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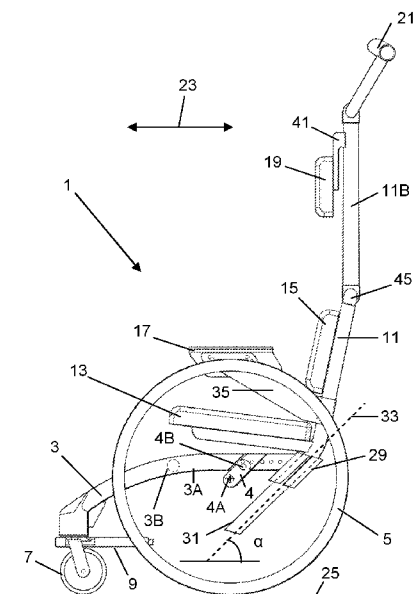
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(54) Title: ADJUSTABLE WHEELCHAIR AND METHOD FOR ADJUSTING SAID ADJUSTABLE WHEELCHAIR, AND
WHEELCHAIR ASSEMBLY

FIG 1A



(57) Abstract: The invention relates to an adjustable wheelchair comprising: -a carriage; -two rear wheels; -at least one front wheel; -at least one footrest; -a sub-frame; -a seat; and -a backrest; wherein the two rear wheels, the at least one front wheel and the at least one footrest are mounted to the carriage, such that in use the footrest is provided at a non-adjustable height level above ground, wherein the seat and the backrest are mounted to the sub-frame, wherein the sub-frame can be mounted to the carriage in a first and second mounting position relative to the carriage, wherein in the second mounting position the vertical distance of the seat with respect to the at least one footrest and the horizontal distance of the backrest with respect to the at least one footrest are larger than in the first mounting position.

Adjustable wheelchair and method for adjusting said adjustable wheelchair, and wheelchair assembly

The invention relates to an adjustable wheelchair for children. The invention further relates to a method for adjusting said wheelchair to the dimensions of a child.

5 The main challenge with wheelchairs for children is the fact that children continuously grow and thus the wheelchair continuously needs to be adjusted to the changing dimensions of a particular child in order to optimally perform its function of comfortably supporting the child.

10 An example of a prior art adjustable wheelchair is disclosed in European patent application EP1.859.764A2. In this publication a wheelchair is disclosed having a frame and mounted thereto two rear wheels, a front wheel, a footrest, a seat and a backrest, wherein the seat is mounted to the frame at a fixed height level relative to the frame. All other parameters, e.g. width, depth and height, are adjustable through telescopic matches relative to the frame.

15 The main disadvantage of known adjustable wheelchairs is that adjusting the wheelchair is a relatively complex process and requires a lot of time with no guarantee that at the end the optimal settings have been found. For instance, adjusting the wheelchair to a child may result in the child not being able to get in and out of the wheelchair itself as the footrests and/or seat are at a too high height level which does not allow the child to reach the ground by itself.

20 It is thus an object of the invention to provide an improved adjustable wheelchair for children, in particular an adjustable wheelchair which is easy to adjust to the (changing) dimensions of a particular child.

25 According to a first aspect of the invention, the object of the invention is solved by providing a wheelchair according to claim 1. The first aspect of the invention also relates to a method according to claim 13 for adjusting the wheelchair of claim 1.

30 The invention according to the first aspect is amongst others based on the insight that it is advantageous if the height level of the at least one footrest in use above ground level is substantially non-adjustable and adjustments to the wheelchair are made relative to the at

least one footrest, i.e. the vertical position of the at least one footrest relative to the carriage is non-adjustable. The advantage is that independent of the settings of the wheelchair, the clearance between the at least one footrest and the ground is substantially constant thereby providing a substantially constant step for a child to get in and out of the wheelchair.

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The invention according to the first aspect is further based on the insight that most children fall within a certain range of body proportions and that growing of a child usually means that all body parts grow while staying within the individual range of body proportions. This means that adjusting a wheelchair to a growing child usually means adjusting a lot of parameters at the same time. This insight combined with the insight that it is advantageous to adjust the wheelchair relative to the at least one footrest led to the innovative idea that the seat and backrest need to be mounted to a sub-frame that can be arranged in a first and second mounting position relative to the at least one footrest, wherein in the second mounting position the vertical distance of the seat with respect to the at least one footrest is larger than in the first mounting position, and wherein in the second mounting position the horizontal distance of the backrest with respect to the at least one footrest is larger than in the first mounting position.

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The single adjustment operation in which the sub-frame is changed from the first mounting position to the second mounting position or vice versa replaces two or even three adjustment operations in prior art wheelchairs, because in prior art wheelchairs, the horizontal distance between backrest and the at least one footrest needs to be adjusted separately from the vertical distance between seat and the at least one footrest, thereby making the adjustment easier.

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Example of prior art wheelchairs in which multiple adjustment operations are required to change the seat and backrest between the first and second mounting positions can be found in US 5,667,235 A, US 6,979,010 and WO 01/26598. In another publication, namely US 2001/011805, the seat and backrest are only adjustable by pivoting about a pivot axis at the front of the seat. The position of the pivot axis can be slightly adjusted with respect to the carriage, but this requires an additional adjustment operation.

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Another advantage may be that the wheelchair can be designed simpler and thus lighter. It is the contribution of the inventor that he acknowledges the general relationship present between the adjustment to the horizontal distance and the adjustment to the vertical distance. This has not been acknowledged until now, as current wheelchairs for children are based on wheelchairs designs for adults, where adjustments are only made to take care of

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individual size or body proportions differences and not to take growth into account. To take care of growth, prior art wheelchairs only extend the adjustment range to make the wheelchair design suitable for growing children.

- 5 It is to be noted that the invention allows additional adjustments to be carried out to optimally adapt a wheelchair to a child that may have dimensions that deviate from average body proportions. However, in such a case, an additional advantage may be that the required adjustment ranges can be made relatively small as they only have to cover a certain range around the main adjustment of the sub-frame in accordance with average body proportions.
- 10 This can be made clear by using the following example: after moving the sub-frame to set the vertical distance between seat and the at least one footrest it may be necessary to adjust the vertical distance between backrest and the at least one footrest. In the wheelchair according to the invention this is done by adjusting the vertical position of the backrest relative to the sub-frame. In the prior art wheelchairs this is done by vertically adjusting the
- 15 backrest relative to the carriage. It will be clear that in the prior art case the vertical adjustment range of the backrest also has to cover the vertical adjustment range of the seat, but that the adjustment range for a wheelchair according to the invention can be smaller because the backrest is moved along with the seat when the seat is adjusted and any additional adjustments are made relative to the seat.

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- In other words, the adjustable wheelchair is configured to allow coarse adjustments in accordance with average or expected body proportions and an average growth rate of children by simply adjusting the mounting position of the sub-frame relative to the carriage and to allow fine adjustments of individual wheelchair parts to find the optimal position or
- 25 size of that part for a particular child.

- In summary, advantages of a wheelchair according to the first aspect of the invention may be that adjustable parts are adjusted together in accordance with average body proportions and corresponding growth rates, which can lead to less adjustment operations and smaller
- 30 adjustment ranges, and that the clearance between the at least one footrest and ground is independent of the adjustments made to the wheelchair, which makes getting in and out of the wheelchair independent of the adjustments, so that once a child itself is able to get in and out of the wheelchair this ability is not affected.

- 35 In an embodiment, the ratio between the absolute difference in vertical distances of the seat relative to the at least one footrest in the first and second mounting position and the absolute difference in horizontal distances of the backrest relative to the at least one footrest

in the first and second mounting position is in the range of 0.8-1.2, preferably in the range of 0.9-1.1, and most preferably is 1.

In an embodiment, the sub-frame can be mounted to the carriage in at least one
5 intermediate mounting position, which intermediate mounting position is located in between the first and second mounting position. When adjusting a wheelchair to the size of a child, a mounting position of the sub-frame relative to the carriage will be chosen that is closest to the desired mounting position. By providing intermediate mounting positions, it is possible to get more closely to the desired mounting position of said child.

10 Fixing the sub-frame relative to the carriage in the first, second and/or intermediate mounting position can be done using well-known fixation techniques, such as a clamping connection or a pin-hole connection in which a hole in the carriage is aligned with a hole in the sub-frame and a pin is inserted to extend through the two aligned holes. Other fixation
15 known techniques may also be used.

In an embodiment, the sub-frame is slidable relative to the carriage in a sliding direction between the first and second mounting position. This can be implemented for instance by providing a sleeve on the carriage or sub-frame which is configured to slidably receive a
20 complementary tubular member of the other one of the carriage or sub-frame in the sliding direction.

In an embodiment, the sub-frame is slidable relative to the carriage in a sliding direction between the first and second mounting position, wherein the sub-frame can be fixed to the
25 carriage in any position in between the first and second mounting position by a clamping connection. This embodiment has the advantage that the sub-frame can be mounted to any desired mounting position of the sub-frame relative to the carriage, so that the wheelchair can be optimally adjusted to a child.

30 The sliding direction seen in side view of the wheelchair preferably makes an angle relative to the horizontal in the range of 40-50 degrees, more preferably in the range of 43-47 degrees, and most preferably the angle relative to the horizontal is 45 degrees.

In an embodiment, the seat and the backrest are mounted to the sub-frame, such that in use
35 the vertical position of either the seat or the backrest relative to the sub-frame is fixed, i.e. non-adjustable, and the vertical position of the other one of the seat or backrest is adjustable relative to the sub-frame, so that the height level, i.e. the vertical position, of the

'fixed' seat or backrest above the ground can only be adjusted by positioning the sub-frame and the height level, i.e. the vertical position, of said other one of the seat or backrest is adjusted by positioning the other one of the seat or backrest relative to the sub-frame. In a preferred embodiment, the vertical position of the seat relative to the sub-frame is fixed and the vertical position of the backrest is adjustable relative to the sub-frame. The fixed or non-fixed height level of the seat and/or backrest does not mean that other adjustments, such as seat depth and width, are also fixed or non-fixed. On the contrary, it is preferred that the seat is adjustable in width and seat depth and that the backrest is adjustable in width as well.

In an embodiment, the carriage is adjustable in width. The width of the carriage then defines the wheelbase of the wheelchair and indirectly defines the maximum width of the seat in between the two rear wheels and possibly also the maximum width of the backrest. Although not necessary, it is preferred that the sub-frame is also adjustable in width direction along with the carriage as this makes it possible to make the connection between carriage and sub-frame independent of the width.

The width adjustment of the carriage and/or sub-frame is preferably implemented by telescopic matches.

In an embodiment, the wheelchair further comprises at least one armrest which is mounted to the sub-frame so as to be adjustable along with the sub-frame.

An armrest typically comprises a support surface on which an arm of a person can rest. The armrest may be mounted to the sub-frame via an armrest frame member. To adjust the position the support surface of the armrest relative to the sub-frame or armrest frame member, the armrest is preferably mountable to the sub-frame or armrest frame member in a first armrest mounting position relative to the sub-frame or armrest frame member and a second armrest mounting position relative to the sub-frame or armrest frame member, wherein in the second armrest mounting position, the vertical distance between the armrest and the seat and the horizontal distance between the armrest and the backrest are preferably larger than in the first armrest mounting position. As with the sub-frame, this allows to use a single adjustment operation of the support surface carrying portion to adjust both the aforementioned vertical and horizontal distances to respectively the seat and backrest in accordance with body proportions and growth rates.

Individual deviations from the average body proportions and growth rates can be compensated for by introducing an additional adjustment possibility in a direction different from a direction defined by the first and second armrest mounting position as described above. For instance, when using an armrest frame member to mount the armrest to the sub-
5 frame, the armrest frame member may be adjustable relative to the sub-frame, e.g. in a vertical or horizontal direction only.

In an embodiment, the armrest can be mounted to the sub-frame or armrest frame member in at least one intermediate armrest mounting position, which intermediate armrest mounting
10 position is located in between the first and second armrest mounting positions. When adjusting a wheelchair to the size of a child, a mounting position of the armrest relative to the sub-frame will be chosen that is closest to the desired armrest mounting position. By providing intermediate armrest mounting positions, it is possible to get more closely to the desired armrest mounting position of said child.

15 Fixating the armrest relative to the sub-frame or the armrest frame member in the first, second and/or intermediate armrest mounting position can be done using well-known mounting techniques, such as a clamping connection or a pin-hole connection in which a hole in the sub-frame or armrest frame member is aligned with a hole in the armrest and a
20 pin is inserted to extend through the two aligned holes.

In an embodiment, the armrest is slidable relative to the sub-frame or armrest frame member in an armrest sliding direction between the first and second armrest mounting position. This may be implemented by providing a slot and pin guiding arrangement, wherein e.g. the
25 armrest is provided with a pin that is slidably received in a slot provided on the sub-frame or armrest frame member.

In an embodiment, the armrest is slidable relative to the sub-frame or armrest frame member in an armrest sliding direction between the first and second armrest mounting position,
30 wherein the armrest can be fixed to the sub-frame or armrest frame member in any position in between the first and second armrest mounting position by a clamping connection. This embodiment has the advantage that the armrest can be mounted to any desired armrest mounting position of the armrest relative to the sub-frame or armrest frame member, so that the wheelchair can be optimally adjusted to a child.

In a preferred embodiment, the wheelchair comprises two armrests, i.e. an armrest per arm, wherein the abovementioned features relating to the at least armrest can be applied to each armrest.

- 5 In a preferred embodiment, the wheelchair comprises two footrests, i.e. a footrest per foot.

The footrests may be moveable between an operative orientation in which the footrests are able to support the feet, and an inoperative orientation in which a user of the wheelchair is able to reach the ground in order to get in or out of the wheelchair. This may be
10 implemented by providing footrests that are rotatable about a horizontal rotation axis extending in a normal traveling direction of the wheelchair, wherein in the operative orientation of the footrests the footrests are oriented in a substantially horizontal manner to provide a horizontal support surface for the feet, and wherein in the inoperative orientation of the footrests the footrests are oriented in a substantially vertical manner, thereby creating
15 space for the feet to reach the ground.

In an embodiment, the footrests may be lockable in both the operative and inoperative orientation, wherein the footrests are preferably moved from the operative to the inoperative orientation by unlocking of the footrests, subsequently putting weight on the footrests to
20 rotate the footrests to the inoperative orientation, and locking the footrests when the inoperative orientation is reached, which locking is preferably done automatically.

In an embodiment, the footrests are each provided with a spring that urges the respective footrest to the operative orientation, so that moving the footrests from the inoperative
25 orientation to the operative orientation only requires unlocking of the footrests, after which the footrests are preferably automatically locked when the operative orientation is reached.

In an embodiment, the wheelchair comprises a headrest mounted to the sub-frame. The headrest is preferably adjustable in height relative to the sub-frame, so that the headrest can
30 be placed at the height of the head of a child. In other words, the vertical position of the headrest relative to the sub-frame is adjustable.

The headrest may be mounted to a moveable portion of the sub-frame, which portion is configured to be moveable between a position in which the headrest is able to perform its
35 function, and a position in which the headrest is in an inoperative position, e.g. a storage position.

The wheelchair may also be provided with a push handle, allowing another person behind the wheelchair to drive and steer the wheelchair. This push handle is preferably attached to the portion supporting the headrest.

5 In an embodiment, the headrest is mounted to the sub-frame via a headrest frame member. The headrest frame member may be mountable to the sub-frame at a location that is off centre of the adjustment range of the headrest relative to the headrest frame member. The adjustment range of the headrest can then be extended if the headrest frame member is also able to be mounted to the sub-frame in an upside down orientation.

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In an embodiment, the carriage is configured to be used with different sized rear wheels, because when the sub-frame is adjusted relative to the carriage, the situation may arise that the child is no longer able to comfortably reach the rear wheels to manually drive and steer the wheelchair.

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It is noted here that although the wheelchair may be manually drivable and steerable, this does not exclude the possibility for additional driving and steering possibilities as for instance described above with respect to the push handle allowing another person to drive and steer the wheelchair.

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In an embodiment, the carriage is configured to allow the mounting of different sized rear wheels to the carriage without affecting the orientation or position of the carriage which may result from the difference in location of the rotation axis inherent to a different sized rear wheel. This can be implemented by providing multiple mounting positions on the carriage
25 each mounting position corresponding to a specific rear wheel size.

It may also occur that adjusting the position of the sub-frame relative to the carriage results in a change in horizontal position of the center of gravity relative to the rear wheels with the risk of easily tipping backwards during use. In such cases it may be beneficial if the
30 mounting position of the rear wheels relative to the carriage in the horizontal direction can be adjusted. This may be implemented by mounting the rear wheels to the carriage using a mounting member which can be mounted to the carriage at different horizontal positions relative to the carriage. It is then preferred that the multiple mounting position for use with different sized rear wheels are provided on the mounting member.

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The invention also relates to a method to adjust an adjustable wheelchair according to the invention to the size of a child, said method comprising the following steps:

- providing a wheelchair according to the invention;
 - mounting the sub-frame to the carriage in the first mounting position or second mounting position based on which mounting position provides the best vertical distance between seat and the at least one footrest and the best horizontal distance
- 5 between backrest and the at least one footrest;

In an embodiment, the method also comprises one or more of the following steps after the step of mounting the sub-frame to the carriage:

- adjusting the seat width and/or the seat depth;
- 10 - adjusting the vertical position of the backrest relative to the sub-frame;
- adjusting the width of the backrest;
 - adjusting the width of the carriage and/or sub-frame;
 - adjusting the vertical position of a headrest, which is mounted to the sub-frame, relative to the sub-frame;
- 15 - adjusting the position of an armrest relative to the sub-frame;
- changing the size of the rear wheels;

The abovementioned wheelchair according to the first aspect of the invention is preferably configured for a predefined size range of children, as it may be difficult to configure the

20 wheelchair to be adjustable to all possible sizes of children.

In order to substantially cover the entire possible size range of children, different wheelchairs may be provided where each wheelchair is configured for a specific size range of children that only partially overlaps with an adjacent specific size range of a respective

25 wheelchair, and wherein preferably the combined specific size ranges substantially cover the size ranges from 4-16 year old children.

However, specific problems may occur when the wheelchairs are used by children having body proportions outside the average body proportion range or when a child grows out of a

30 small wheelchair and needs a larger wheelchair. It is then possible that the end of an adjustment range of a particular part is reached, but others are still sufficient.

One or more of these problems may be solved by an assembly according to a second aspect of the invention, in which a first set of parts of a first wheelchair according to the

35 invention is provided, and in which a second set of parts of a second wheelchair according to the invention is provided, said first wheelchair being associated with a first size range of children and said second wheelchair being associated with second size range of children,

wherein the first size range and the second size range only partially overlap, and wherein the parts of the first and second set of parts are configured to be exchangeable with respect to each other, so that a particular dimension of the first or second wheelchair can be adapted to the size of the child using a respective part of the set of parts associated with the other one of the first or second wheelchair. For example, the first wheelchair may be assembled using a carriage of the second set of parts in order to more easily adjust the first wheelchair to a larger upper leg dimension than average. Or the second wheelchair may be assembled using a seat of the first set of parts in order to more easily adjust the second wheelchair to a smaller required seat depth. As will be apparent to the person skilled in the art of wheelchairs for children, this provides many adjustment possibilities using minimal parts.

In an embodiment, this is implemented by configuring each part of the first and second set of parts, such that a part of the first set of parts has one or more general portions and one or more specific portions, wherein the corresponding part of the second set of parts has the same one or more general portions and different one or more specific portions. The general portions are preferably at least the portions of a part that has to cooperate with other parts, such as the connection portions.

In an embodiment, the assembly comprises a third set of parts to form a third wheelchair according to the invention, said third wheelchair being associated with a third size range of children, wherein the third size range only partially overlaps with either the first or second size range of children. The parts of the third set of parts are at least exchangeable with corresponding parts of the set of parts associated with the size range of children with which the third size range overlaps.

By exchanging parts between wheelchairs corresponding to adjacent size ranges, hybrid wheelchairs can be formed which comprise parts of different sets of parts. The advantage is that it should always be possible to form a hybrid wheelchair that can be optimized to a particular child.

The invention will now be described in a non-limiting way with reference to the accompanying drawings, in which like parts are indicated by like reference symbols, and in which:

Fig. 1A depicts a side view of a wheelchair according to an embodiment of the invention in its smallest configuration;

Fig. 1B depicts a front view of the wheelchair of Fig. 1A in its smallest configuration;

Fig. 2A depicts a side view of the wheelchair of Fig. 1A in its biggest configuration;

5 Fig. 2B depicts a front view of the wheelchair of Fig. 1A in its biggest configuration.

Fig. 3A depicts in one view the side view of Fig. 1A in solid lines and the side view of Fig. 2A in dashed lines for comparison;

10 Fig. 3B depicts in one view the front view of Fig. 1B in solid lines and the front view of Fig. 2B in dashed lines for comparison;

Fig. 4A depicts the adjustability of some parts of the wheelchair of Fig. 1A in side view;

Fig. 4B depicts the adjustability of some parts of the wheelchair of Fig. 1A in front view;

15 Fig. 5A depicts the wheelchair of Fig. 1A with different sized rear wheels in a single side view;

Fig. 5B depicts the wheelchair of Fig. 1A with different sized rear wheels in a single front view;

20 Fig. 6 depicts in side view the adjustability of the wheelchair of Fig. 1A to a changing center of gravity.

Fig. 7A depicts a side view of a wheelchair according to another embodiment of the invention which view is similar to Fig. 1A; and

Fig. 7B depicts in side view the adjustability of the wheelchair of Fig. 7A to a changing center of gravity, which view is similar to Fig. 6.

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Fig. 1A, 1B, 2A, 2B, 3A, 3B, 4A, 4B, 5A, 5B and 6 all relate to the same adjustable wheelchair 1, in particular to the same adjustable manually drivable wheelchair 1 according to an exemplary embodiment of the invention.

30 The adjustable wheelchair 1 comprises a carriage 3, two rear wheels 5, two front wheels 7, two footrests 9, a sub-frame 11, a seat 13, a backrest 15, two armrests 17, a headrest 19, and a push handle 21.

35 The two rear wheels 5, the two front wheels 7 and the two footrests 9 are mounted to the carriage 3. The footrests are mounted to the carriage such that in normal operative use the height level of the footrests, i.e. the vertical position of the footrests relative to the carriage 3, is substantially fixed, i.e. non-adjustable, which means that without adding, replacing or

omitting parts of the wheelchair it is not possible to adjust the height level of the footrests relative to the carriage. This leaves the option open that the footrests are adjustable in other directions, e.g. a normal driving direction 23, to optimally position the footrests in said directions.

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The rear wheels 5 and the front wheels 7 stably support the carriage 3 from a ground 25.

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The carriage 3 is in this embodiment formed by two elongated members 3a extending substantially in the driving direction 23, which members 3a are interconnected by a cross member 3b, see Fig. 1A and 1B. The cross member 3b may be formed by two telescopic matches each connected to a respective elongated member to allow an adjustment in the width direction 27. The width of the wheelchair may be fixed by fixating the two telescopic matches with respect to each other. However, as in this embodiment, the cross member may also be formed by two extensions 3c, each extending in width direction from a respective elongated member 3a, which are telescopically connected by a sleeve member 3d.

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The telescopic arrangement allows the wheelchair to be adjusted in the width direction 27, which width can be fixed by fixation of the sleeve member 3d with respect to both extensions 3c. This can be seen in Fig. 2B in which the wheelchair is shown having a different width than e.g. in Fig. 1B due to the telescopic extension of cross member 3b.

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Referring back to Fig. 1A and 1B, the elongated members 3a extend from the front wheels 7 to the back of the wheelchair and end with a sleeve shaped clamp 29 to slidably receive a respective tubular-shaped sub-frame member 31 in a sliding direction 33.

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The position of the sub-frame member 31 relative to the carriage 3 can be fixed by a clamping action of the sleeve clamp 29 on the sub-frame member 31. In Fig. 1A and 1B, the sub-frame 11 is shown in a first mounting position relative to the carriage 3, where Fig. 2A and 2B show the same wheelchair with the sub-frame 11 in a second mounting position relative to the carriage 3. Due to the slidable configuration in combination with the clamping action, any position in between the first and second mounting position can serve as an intermediate mounting position for the sub-frame 11 relative to the carriage 3. Alternatives may include connection types that only define discrete intermediate mounting positions, such as a pin-hole connection type instead of clamping, where the number of mounting positions will usually determined by the amount of holes and/or pins.

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The guiding configuration of clamp 29 and sub-frame member 31 define a sliding direction 33 in between the first and second mounting position of the sub-frame seen in side view. All intermediate mounting positions possible lie on the trajectory defined by the sliding direction between the first and second mounting position. In this embodiment, the sliding direction makes an angle α with the horizontal of about 45 degrees. However, other embodiments may use angles in the range of 43 to 47 degrees or even in the range of 40 to 50 degrees.

In a practical embodiment, the wheelchair will probably be designed for a certain age range, wherein the angle α is preferably equal to the average growth rate associated with said age range. Angle α is for instance determined by the ratio between the growth rate of the lower leg and the growth rate of the upper leg.

The advantage of the wheelchair according to this embodiment of the invention is that the changing from the first mounting position to the second mounting position is carried out by a single adjustment operation here embodied by sliding from the first to the second mounting position or vice versa.

The rear wheels 5 are mounted to the carriage 3 via mounting members 4. Mounting member 4 defines two rotation axes for the rear wheels, wherein each rotation axis corresponds to a predefined rear wheel size. In the first mounting position of the sub-frame relative to the carriage, a relatively small sized rear wheel can be used, which is mounted to the mounting member to be rotatable about rotation axis 4a as shown in Figs. 1A, 1B, Fig. 4A, Fig. 4B and Fig. 6.

When the sub-frame is, starting from the first mounting position, moved towards the second mounting position, there comes a point where it becomes difficult for the child to reach the rear wheels for manually driving the wheelchair. This can be solved by providing larger rear wheels 5A as shown in Figs. 5A and 5B. However, in case no measures are taken, the larger wheels would lift the entire rear end of the wheelchair due to a higher rotation axis. This can be avoided by using rotation axis 4B of mounting member 4.

Further moving the sub-frame towards the second mounting position will result in the rear wheels 5A becoming too small, which can be solved by providing larger rear wheels 5B. However, in the shown orientation of mounting member 4 in e.g. Figs. 1A and 1B, mounting member 4 does not provide for a further rotation axis. This is solved by configuring mounting member 4 and carriage 3 such that mounting member 4 can be rotated 180 degrees about a

substantially horizontal axis extending in width direction 27 and can be mounted in that orientation to carriage 3 as is shown in dashed lines in Fig. 5A, but which can also be seen in Fig. 2A and 2B. Mounting member 4 is then mounted upside down to carriage 3 so that rear wheels 5B can be rotatably mounted about rotation axis 4B' without influencing the orientation of the carriage. In the same manner even larger rear wheels 5C can be mounted to the carriage to be rotatable about rotation axis 4A'. Hence, by a simple design of mounting member 4 and carriage 3, different sized rear wheels can be mounted to the carriage without influencing the orientation of the carriage.

10 It is to be noted that the available rotation axes 4A, 4B, 4B' and 4A' lie on a line extending parallel to the sliding direction 33 seen in side view, so as to compensate for the changing center of gravity of the wheelchair due to the adjustment of the sub-frame 11 relative to the carriage 3.

15 Although only four different sized rear wheels are shown, it will be apparent to the person skilled in the art that any number of different rear wheels and any size of said rear wheels can be used. It is only required that mounting member 4 is adapted to, i.e. specially designed for, the different sizes used for the rear wheels.

20 In case the horizontal position of the center of gravity of the wheelchair relative to the rear wheels is changing without requiring a different sized rear wheel, the horizontal position of the respective rotation axis of the wheelchair can be adjusted by adjusting the horizontal mounting position of the mounting member 4 relative to the carriage 3 as shown in Fig. 6. The mounting member 4 is shown in solid lines in a front mounting position and in dashed
25 lines in a rear mounting position, wherein the rear wheels 5 are positioned more to the rear relative to the carriage in the rear mounting position.

Due to the fact that the rotation axis of the rear wheels can be positioned in a horizontal direction relative to the carriage, it is possible to position the rotation axis relative to the center of gravity of the wheelchair, possibly including child, so that the driving performance, e.g. the tipping point for backward stability, can be made substantially constant.

The armrests 17 are mountable to the sub-frame 11 via respective armrest frame members 35. The armrest frame members can be mounted to the sub-frame at different vertical
35 positions relative to the sub-frame as can be seen by comparing Fig. 1A and Fig. 2A. In addition to this adjustment possibility, the armrests 17 can be adjusted relative to their respective armrest frame member 35 between a first armrest mounting position as shown in

Fig. 1A and 1B and a second armrest mounting position as shown in Fig. 2A and 2B. each armrest 17 is provided with two parallel slots 39 (see the dashed wheelchair in Fig. 3A which corresponds to the configuration of Fig. 2A), defining an armrest sliding direction 37. The respective armrest frame members are provided with corresponding pins 38 to be received
5 in the respective slots 39. This allows each armrest 37 to take any position in between the first and second armrest mounting positions. The armrest sliding direction 37 makes an angle β with respect to the horizontal in the range of 40-50 degrees. This angle β is preferably corresponding to an average growth rate and average body proportions, so that for average children, a single adjustment of the armrests relative to the armrest frame
10 members are sufficient to adjust the armrest.

The headrest 19 is mounted to the sub-frame via a headrest frame member 41. The headrest frame member 41 is mountable to the sub-frame in two orientations as can be clearly seen by comparing the orientation of Fig. 1A and 1B with the orientation of Fig. 2A
15 and 2B in which the headrest frame member 41 is shown upside down. By providing an adjustment range of the headrest 19 relative to the headrest frame member 41 which extends mainly to one side of the point of connection 43 of the headrest frame member 41, it is possible to provide a much larger adjustment range when the headrest frame member can also be mounted upside down. Headrest 19 may be slidable relative to the headrest
20 frame member so as to be able to take any position in between the two extreme positions shown in Figs. 1A, 1B, 2A and 2B.

As headrest 19 is not always necessary, the headrest may be mounted to a portion 11b of the sub-frame 11. Portion 11b is in this embodiment rotatable about a pivot axis 45 between
25 a position as shown in solid lines in Figs. 4A and 4B in which the headrest is able to perform its function, and a position after being rotated more than 180 degrees in which the headrest is in an inoperative position, i.e. a storage position. The advantage of the moveability of the portion 11b is that in the storage position, the headrest 19 and portion 11b occupy minimal space.

30 The sub-frame 11 has, similar to the carriage 3, two elongated sub-frame members 31 which are connected to each other at their top by a cross member 11c. The portion 11b is simply a rod connected to the middle of the cross member 11c, which allows the portion and thus the headrest to be received in between the two elongated sub-frame members 31 when in the
35 storage position.

In Fig. 4A and 4B, the portion 11B is also shown in dashed lines in an intermediate position in between the operative position of the headrest and the storage position to indicate the direction of rotation.

5 Fig. 4A and 4B also indicate the adjustability of the push handle 21. Push handle 21 is rotatably mounted to the portion 11b. In this way, when the mounting position of the sub-frame relative to the carriage tends to change the height of the push handle, the orientation of the push handle relative to the sub-frame can be changed in order to compensate for this change. In Fig. 4A and Fig. 4B, the push handle is shown in three distinct positions relative
10 to the portion 11b.

Fig. 4A and 4B also show that footrests 9 can be moved in between different orientations, namely an operative orientation in which the footrests are able to support the feet of a child sitting in the wheelchair, and an inoperative position in which the child is able to reach the
15 ground to get in and out of the wheelchair. The footrests are therefore rotatable about respective rotation axes extending parallel to the driving direction 23, wherein in the operative orientation of the footrests the footrests are oriented in a substantially horizontal manner to provide a horizontal support surface for the feet, and wherein in the inoperative orientation of the footrests the footrests are oriented in a substantially vertical manner,
20 thereby creating space for the feet to reach the ground. The footrests are also shown in an intermediate orientation to indicate how the orientation of the footrests change when going from the operative orientation to the inoperative orientation or vice versa.

The seat and backrest are also adjustable in width direction and the seat is also adjustable
25 in seat depth. In fig. 1A and 1B, the wheelchair is shown in its smallest configuration, and in Fig. 2A and 2B in its biggest configuration to show the adjustment ranges possible. Fig. 3A and 3B allow to compare the smallest and biggest configuration in one view. Preferably, many configurations in between the smallest and biggest configuration are possible.

30 Fig. 7A and 7B depict an adjustable manually drivable wheelchair 1 according to another embodiment of the invention. The wheelchair 1 is identical to the wheelchair of the embodiment described in relation Figs. 1A to 6 except for the differences described below. Hence, all features described above may also apply to this embodiment unless explicitly described as a difference.

35

The main difference between the two embodiments is related to the horizontal adjustment range of the rotation axis of the rear wheels with respect to the carriage. Depending on the

weight distribution of the wheelchair and possibly also of the child using the wheelchair, the gravity of center may shift differently for different wheelchairs and/or users. This difference can be dealt with by using a wheelchair with a different horizontal adjustment range for the rear wheels with respect to the carriage. As shown in solid lines in Figs. 7A and 7B, the mounting member 4 which connects the rear wheels 5 to the carriage 3 is shown in a position in front of the clamp 29. In dashed lines in Fig. 7B, the same mounting member is shown in a position behind the clamp 29, thereby changing the horizontal distance between front and rear wheels.

In the embodiment of Figs. 1A – 6, the adjustment range was entirely in front of the clamp 29, where in Figs. 7A and 7B, the adjustment range extends on both sides of the clamp. In order to implement this, the carriage 3 of Figs. 7A and 7B is extended at the rear and the mounting holes allowing the mounting member 4 to be connected at different positions have been shifted to the rear with respect to the embodiment of Figs. 1A – 6.

A minor difference is clamp 29 which in Figs. 7A and 7B is constructed such that the top and bottom surfaces are substantially parallel to the horizontal, where in Figs. 1A – 6 the top and bottom surfaces of clamp 29 extend in an oblique direction with respect to the horizontal. This is merely a construction alternative.

It is to be noted that although the invention is very suitable for children, the invention may also be used for adults.

It is further noted that although the above described wheelchairs are manually drivable via the rear wheels, this does not exclude the possibility for additional driving possibilities, such as motors or manual driving possibilities via a push handle or chain drives.

The invention may further be summarized by the following clauses:

1. An adjustable wheelchair, in particular an adjustable wheelchair for children, comprising:
 - a carriage;
 - two rear wheels;
 - at least one front wheel;
 - at least one footrest;
 - a sub-frame;
 - a seat; and

- a backrest;

wherein the two rear wheels, the at least one front wheel and the at least one footrest are mounted to the carriage, such that in use the at least one footrest is provided at a non-adjustable height level above ground,

5 wherein the seat and the backrest are mounted to the sub-frame,

wherein the sub-frame can be mounted to the carriage in a first mounting position relative to the carriage and a second mounting position relative to the carriage,

wherein in the second mounting position the vertical distance of the seat with respect to the at least one footrest is larger than in the first mounting position,

10 and wherein in the second mounting position the horizontal distance of the backrest with respect to the at least one footrest is larger than in the first mounting position.

2. A wheelchair according to clause 1, wherein the ratio between the absolute difference in vertical distances of the seat relative to the at least one footrest in the first and second mounting position and the absolute difference in horizontal distances of the backrest relative to the at least one footrest in the first and second mounting position is in the range of 0.8-1.2, preferably in the range of 0.9-1.1, and most preferably is 1.

3. A wheelchair according to clause 1 or 2, wherein the sub-frame can be mounted to the carriage in at least one intermediate mounting position, which intermediate mounting position is located in between the first and second mounting position.

4. A wheelchair according to any of the clauses 1-3, wherein the sub-frame is slidable relative to the carriage in a sliding direction between the first and second mounting position.

5. A wheelchair according to clause 4, wherein the sub-frame can be fixed to the carriage in any position in between the first and second mounting position by a clamping connection.

6. A wheelchair according to clause 4 or 5, wherein the sliding direction seen in side view of the wheelchair makes an angle relative to the horizontal in the range of 40-50 degrees, preferably in the range of 43-47 degrees, and more preferably the angle relative to the horizontal is 45 degrees.

7. A wheelchair according to any of the clauses 1-6, wherein the seat and the backrest are mounted to the sub-frame, such that in use the vertical position of either the seat or the backrest relative to the sub-frame is non-adjustable, and the vertical position of the other one of the seat or backrest is adjustable relative to the sub-frame.

8. A wheelchair according to any of the clauses 1-7, wherein the wheelchair further comprises at least one armrest which is mounted to the sub-frame.
9. A wheelchair according to any of the clauses 1-8, wherein the wheelchair comprises two footrests, and wherein the footrests are moveable between an operative orientation in which the footrests are able to support the feet, and an inoperative orientation in which a user of the wheelchair is able to reach the ground in order to get in or out of the wheelchair.
10. A wheelchair according to any of the clauses 1-9, wherein the wheelchair comprises a headrest mounted to the sub-frame.
- 10 11. A method to adjust an adjustable wheelchair to the size of a child, said method comprising the following steps:
 - a. providing a wheelchair according to clause 1;
 - b. mounting the sub-frame to the carriage in the first mounting position or second mounting position based on which mounting position provides the best vertical distance between seat and the at least one footrest and the best horizontal distance between backrest and the at least one footrest.
12. A method according to clause 11, the method also comprises one or more of the following steps after the step of mounting the sub-frame to the carriage:
 - a. adjusting the seat width and/or the seat depth;
 - 20 b. adjusting the vertical position of the backrest relative to the sub-frame;
 - c. adjusting the width of the backrest;
 - d. adjusting the width of the carriage and/or the sub-frame;
 - e. adjusting the vertical position of a headrest, which is mounted to the sub-frame, relative to the sub-frame;
 - 25 f. adjusting the position of an armrest relative to the sub-frame;
 - g. changing the size of the rear wheels.
13. An assembly comprising:
 - a. a first set of parts to form a first wheelchair according to clause 1;
 - b. a second set of parts to form a second wheelchair according to clause 2;wherein the first wheelchair corresponds to a first size range of children, wherein the second wheelchair corresponds to a second size range of children, wherein the first and second size range of children only partially overlap, and wherein each part of the first set of parts can be exchanged by its corresponding part of the second set of parts in order to form a hybrid wheelchair made of parts of the first and second set of parts.
- 35 14. An assembly according to clause 13, wherein each part of the first and second set of parts is configured, such that a part of the first set of parts has one or more

general portions and one or more specific portions, wherein the corresponding part of the second set of parts has the same one or more general portions and different one or more specific portions.

- 5 15. An assembly according to clause 13 or 14, wherein the assembly comprises a third set of parts to form a third wheelchair according to the invention, said third wheelchair being associated with a third size range of children, wherein the third size range only partially overlaps with either the first or second size range of children, and wherein the parts of the third set of parts are at least exchangeable with corresponding parts of the set of parts associated with the size range of
- 10 children with which the third size range overlaps.

C L A I M S

1. An adjustable wheelchair, in particular an adjustable wheelchair for children, comprising:

- a carriage;
- two rear wheels;
- 5 - at least one front wheel;
- at least one footrest;
- a sub-frame;
- a seat; and
- a backrest;

10 wherein the two rear wheels, the at least one front wheel and the at least one footrest are mounted to the carriage, such that in use the at least one footrest is provided at a non-adjustable height level above ground,

wherein the seat and the backrest are mounted to the sub-frame,

wherein the sub-frame can be mounted to the carriage in a first mounting position

15 relative to the carriage and a second mounting position relative to the carriage,

wherein in the second mounting position the vertical distance of the seat with respect to the at least one footrest is larger than in the first mounting position,

wherein in the second mounting position the horizontal distance of the backrest with respect to the at least one footrest is larger than in the first mounting

20 position, and

wherein the sub-frame and carriage are configured such that changing between the first and second mounting positions can be done using a single adjustment operation.

2. A wheelchair according to claim 1, wherein the ratio between the absolute
25 difference in vertical distances of the seat relative to the at least one footrest in the first and second mounting position and the absolute difference in horizontal distances of the backrest relative to the at least one footrest in the first and second mounting position is in the range of 0.8-1.2, preferably in the range of 0.9-1.1, and most preferably is 1.

3. A wheelchair according to claim 1 or 2, wherein the sub-frame can be mounted
30 to the carriage in at least one intermediate mounting position, which intermediate mounting position is located in between the first and second mounting position.

4. A wheelchair according to any of the claims 1-3, wherein the sub-frame is slidable
35 relative to the carriage in a sliding direction between the first and second mounting position.

5. A wheelchair according to claim 4, wherein the sub-frame can be fixed to the carriage in any position in between the first and second mounting position by a clamping connection.
- 5 6. A wheelchair according to claim 4 or 5, wherein the sliding direction seen in side view of the wheelchair makes an angle relative to the horizontal in the range of 40-50 degrees, preferably in the range of 43-47 degrees, and more preferably the angle relative to the horizontal is 45 degrees.
7. A wheelchair according to any of the claims 1-6, wherein the seat and the backrest are mounted to the sub-frame, such that in use the vertical position of
10 either the seat or the backrest relative to the sub-frame is non-adjustable, and the vertical position of the other one of the seat or backrest is adjustable relative to the sub-frame.
8. A wheelchair according to any of the claims 1-7, wherein the wheelchair further comprises at least one armrest which is mounted to the sub-frame.
- 15 9. A wheelchair according to any of the claims 1-8, wherein the wheelchair comprises two footrests, and wherein the footrests are moveable between an operative orientation in which the footrests are able to support the feet, and an inoperative orientation in which a user of the wheelchair is able to reach the ground in order to get in or out of the wheelchair.
- 20 10. A wheelchair according to any of the claims 1-9, wherein the wheelchair comprises a headrest mounted to the sub-frame.
11. A wheelchair according to any of the claims 1-10, wherein the carriage is configured to be used with different sized rear wheels, preferably the carriage is configured to allow the mounting of different sized rear wheels to the carriage
25 without affecting the orientation or position of the carriage.
12. A wheelchair according to any of the claims 1-11, wherein the mounting position of the rear wheels relative to the carriage in the horizontal direction is adjustable.
13. A method to adjust an adjustable wheelchair to the size of a child, said method comprising the following steps:
30 a. providing a wheelchair according to claim 1;
b. mounting the sub-frame to the carriage in the first mounting position or second mounting position based on which mounting position provides the best vertical distance between seat and the at least one footrest and the best horizontal distance between backrest and the at least one footrest.
- 35 14. A method according to claim 13, the method also comprises one or more of the following steps after the step of mounting the sub-frame to the carriage:
a. adjusting the seat width and/or the seat depth;

- b. adjusting the vertical position of the backrest relative to the sub-frame;
- c. adjusting the width of the backrest;
- d. adjusting the width of the carriage and/or the sub-frame;
- e. adjusting the vertical position of a headrest, which is mounted to the sub-frame, relative to the sub-frame;
- f. adjusting the position of an armrest relative to the sub-frame;
- g. changing the size of the rear wheels.

5

15. An assembly comprising:

- a. a first set of parts to form a first wheelchair according to claim 1;

10

- b. a second set of parts to form a second wheelchair according to claim 1;

wherein the first wheelchair corresponds to a first size range of children, wherein the second wheelchair corresponds to a second size range of children, wherein the first and second size range of children only partially overlap, and wherein each part of the first set of parts can be exchanged by its corresponding part of the second set of parts in order to form a hybrid wheelchair made of parts of the first and second set of parts.

15

16. An assembly according to claim 15, wherein each part of the first and second set of parts is configured, such that a part of the first set of parts has one or more general portions and one or more specific portions, wherein the corresponding part of the second set of parts has the same one or more general portions and different one or more specific portions.

20

17. An assembly according to claim 15 or 16, wherein the assembly comprises a third set of parts to form a third wheelchair according to the invention, said third wheelchair being associated with a third size range of children, wherein the third size range only partially overlaps with either the first or second size range of children, and wherein the parts of the third set of parts are at least exchangeable with corresponding parts of the set of parts associated with the size range of children with which the third size range overlaps.

25

30

FIG 1A

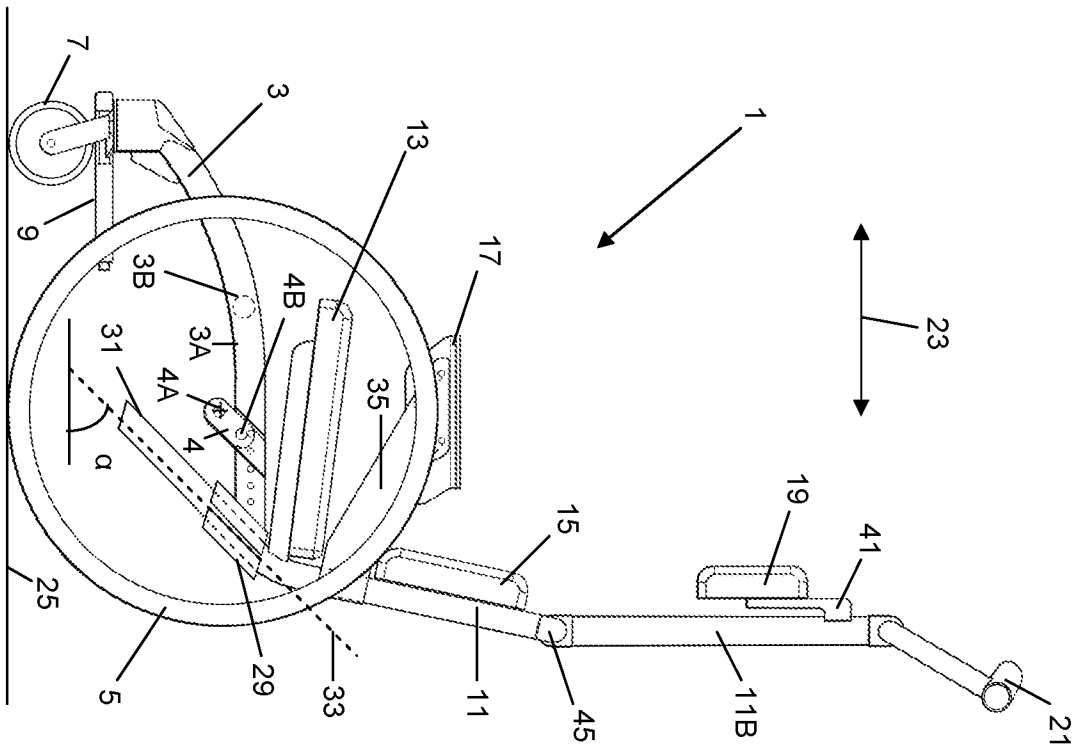


FIG 1B

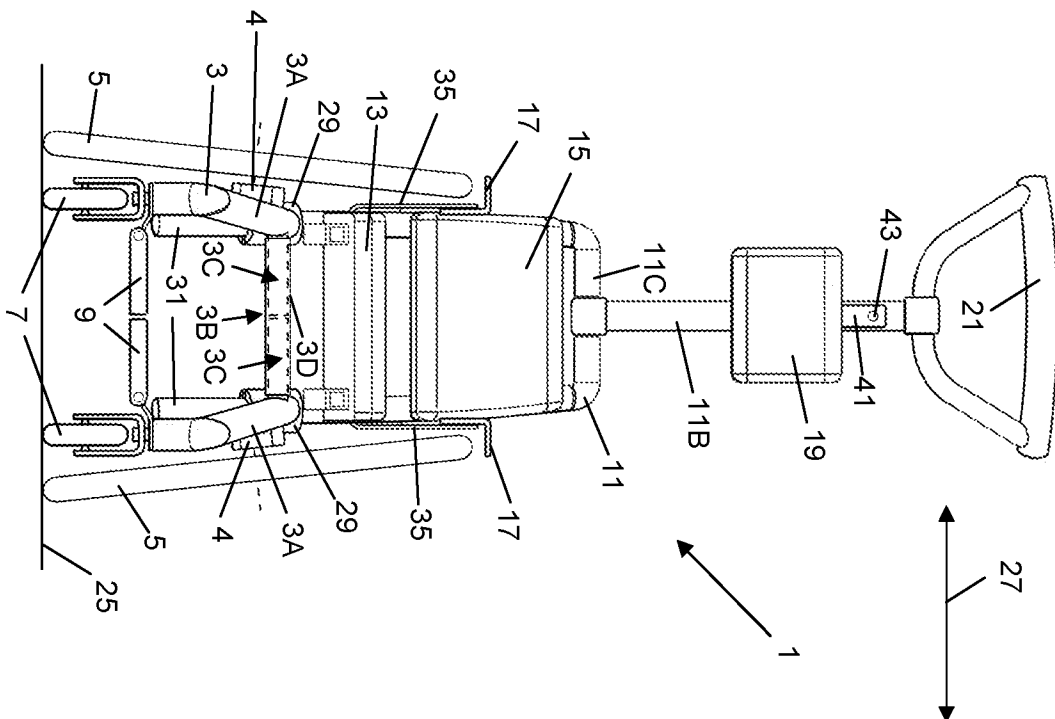


FIG 2A

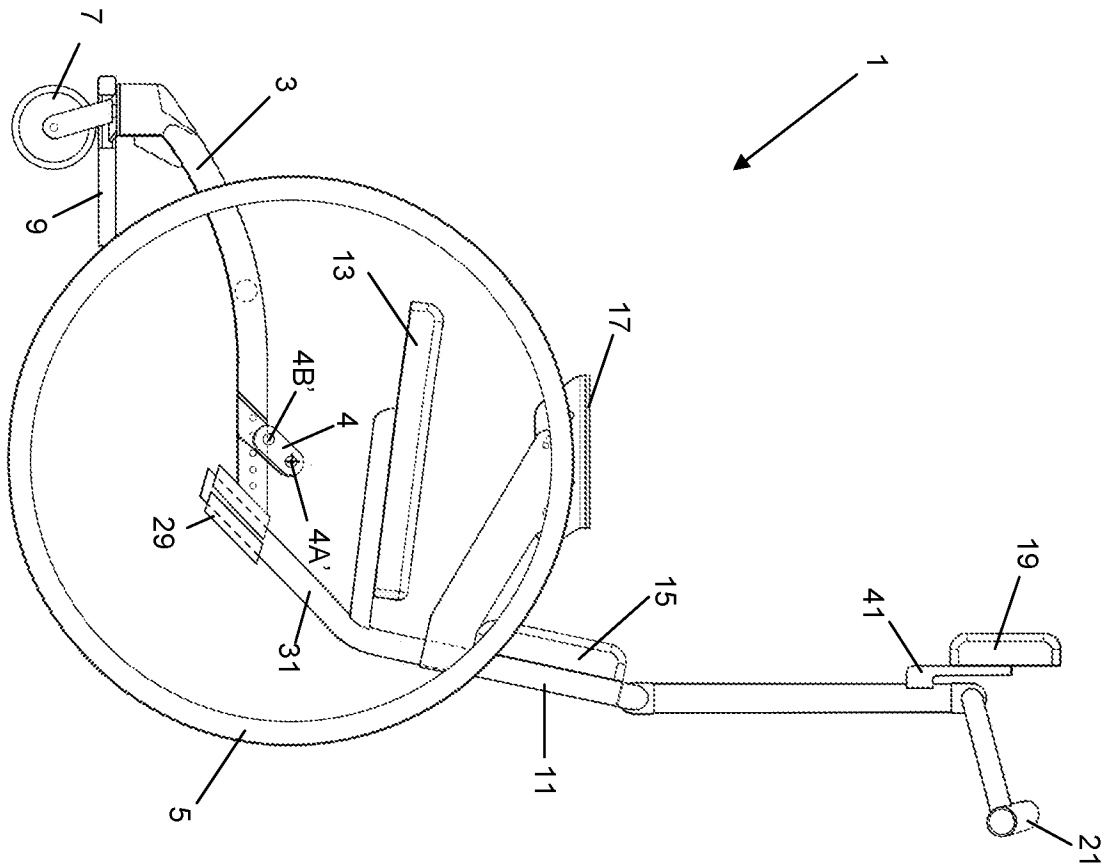


FIG 2B

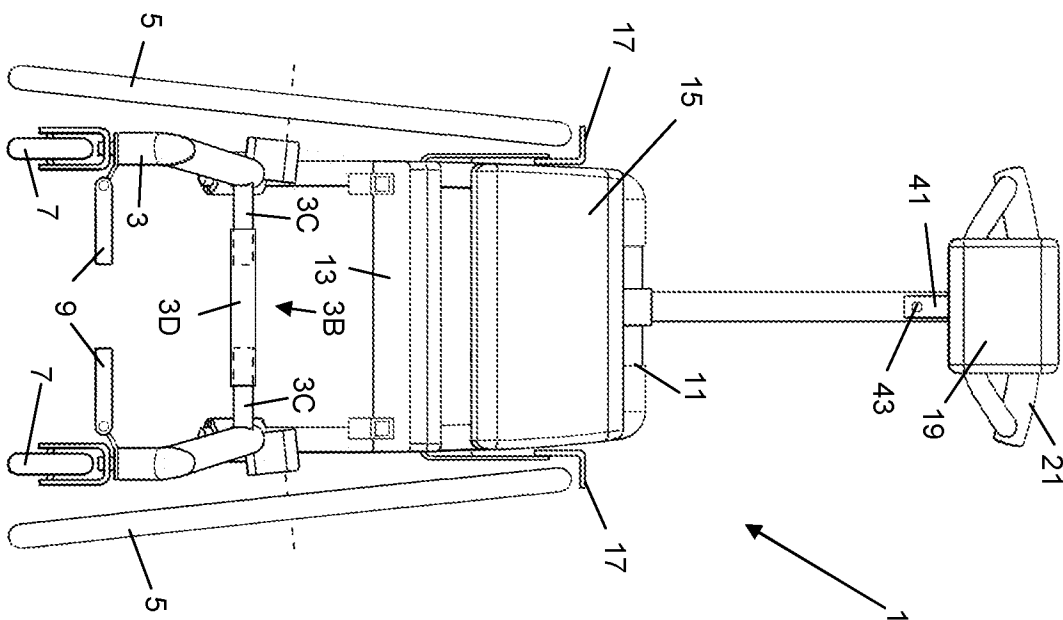


FIG 3A

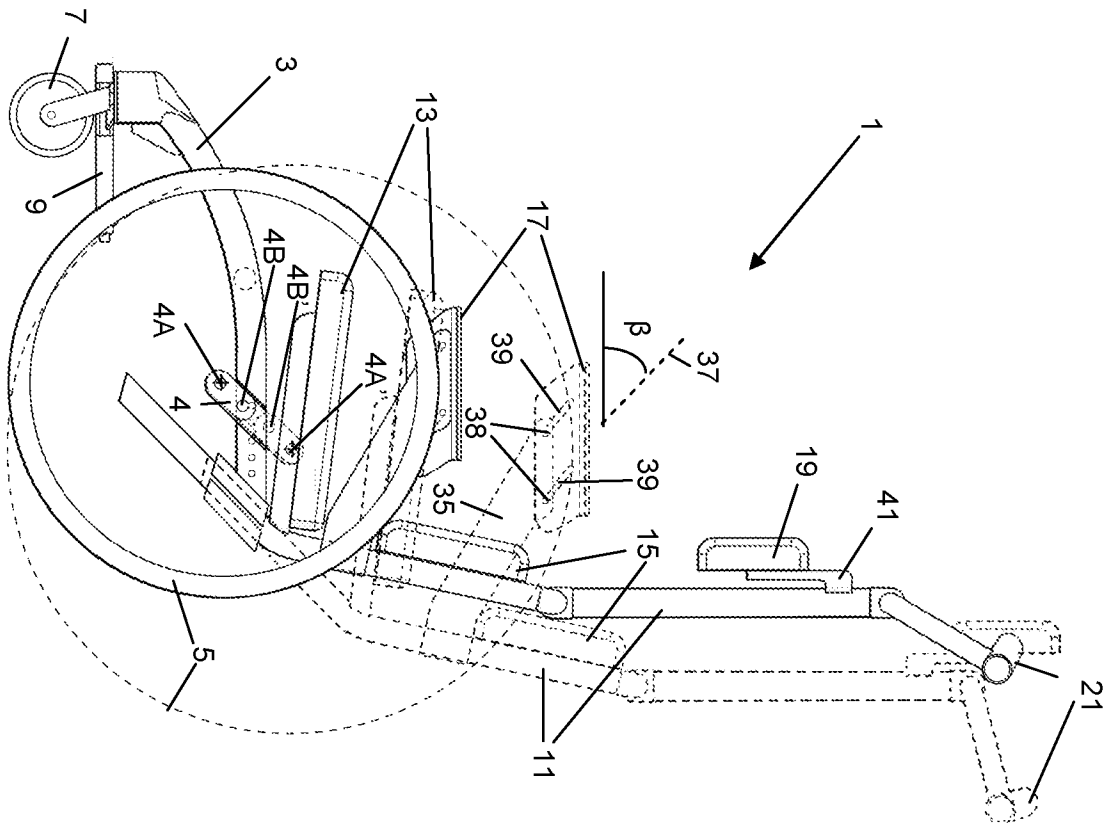


FIG 3B

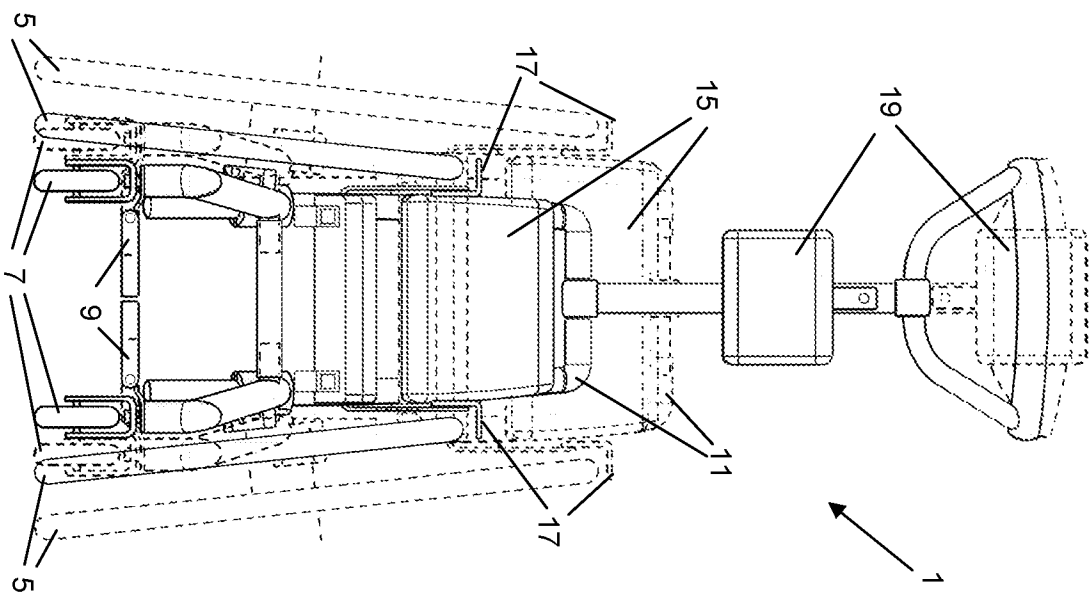


FIG 4A

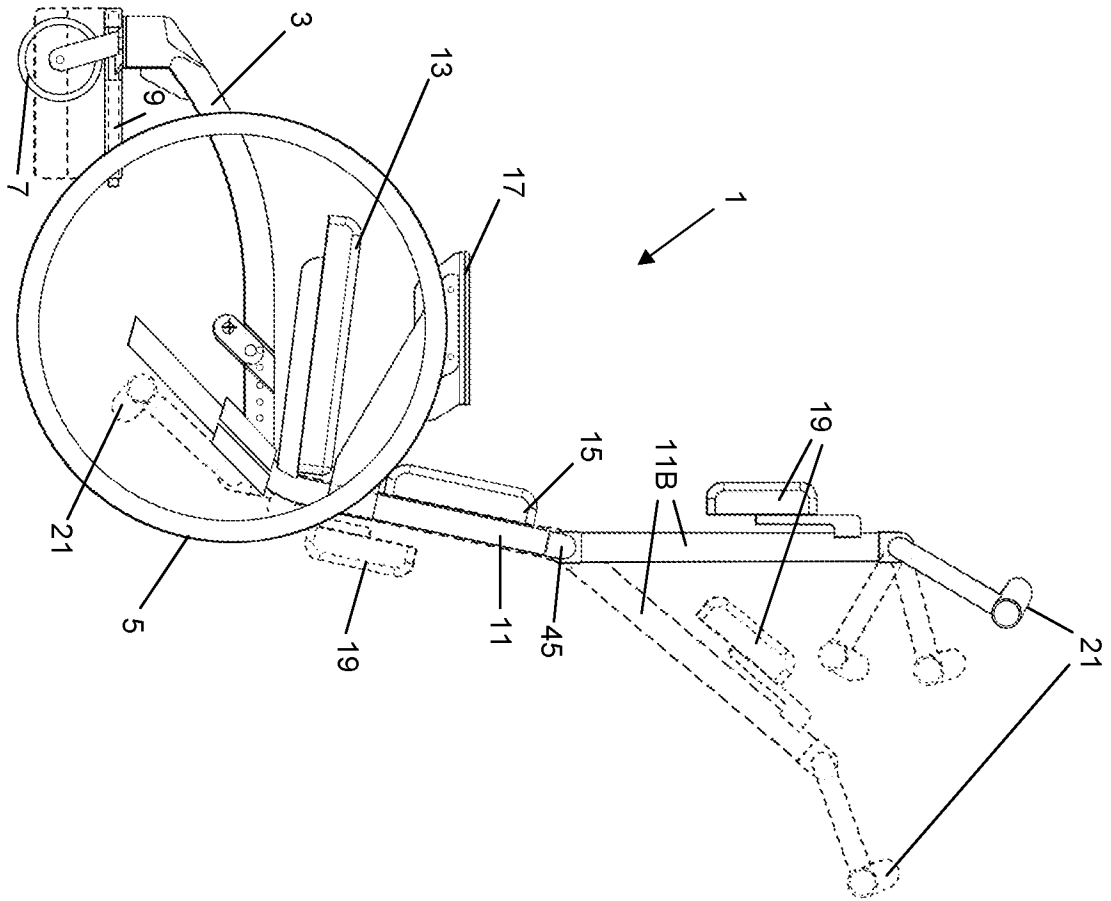


FIG 4B

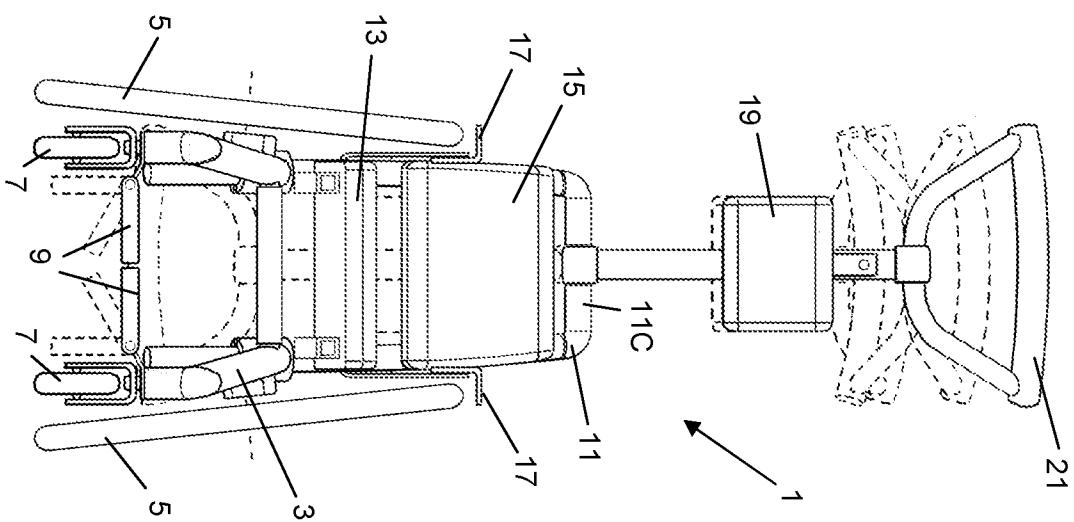


FIG 5A

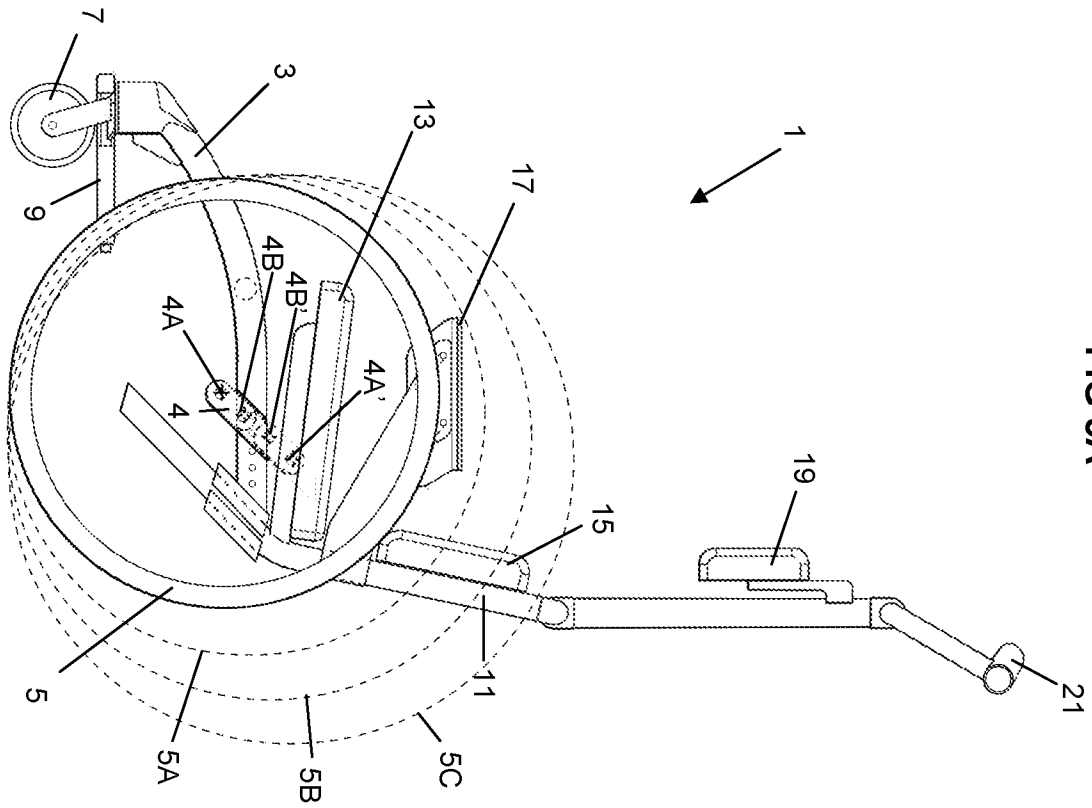


FIG 5B

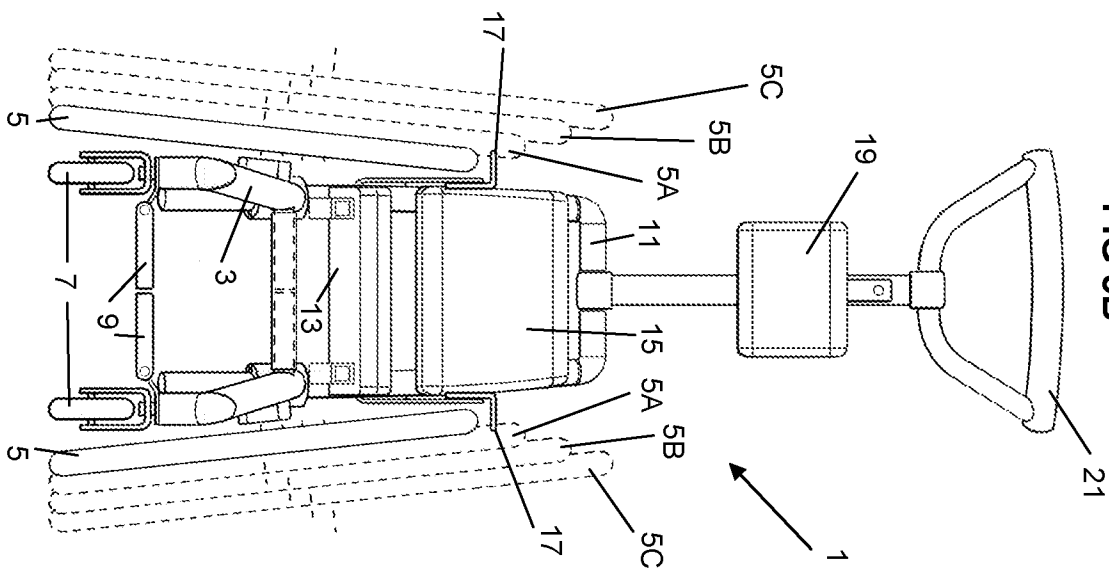


FIG 6

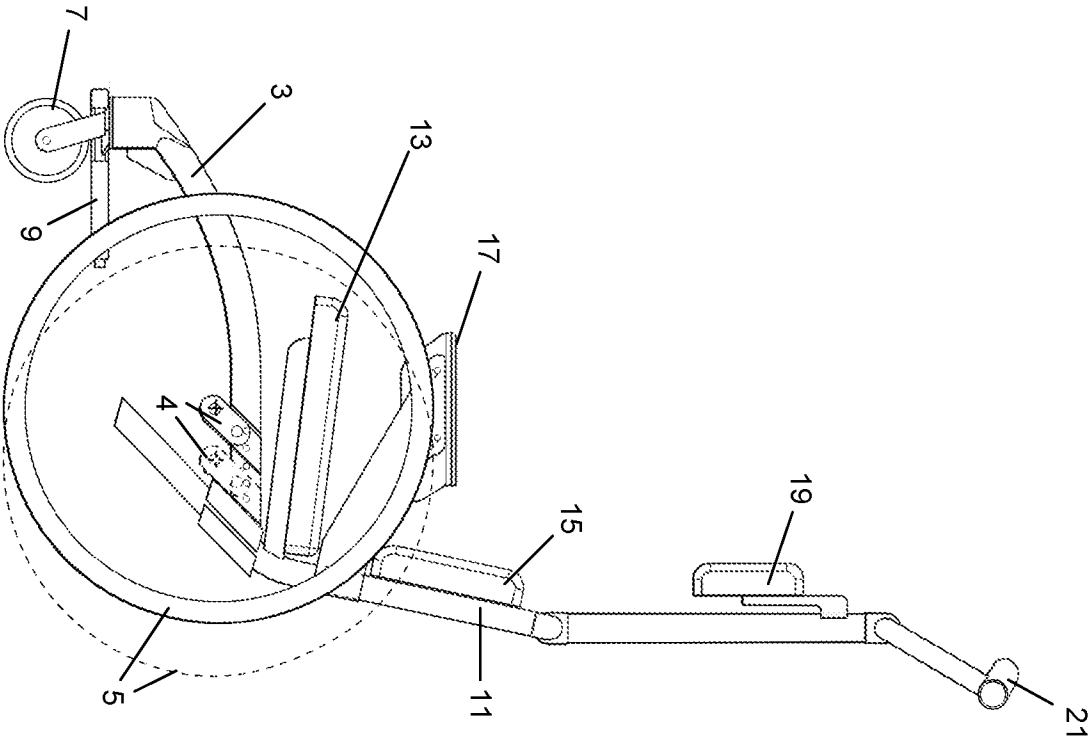


FIG 7A

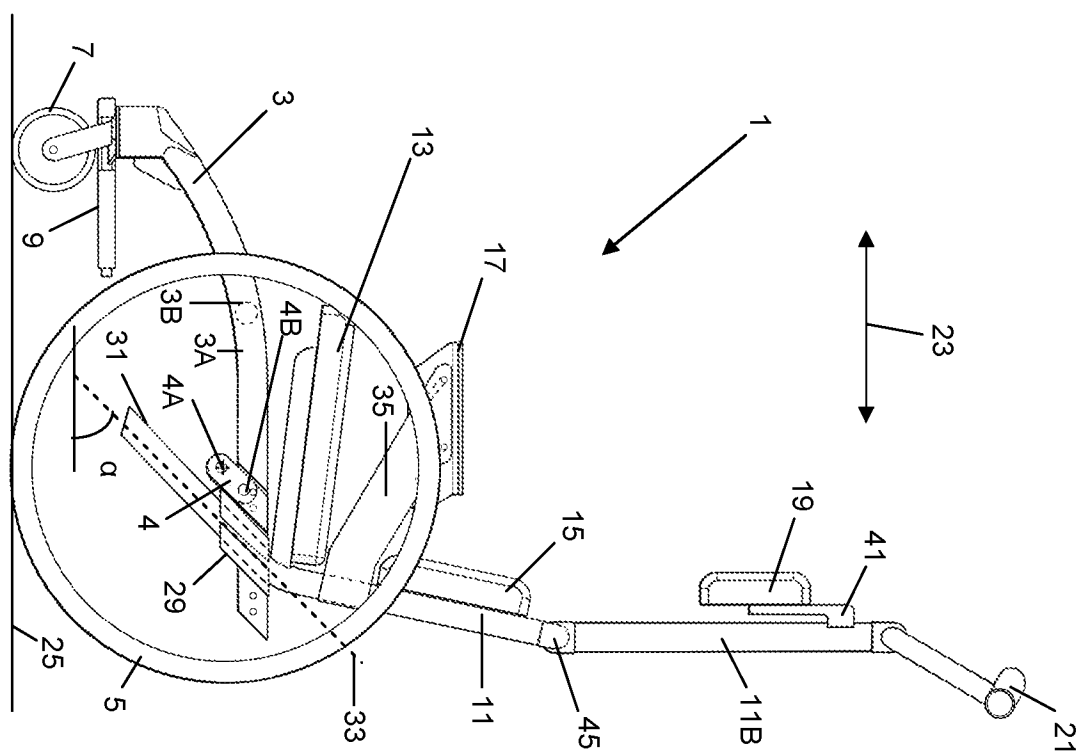
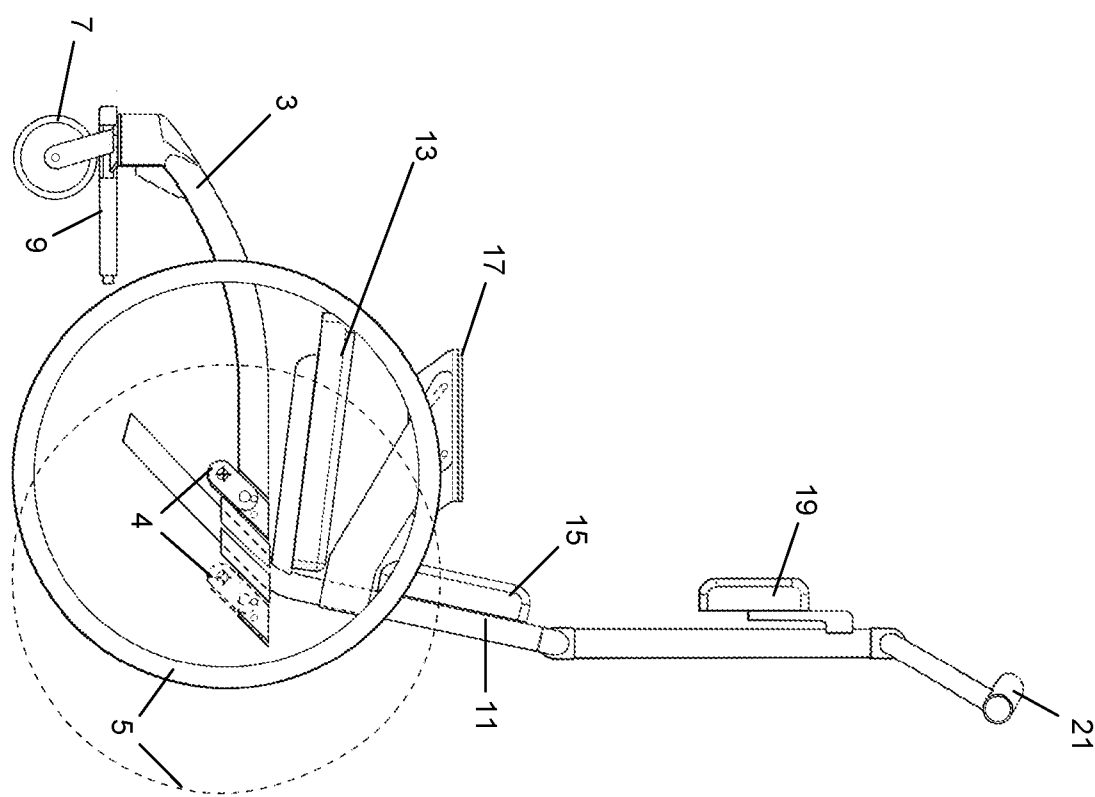


FIG 7B



INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2013/050226

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61G5/10

ADD. A61G5/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BE 901 147 A2 (COTTELEER CHRISTIAAN) 15 March 1985 (1985-03-15)	1-6,8,13
Y	page 1, line 26 - line 28; figures 2,11-13 page 5, line 22 - line 24 -----	7,9-12, 14-17
Y	WO 01/26598 A1 (INVACARE REA AB [SE]; HAANING HENRIK [DK]) 19 April 2001 (2001-04-19) cited in the application	7,10-12, 14-17
A	the whole document -----	1-5,8
Y	US 6 979 010 B1 (KWAPIS RANDAL J [US]) 27 December 2005 (2005-12-27) cited in the application column 7, line 55 - line 62; figure 9 -----	9

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 May 2013

Date of mailing of the international search report

23/05/2013

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Sommer, Jean

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/NL2013/050226

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