and front arms 431a, 432a, 431b, 432b by left and right, rear and front struts 438a, 439a, 438b, 439b respectively, said left and right, rear and front struts being pivotally connected at one of their ends to said lower rod 436j, 436k. Thus, when the folding frame 43 moves from its unfolded position to its folded position, the lower section 436j, 436k moves upwards and rearwards with regard to its position in the unfolded position of the folding frame 43.

[0029] As shown in Figure 5c, the position of the connecting holes 436a, 436b determines the angle α_0 between the plane P1 and an horizontal plane H' or the horizontal H in the normal position of use of the wheelchair 10, the folding frame 43 being in its unfolded position and the chair assembly 20 being in its lower position. Thus, by adjusting the position in height of said connecting holes 436a, 436b relative to the horizontal H, it is possible to adjust the tilting position of the seat frame 22b in the normal position of use of the wheelchair 10. One possibility for adjusting the position in height of said connecting holes 436a, 436b consists in modifying the length of the lower rod 436j, 436k of the T-shape bracket 436. Thus, in the preferred embodiment shown in Figures 2a-2c, said lower rod comprises an inner section 436j and an outer section 436k, said inner section 436j being telescopically received in said outer section 436k and being provided with a plurality of threaded holes so that the position of said inner section 436j with regard to said outer section 436k is adjustable by modifying the screwing positions of fixing screws adapted to be received inside said threaded holes and corresponding through-holes of said outer section 436k. Thus, in the lower position of the chair assembly 20, the angle α_0 between the plane P1 and the horizontal H will preferably lye between -15° and +15°.

[0030] The chair assembly 20 may also advantageously be locked in its upper position when a quick release pin is positioned both into at least one second connecting hole provided in the chair assembly 20 and into at least one corresponding second connecting hole provided in the wheel assembly 40. In the preferred embodiment shown in Figures 1d, 2b and 2c, said at least one second connecting hole corresponds to a hole 223'a and/or 223'b formed inside a vertical flange 225'a, respectively 225'b, integral with or fixedly connected to the rear lateral cross-piece 221c of the seat frame 22b and said at least one corresponding second connecting hole corresponds to a hole 437'a and/or 437'b formed inside a longitudinal flange 436'a, respectively 436'b, extending at the left, respectively the right, end of the lateral branch of the T-bracket 438.

[0031] When the quick release pins are withdrawn from both said at least one first connecting hole 223a and/or 223b and said at least one second connecting hole 223'a and/or 223'b, the chair assembly 20 may be easily separated from the wheel assembly 40 so as to be repaired or replaced, or for facilitating the storage and/or transport of the wheelchair.

[0032] Figures 1a and 5a to 5e show the successive steps permitting to transfer the wheelchair 10 from its normal position of use to its final service or transport position.

[0033] In the normal position of use of the wheelchair, as shown in Figure 1a, the chair assembly 20 is in its lower position, the plane P1 being horizontal or slightly tilted relative to the horizontal and the plane P2 being inclined relative to the plane P1, the angle between the planes P1 and P2 lying preferably between 85° and 100°. The folding frame 43 is locked in its unfolded position through the battery assemblies 44a and 44b which are connected respectively at the left and right side of the folding frame 43. The curb rider 45 is in its extended position. The rear wheels 41a, 41b and the front wheels 42a, 42b are in contact with the ground, the plane tangential to the rear and front wheels 41a, 41b, 42a, 42b and positioned under said wheels defining the horizontal H.

[0034] In a first service position of the wheelchair, as shown in Figure 5a, the backrest assembly 21 has been pivotally moved relative to the seat assembly 22 so that the plane P2 is parallel or approximately parallel to the plane P1.

[0035] In a second service position of the wheelchair, as shown in Figure 5b, the chair assembly 20 has been unlocked from its lower position and positioned into its upper position, in which the plane P1 is inclined relative to the horizontal H, the angle α between the plane P1 and the horizontal H lying preferably between +75° and +105°.

[0036] In a third service position of the wheelchair, as shown in Figure 5c, the battery assemblies 44a and 44b has been disconnected from the folding frame 43. Thus, the folding frame 43 has been unlocked from its unfolded position.

[0037] In a fourth service position of the wheelchair, as shown in figure 5d, the folding frame 43 has been positioned into its folded position and the curb rider 45 has been positioned in its collapsed position. Thus, the rotation axis AR2 has moved rearward relative to the chair assembly 20 while the rotation axis AR1 did not move relative to the chair assembly 20. In the preferred

embodiment shown, the folding frame 43 is also configured such that, during the transfer of the folding frame 43 from its unfolded position to its folded position, the rear and front wheels 41a, 41b, 42a, 42b always stay in contact with the ground or the horizontal H. Thus, any risk that the wheelchair tips over during this transfer is prevented. Such a feature results from the horizontal displacement of the rotation axis AR2 during the transfer of the folding frame 43.

[0038] In a fifth service position of the wheelchair, the cross bar 21c of the backrest assembly 21 has been grabbed by the user with one of his hands such that the plane P1 is relatively more tilted with regard to the ground G than in the fourth service position. In this position, the rear and front wheels 41a, 41b and 42a, 42b do not touch the ground, the wheelchair 10 rolling only on the anti-tip wheels 41f, 41g.

Claims

1. A foldable wheelchair (10) comprising:

- a chair assembly (20) comprising a seat assembly (22), in which a seat frame (22b) defines a plane P1, and a backrest assembly (21), in which a backrest frame (21b) defines a plane P2,
- a wheel assembly (40) comprising a rear wheel assembly (41) including at least two rear wheels (41a, 41b) in rotation around or defining a first rotation axis AR1, a front wheel assembly (42) including at least two front wheels (42a, 42b) in rotation around or defining a second rotation axis AR2, and a folding frame (43) connected to the rear and front wheel assemblies (41, 42), wherein said folding frame (43) is foldable along a longitudinal direction between an unfolded position and a folded position, said first rotation axis AR1 and said second rotation axis AR2 being closer in said folded position than in said unfolded position, **characterized in that**, when the folding frame (43) moves from its unfolded position to its folded position, the second rotation axis AR2 moves rearward relative to the chair assembly (20) and the first rotation axis AR1 does not move relative to the chair assembly (20), and **in that** the folding frame (43) comprises at least two parallel first rear arms, respectively left and right first rear arms (431a, 431b; 431'a, 431'b), and at least two parallel first front arms, respectively left and right first front arms (432a, 432b; 432'a, 432'b), said first rear arms, respectively said first front arms, being pivotally connected at one of their ends to a vertical rear tube (433) connected to the rear wheel assembly (41), respectively to a vertical front tube (434) connected to the front wheel assembly (42), and at their other end to a vertical central tube (435).

2. The wheelchair (10) of claim 1, wherein the folding frame (43) is configured such that the second rotation axis AR2 moves along an horizontal direction when the folding frame (43) moves from its unfolded position to its folded position.

3. The wheelchair (10) of any one of preceding claims, comprising locking means so as to lock the folding frame in its unfolded position.

4. The wheelchair (10) of claim 3, wherein said locking means comprise at least two cylindrical elements (433a, 435a; 433b, 435b; 433'a, 435'a; 433'b, 435'b) protruding respectively from the vertical rear tube (433) and the vertical central tube (435), or from the vertical front tube (434) and the vertical central tube (435), or from the vertical rear tube (433) and the vertical front tube (434), said cylindrical elements extending in the same horizontal plane in parallel lateral directions and being spaced apart in a longitudinal direction when the folding frame (43) is in its unfolded position, each cylindrical element comprising a circumferential groove (g) adapted to receive a locking plate (471) provided with two at least partially hemi-circular openings (471c, 471d) and/or recesses (471'c, 471'd), the hemi-circular portion of said openings or recesses having approximately the same radius as the circumferential groove (g) of said cylindrical elements and the distance (d2) between said two openings or recesses being equal to the distance (d1) between said two cylindrical elements when the folding frame (43) is in its unfolded position.

5. The wheelchair (10) of claim 4, wherein said locking plate (471) is an integral part of a removable battery support frame (47) accommodating a battery (46).

6. The wheelchair (10) of any one of claims 1 to 5, wherein the chair assembly (20) is pivotally connected to the wheel assembly (40) around a first pivot axis AP1 such that the chair assembly (20) is moveable between a lower position, in which the plane P1 is approximately horizontal or slightly tilted relative to the horizontal, the angle α_0 between the plane P1 and the horizontal lying preferably between -15° and +15°, and an upper position, in which the plane P1 is approximately vertical or slightly tilted relative to the vertical, the angle α between the plane P1 and the horizontal lying preferably between +75° and +105°.

7. The wheelchair (10) of claim 6, wherein the chair assembly (20) is provided with at least one first connecting hole (223a, 223b) and the wheel assembly (40) is provided with at least one corresponding first connecting hole (437a, 437b) such that the chair assembly (20) is locked in its lower position when a quick release pin is positioned both into said first

connecting hole (223a, 223b) and said corresponding first connecting hole (437a, 437b).

8. The wheelchair (10) of any one of claims 6 and 7, wherein the chair assembly (20) is provided with at least one second connecting hole (223'a, 223'b) and the wheel assembly (40) is provided with at least one corresponding second connecting hole (437'a, 437'b) such that the chair assembly (20) is locked in its upper position when a quick release pin is positioned both into said second connecting hole (223'a, 223'b) and said corresponding second connecting hole (437'a, 437'b).

9. The wheelchair (10) of any one of claims 6 to 8, wherein the chair assembly (20) is provided with two first connecting holes (223a, 223b) and the wheel assembly (40) is provided with two corresponding first connecting holes (437a, 437b) such that the chair assembly (20) is locked in its lower position when quick release pins are positioned both into said two first connecting holes (223a, 223b) and said two corresponding first connecting holes (437a, 437b), wherein said two corresponding first connecting holes (437a, 437b) of the wheel assembly (40) are disposed at each end of an upper rod (436i) of a T-shape bracket (436), said upper rod (436i) extending in a lateral direction, perpendicularly to a lower rod (436j, 436k) of said T-shape bracket (436), said lower rod (436j, 436k) being telescopically received in the central tube (435) of the folding frame (43) and being connected at its lower end to left and right, first rear and first front arms (431a, 432a, 431b, 432b) by left and right, rear and front struts (438a, 439a, 438b, 439b) respectively, said left and right, rear and front struts (438a, 439a, 438b, 439b) being pivotally connected at one of their ends to said lower rod (436j, 436k) and at their other end to left and right, first rear and first front arms (431a, 432a, 431b, 432b) respectively.

10. The wheelchair (10) of claim 9, wherein the lower rod (436j, 436k) of the T-shape bracket (436) is adjustable in length so as to adjust the position in height of the two first connecting holes (437a, 437b) of the wheel assembly (40) and so as to adjust the angle α_0 between the plane P1 and the horizontal in the lower position of the chair assembly (20).

11. The wheelchair (10) of claim 10, wherein the lower rod (436j, 436k) of the T-shape bracket (436) comprises an inner section (436j) and an outer section (436k), said inner section (436j) being telescopically received in said outer section (436k) and being provided with a plurality of threaded holes so that the position of said inner section (436j) with regard to said outer section (436k) is adjustable by modifying the screwing positions of fixing screws adapted to be received inside said threaded holes and corresponding through-holes of said outer section (436k).

12. The wheelchair (10) of any one of claims 1 to 11, wherein the front wheel assembly (42) comprises a pair of front wheels (42a, 42b), each front wheel (42a, 42b) being rotatably coupled to a fork structure (42c, 42d) pivotally connected to a front swing arm (42e), said front swing arm (42e) being pivotally connected to the folding frame (43).

13. The wheelchair (10) of any one of claims 1 to 12, wherein a curb rider (45) is pivotally connected to the folding frame (43) so as to be moveable between an extended position, in which said curb rider (45) is positioned forward the front wheels (42a, 42b), and a collapsed position, in which said curb rider (45) is positioned between the front wheels (42a, 42b).

14. The wheelchair (10) of any one of claims 1 to 13, wherein the backrest assembly (21) is pivotally connected to the seat assembly (22) around a second pivot axis AP2 between a normal position, in which the plane P2 is inclined relative to the plane P1, and a service or transport position, in which the plane P2 is parallel or approximately parallel to the plane P1.

15. The wheelchair (10) of claim 14, wherein the backrest assembly (21) comprises a U-shape cross bar (21c) disposed at least partially above and rearward the backrest frame (21b) when the plane P2 is vertical or slightly tilted relative to the vertical, for example when the angle between the plane P2 and the vertical lying between -15° and +15°, such that said U-shape cross bar (21c) can be easily seized by a user with one of his hands.

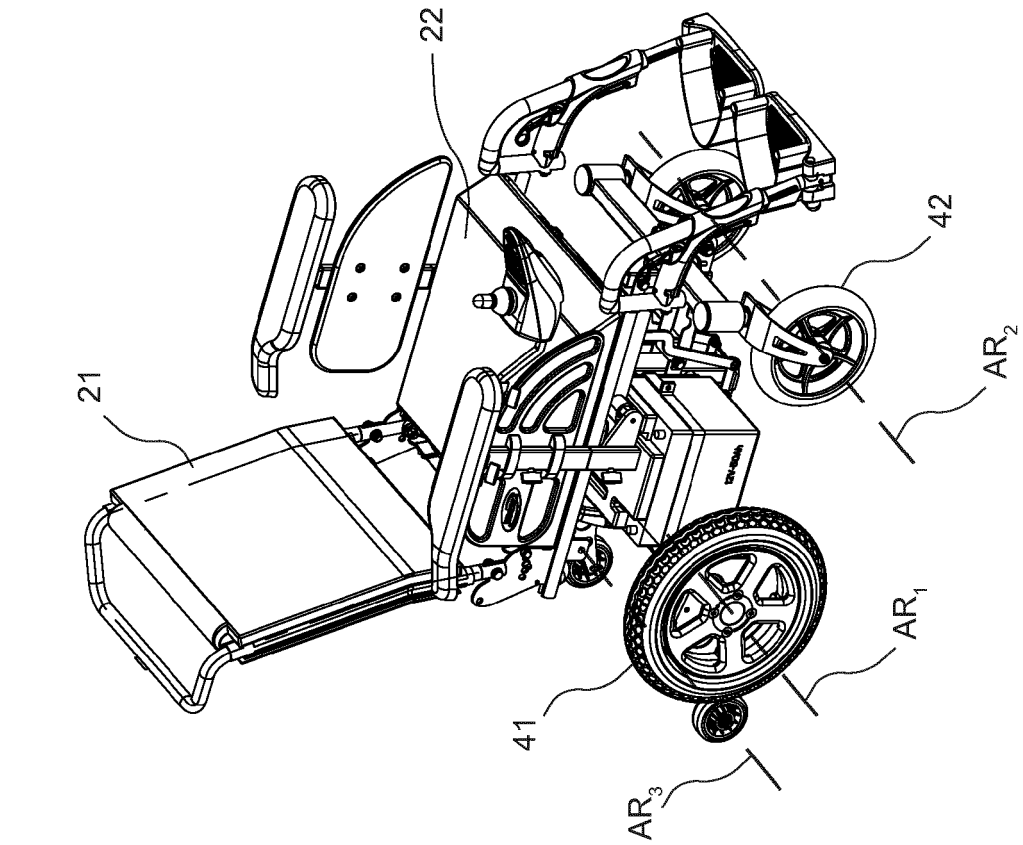


Figure 1b

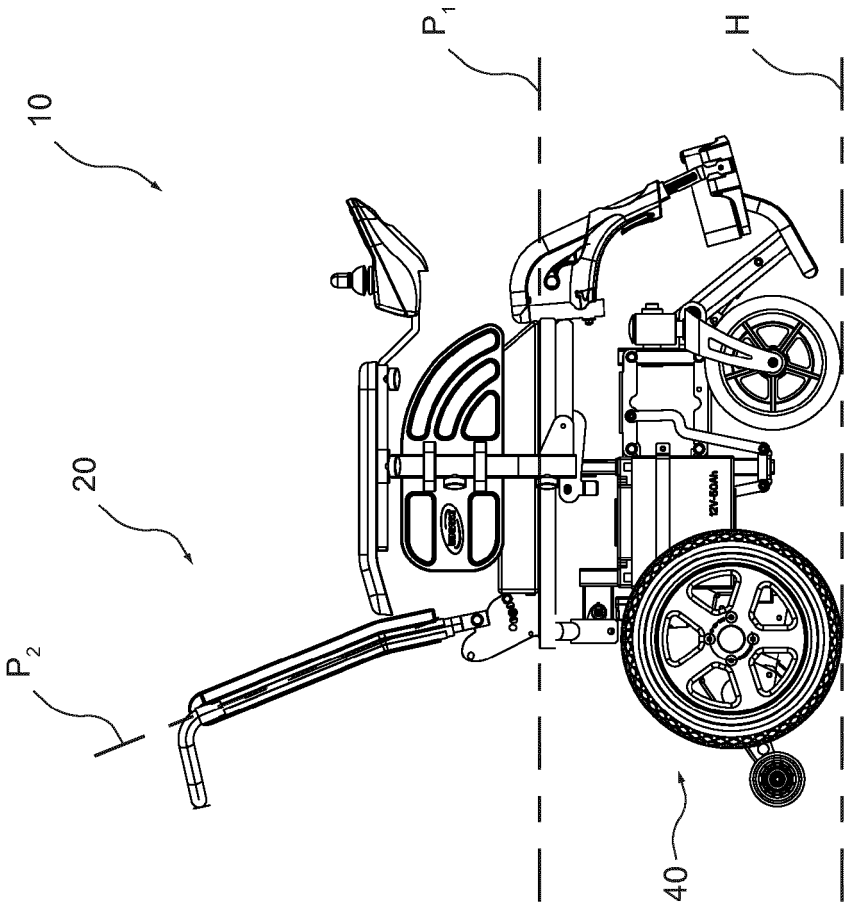


Figure 1a

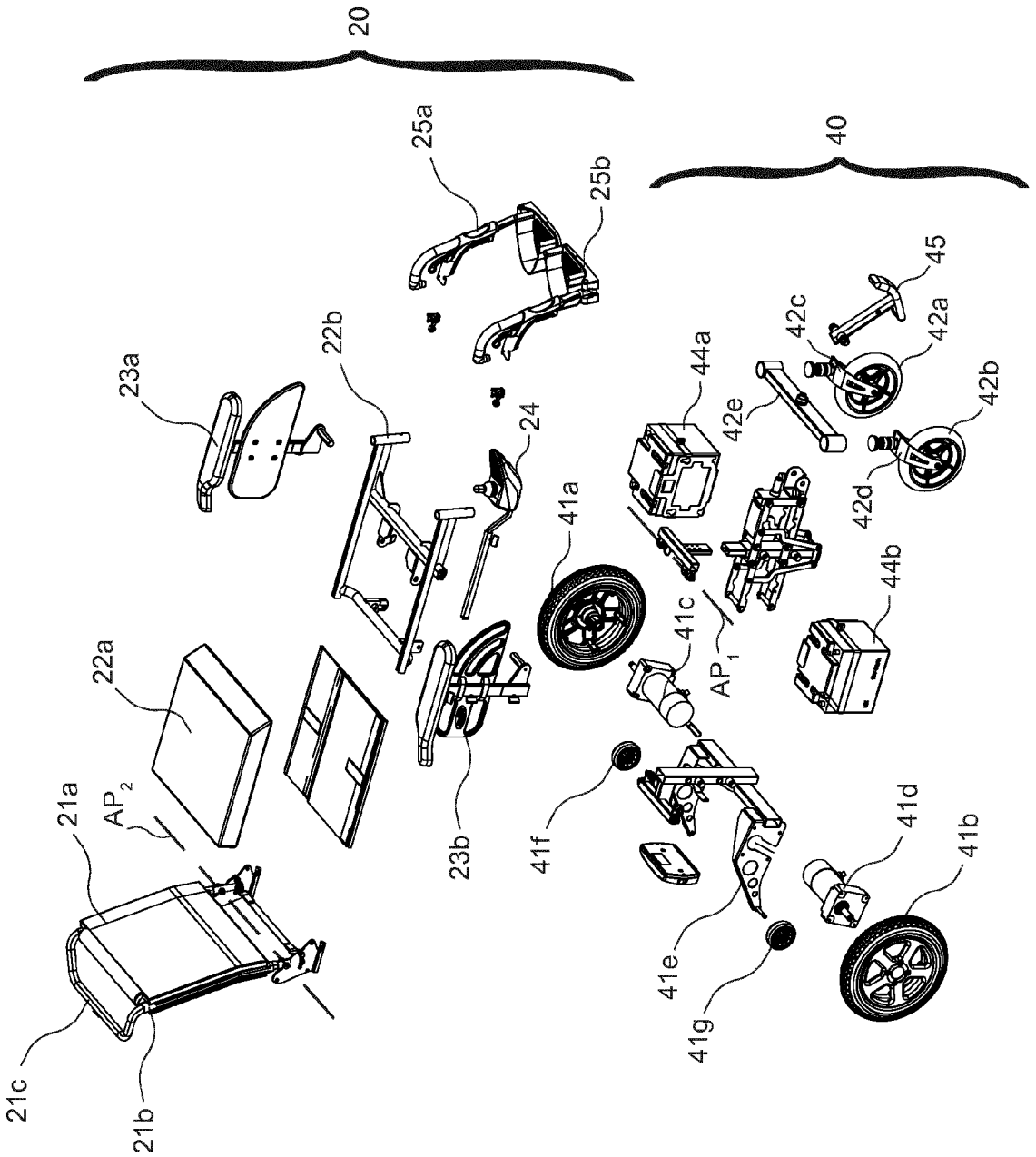

20
40
25a
25b
45
42c
42a
42b
42d
42e
44a
44b
23a
22b
24
41a
41c
AP1
22a
AP2
21a
23b
41f
41d
41b
41e
41g
21c
21b

Figure 1c

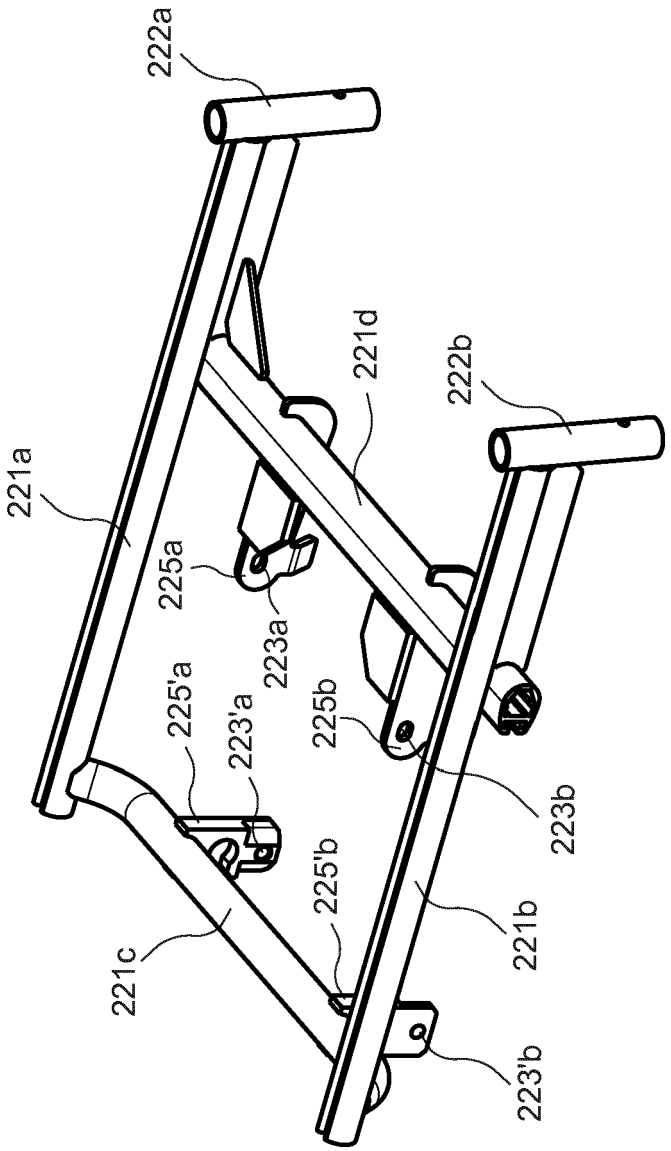

222a
221d
222b
221a
225a
223a
225'a
223'a
225b
223b
225'b
221b
221c
223'b

Figure 1d

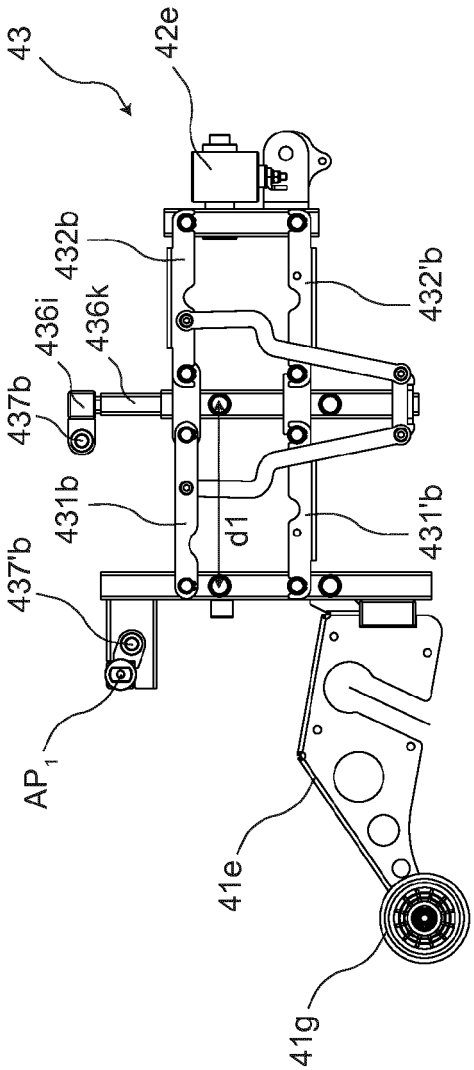


Figure 2a

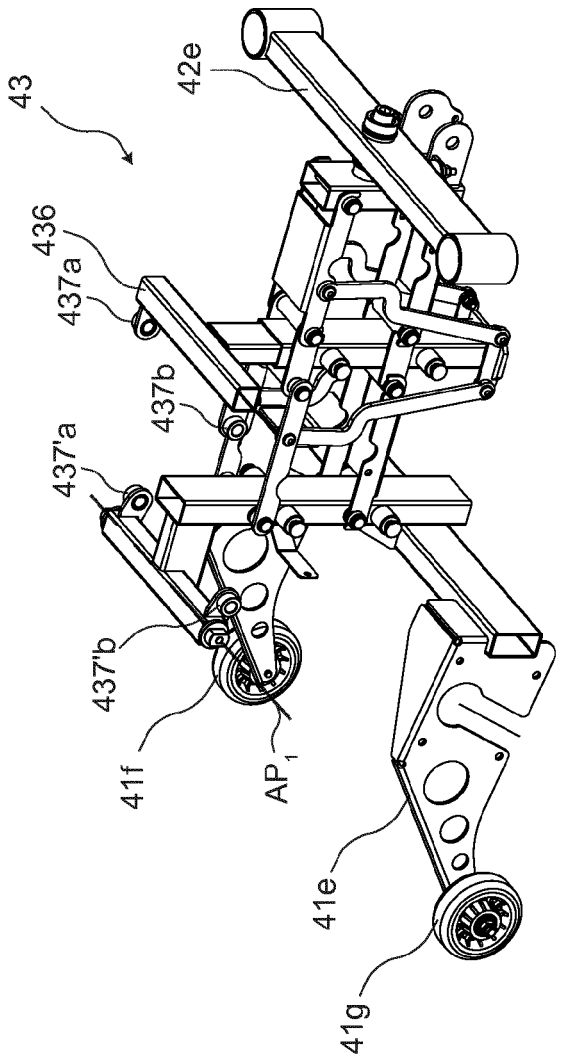
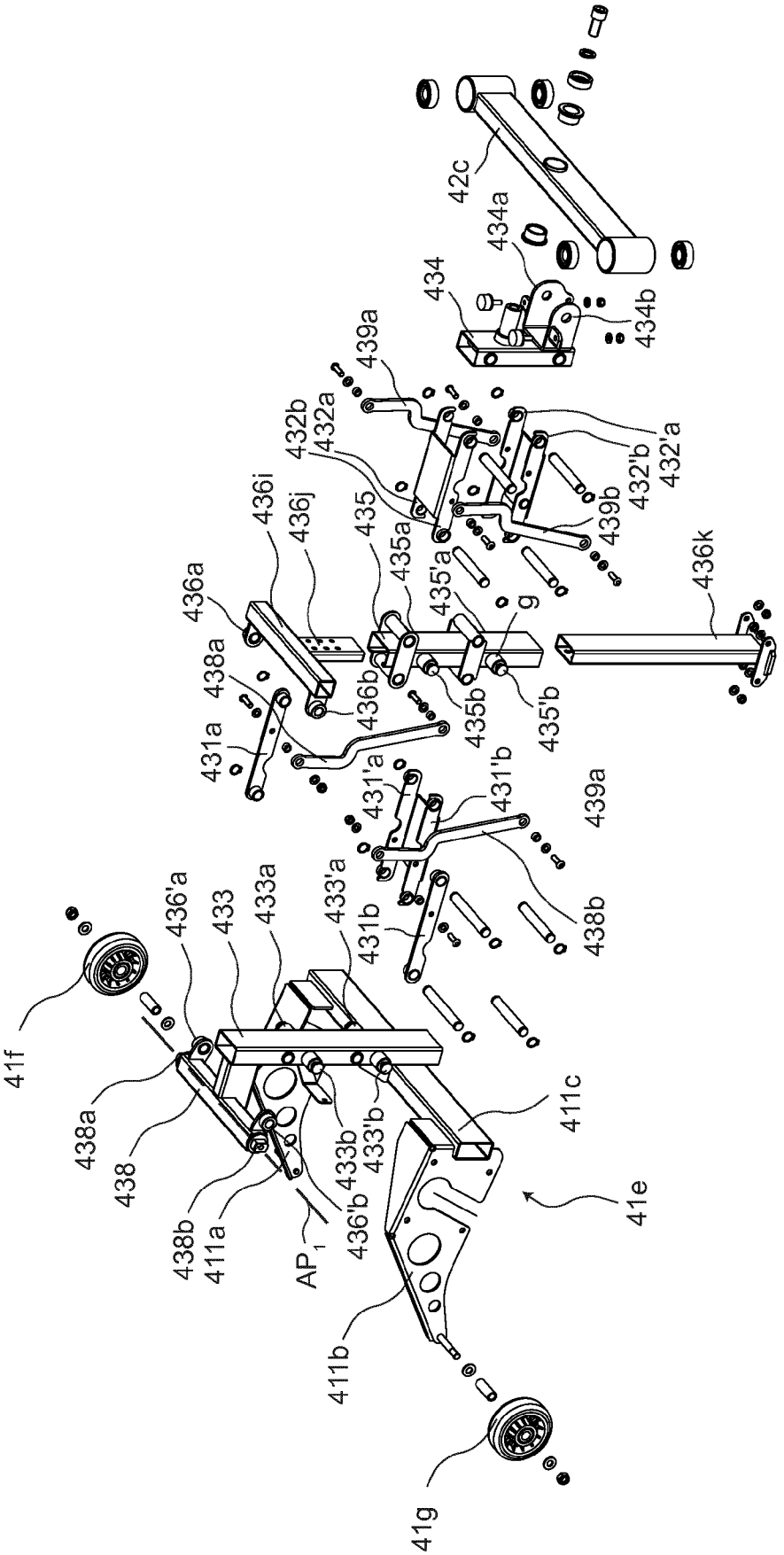


Figure 2b


42c
434a
434
434b
439a
432b
432a
432'b
432'a
436i
436j
435
435a
439b
436k
436a
435'a
g
438a
436b
435b
435'b
431a
431'a
431'b
439a
436'a
433
433a
433'a
431b
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436'b
411c
41e
411b
41g

Figure 2c

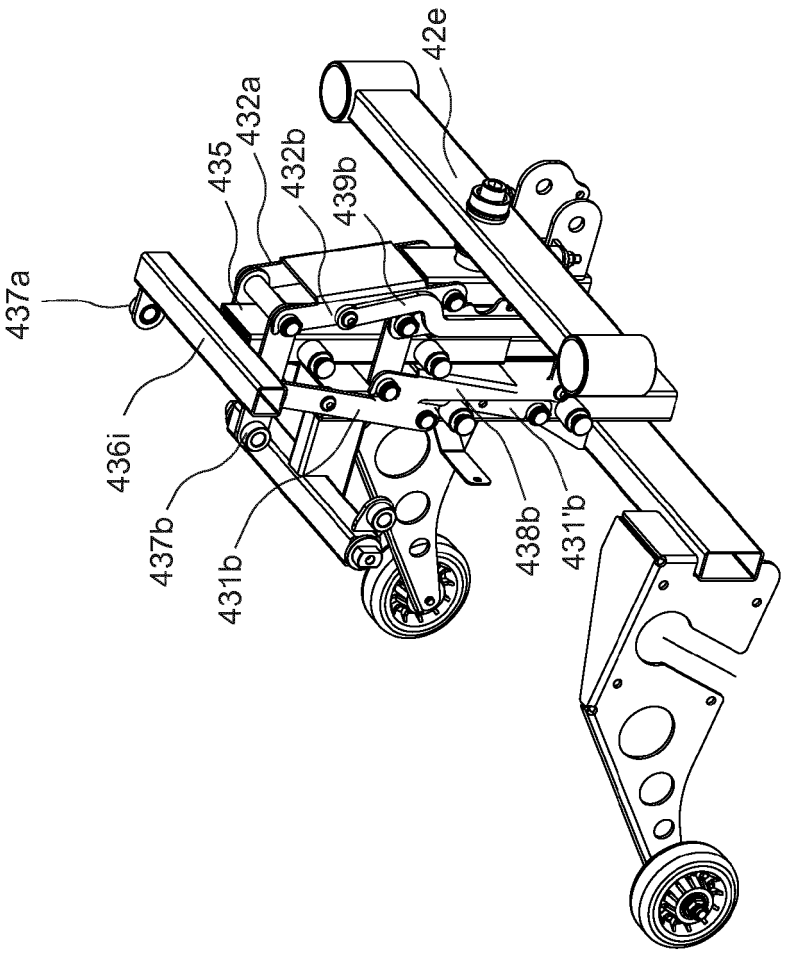

Figure 3b

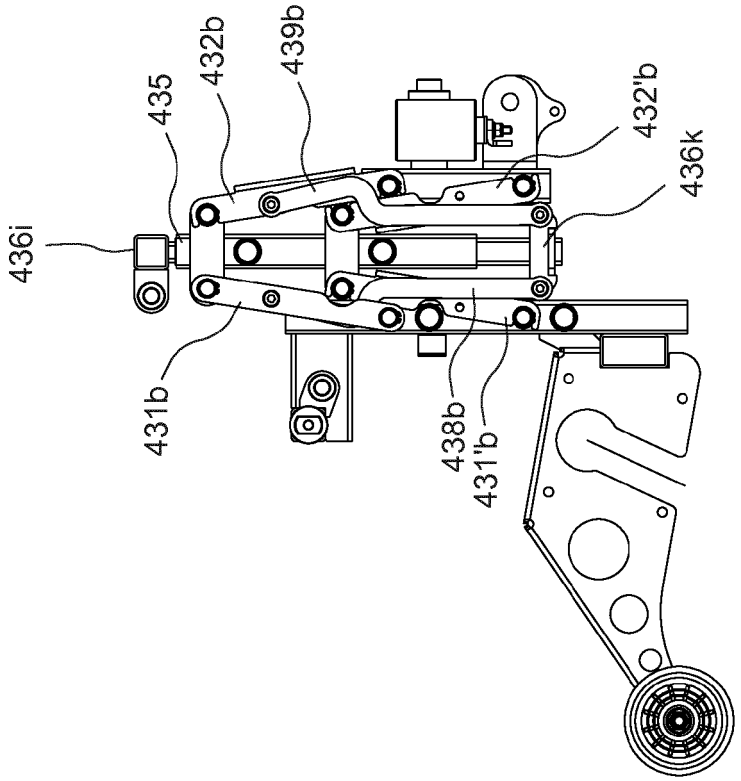

Figure 3a

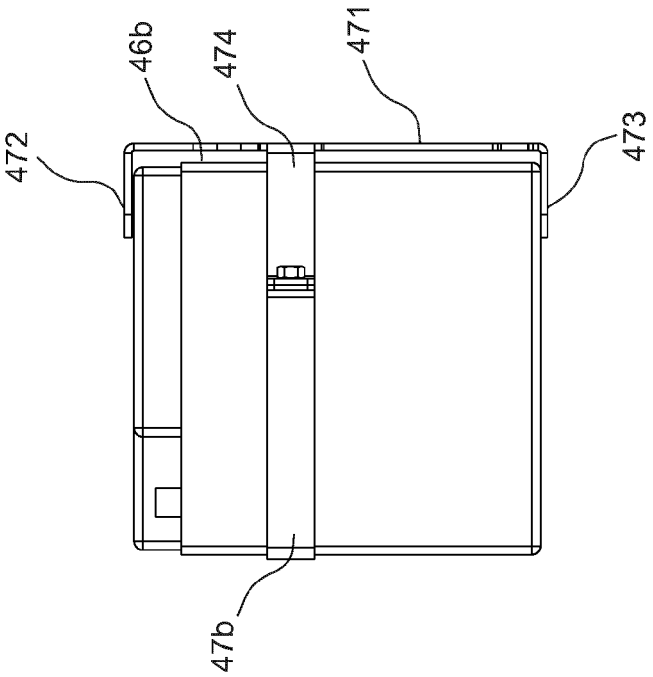

Figure 4c

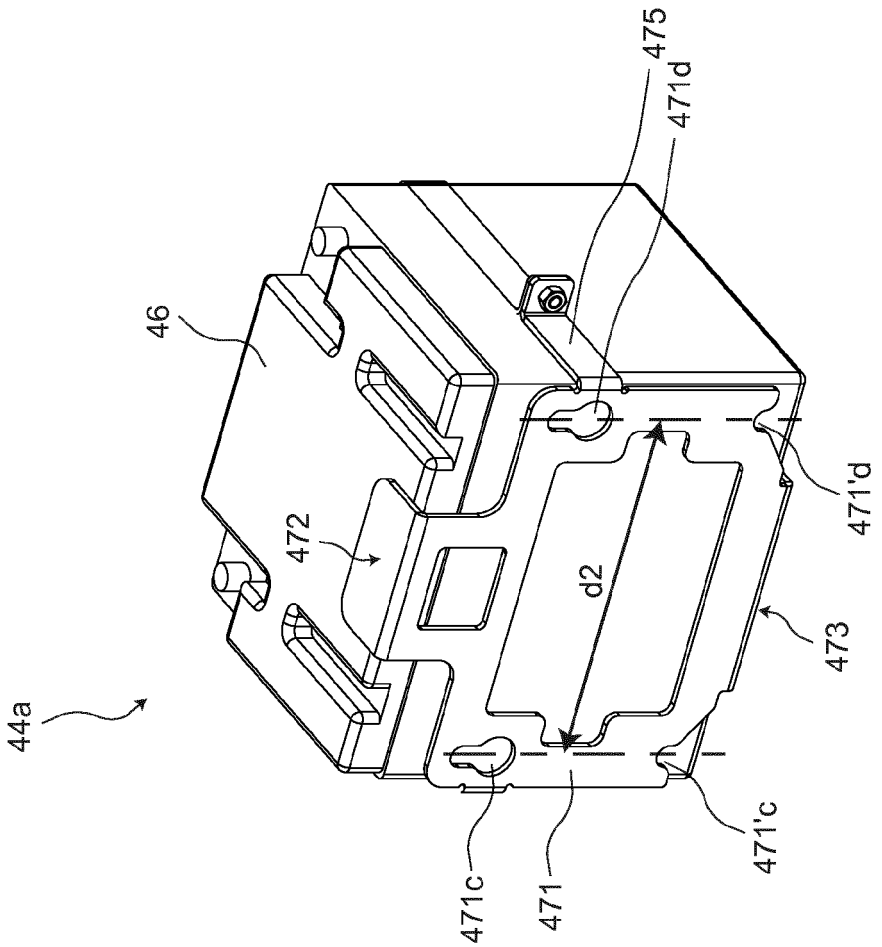

Figure 4a

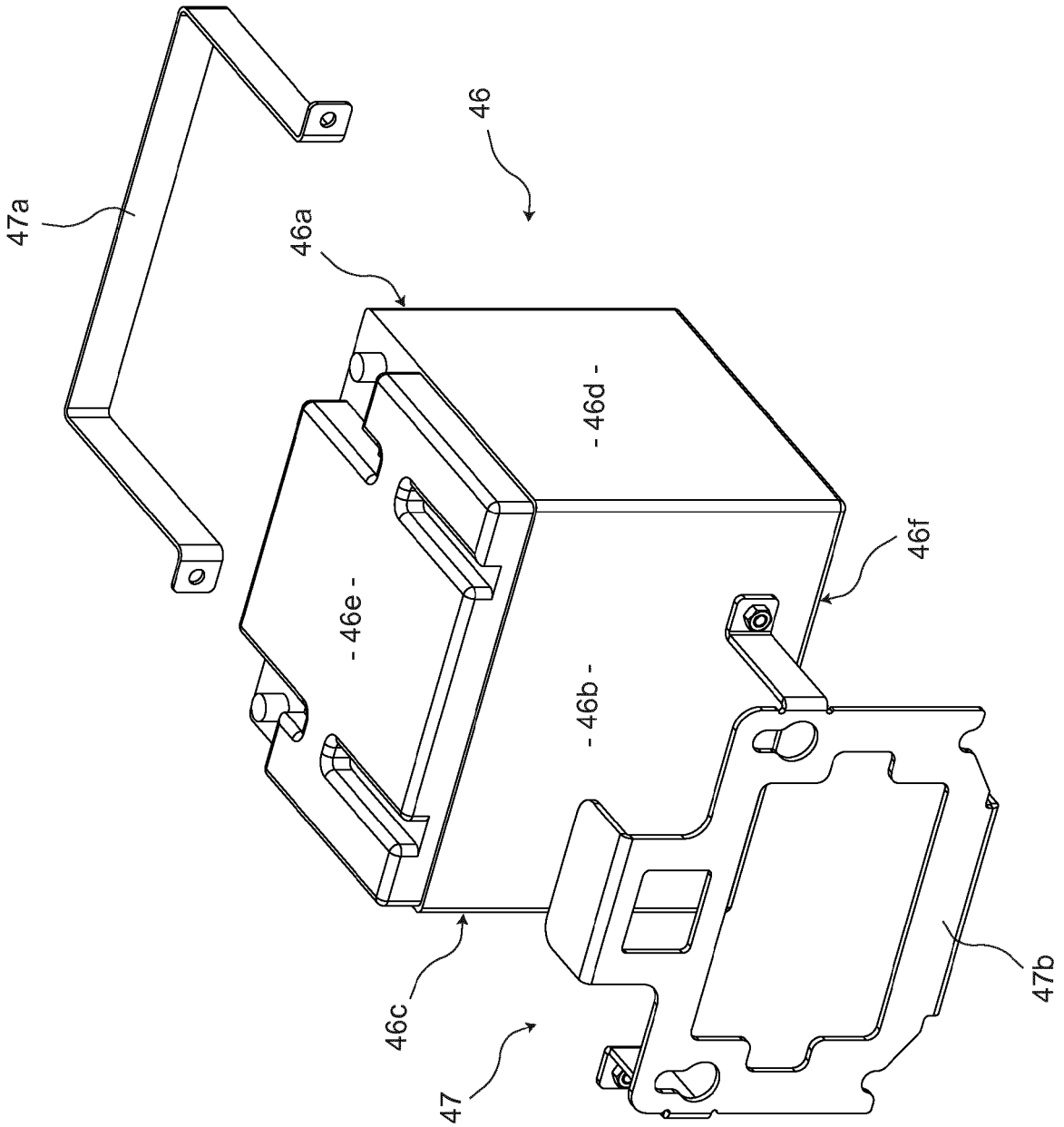

Figure 4b

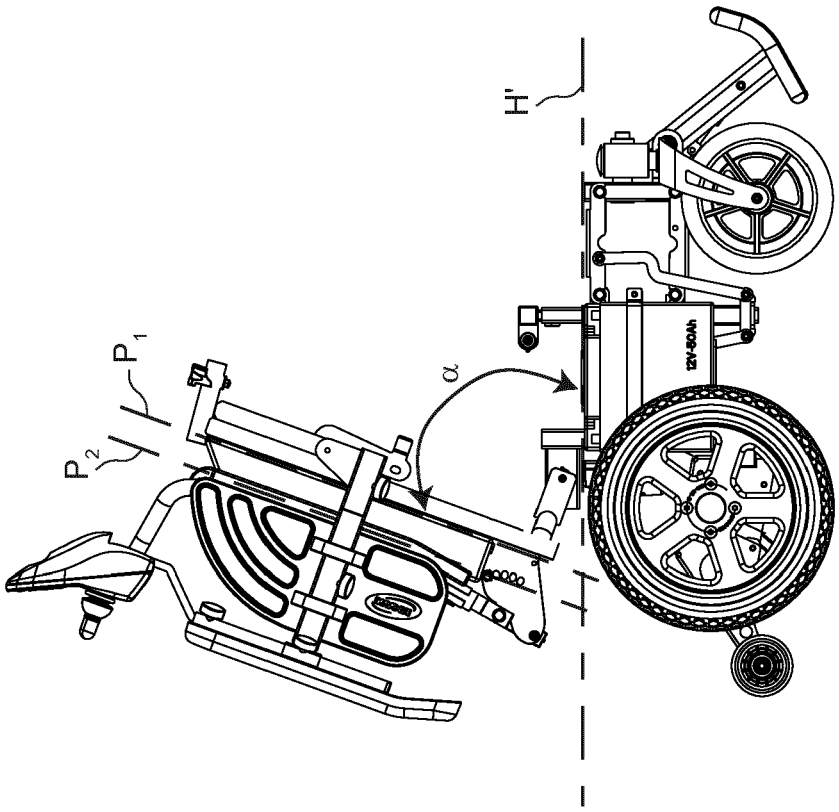

Figure 5b

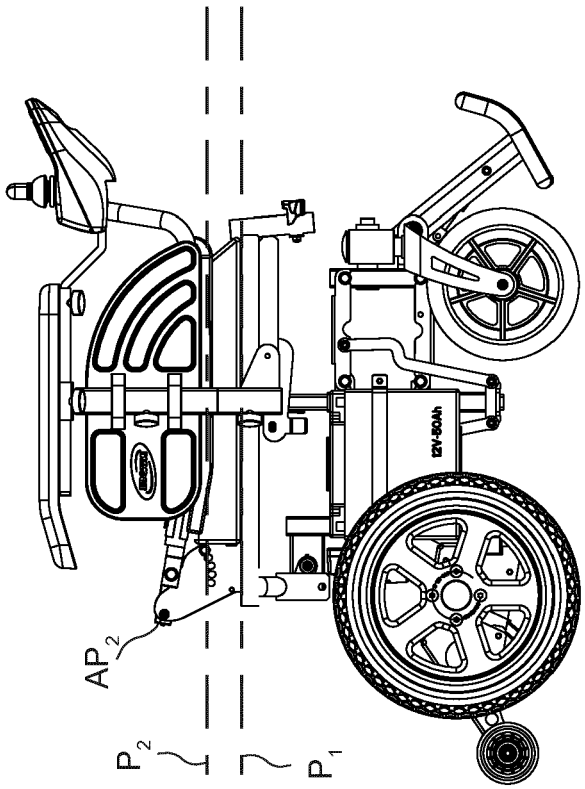

Figure 5a

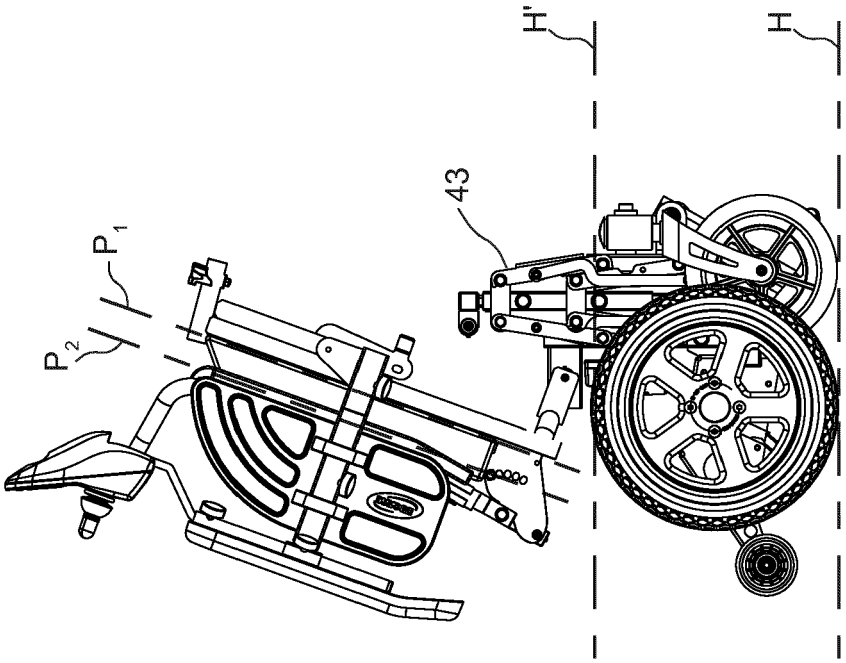

Figure 5d

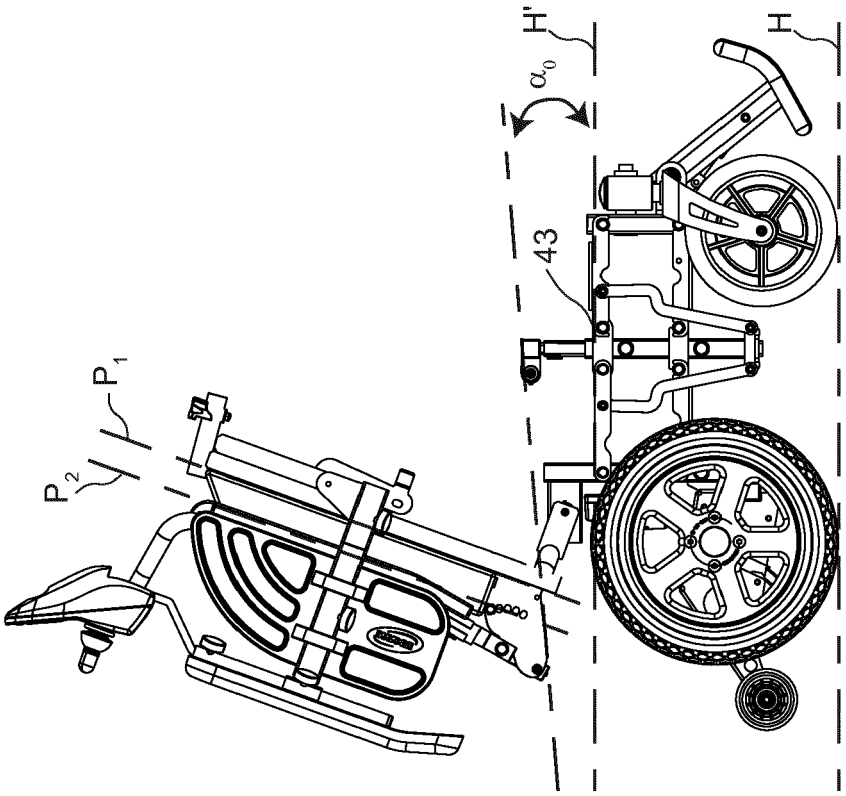

Figure 5c

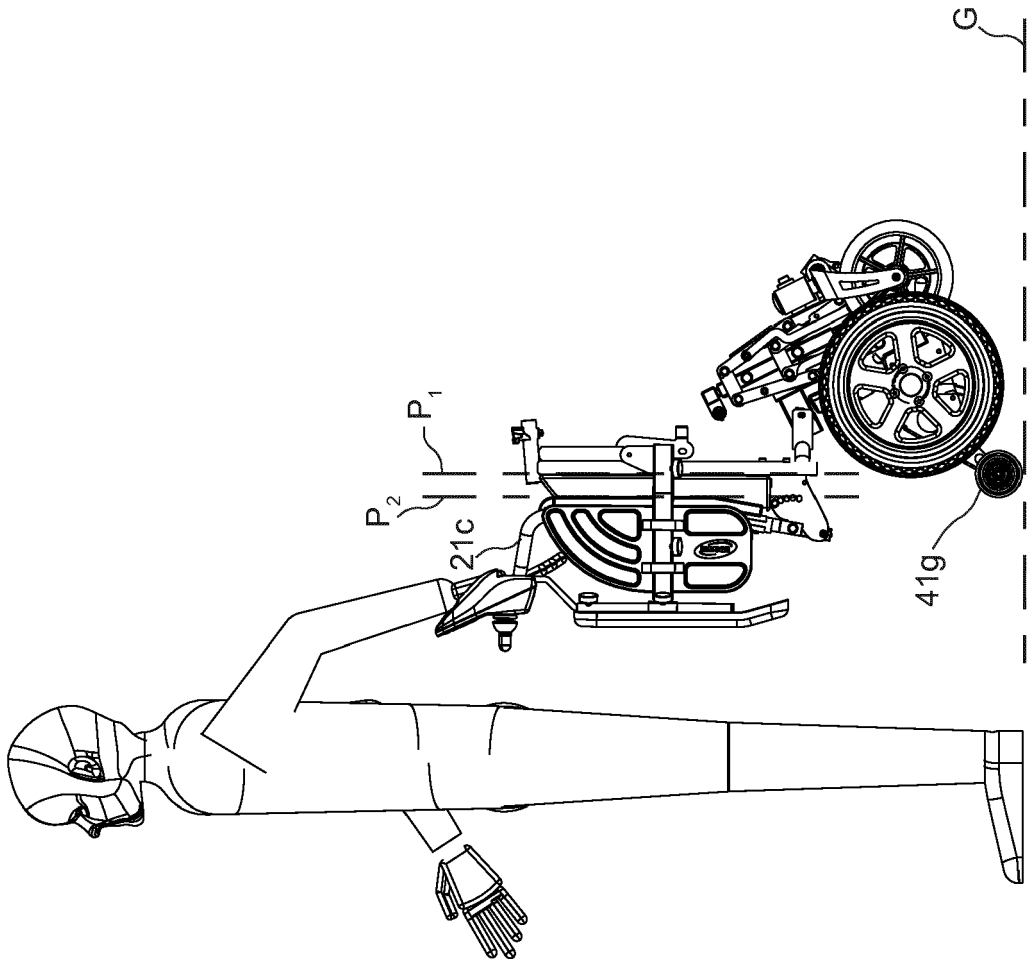

Figure 5e

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 9648

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 4 678 202 A (JENSEN TOM M [US] ET AL) 7 July 1987 (1987-07-07) * column 3, lines 1-5; figures 1,3,5,7 * * column 4, lines 7-11 * -----	1-15	INV. A61G5/08 A61G5/04
A	US 4 639 012 A (JENSEN TOM M [US]) 27 January 1987 (1987-01-27) * column 6, lines 26-29,40-44; figures 2,5 * -----	1-15	
A	US 6 135 475 A (BROWN RICHARD [US] ET AL) 24 October 2000 (2000-10-24) * figures 3,5,10,11 * -----	1-15	
A	US 2001/005073 A1 (CHOI OONG [US] ET AL) 28 June 2001 (2001-06-28) * paragraph [0039]; figures 1,8,9 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC) A61G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	5 July 2017	Gkama, Alexandra

CATEGORY OF CITED DOCUMENTS

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05-07-2017

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