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(54) **Foldable wheelchair**

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Fauteuil roulant pliable

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Description

Filed of the Invention

[0001] The present invention relates in general to foldable wheelchairs, and more particularly, to wheelchairs which have X-shaped cross-bracing frame assemblies that fold or scissor to allow the side frames of the wheelchairs to be moved between a spaced apart deployed position for use and a folded position for storage or transport.

Prior Art and the Problem Underlying the Invention

[0002] Foldable wheelchairs with cross-wise arranged struts are disclosed in US 4,989,890 and US 6,050,582. In wheelchairs of this type, cross-struts are pivotally attached, with their bottom ends, to lower parts of a respective side frame. At their upper end, the cross-struts carry a seat profile. Attachment of each strut to an upper, longitudinal tube of the left and right side frames, respectively, is provided by means of a link element, also referred to as link plate or simply link. Each left and right link element is pivotally attached to a longitudinal tube of the side frame and also to the corresponding cross-strut, so that folding of the wheelchair is allowed for by the pivoting connections of the cross-struts to the tubes of the left and right side frames of the wheelchair.

[0003] Foldable wheelchairs comprising a link element as disclosed in US 4,989,890 and US 6,050,582 are difficult to fold and/or unfold. Especially for a wheelchair user constrained to make the wheelchair ready for use from a sitting position, unfolding is difficult. For example, when a wheelchair user sits on the side of a bed and prepares the wheelchair before the moving onto the wheelchair it would be important, that unfolding is easy to accomplish. However, even with foldable wheelchairs commercialised in these days, the wheelchair user encounters the difficulty that the unfolding or folding requires substantial efforts. It is observed that the geometry of the foldable wheelchair using a link element actually opposes or counteracts the folding and/or unfolding, and a substantial effort is needed to unfold and/or fold the wheelchair. In some situations, it is even necessary that staff performs the folding /unfolding for the wheelchair user.

[0004] As indicated, the geometry of the cross-bracing arrangement of the foldable wheelchair is at the origin of the exhausting folding process. More particularly, there is the problem that during the folding process, the side frames have the tendency not to stay in parallel but assume a V-shape, with the upper side frames staying apart from each other. This can also be referred to as a splaying or tilting of the side frames during folding, due to the geometry of the articulation provided by the link element together with the cross-struts, comprising as many as seven pivoting axis. The link element experiences forces in its longitudinal axis during folding, and thus resists to the side frames getting together in parallel. Actually, during folding, the distance between the two pivoting attachments of an individual link element, one to the upper side frame tube and the other to a cross-strut, is transitionally reduced during the folding process. On the other hand, the upholstery on the backrest may oppose to the backrest tubes assuming a V-shape, which means in the end that more force has to be applied to unfold the wheelchair. In wheelchairs with bigger seat width and, as a consequence, longer cross-struts, the force to be overcome increases and may become too hard for some wheelchair users to overcome.

[0005] Foldable wheelchairs requiring less effort when folding have been proposed, such as those disclosed in DE 20112335 and US 2006/0145456, where a link element comprising an elastic section or a spring, respectively, is suggested. Upon folding, the elastic section or the spring at least partly compensates for the reduction of the distance between the pivoting attachments of the link element. However, the compensation provided by an elastic section or by the spring of the link element is limited and goes hand in hand with a decrease of the overall stability and/or rigidity of the attachment provided by the link element. In particular when in the folded position, wheelchairs using a elastic link element are not stable and constitute a shaky, waggly and unfirm device. During transport in a folded position, for example, these wheelchairs may experience oscillation and/or see-sawing.

[0006] The aspect of convenience and easy manipulation is a main objective underlying the present invention. It is a goal to provide a foldable wheelchair, that can be folded and/or unfolded with less effort than any other foldable wheelchair available on the market. Preferably, such an effortlessly foldable and/or unfoldable wheelchair still presents a high stability and/or firmness, in the unfolded position of use as well as during the folding process and in the folded position of storage and transport.

[0007] US 2,165,529 discloses a foldable wheelchair with unequal cross-struts, wherein slotted link elements are used. Similar to the situation in DE 20112335 and US 2006/0145456, the connection via a slot results in unstable, loose connection between the side frames, which will be noted in particular during the folding process. The wheelchair of US 2,165,529 thus further requires upper and lower pivotally jointed cross-bar connections in order to stabilise the entire chair and in particular the back in the unfolded position of use.

Summary of the Invention

[0008] The present invention provides the wheelchair a foldable wheelchair, the wheelchair comprising a pair of left and right side frames, each side frame comprising:

- a longitudinal frame profile; and,
- a hinge with an axis of pivoting for pivotal connection of each side frame with a cross-strut at a lower section of said cross-strut;

the wheelchair further comprising:

- a cross brace assembly coupling the said side frames together for movement between a spaced apart deployed position and a proximate folded position, said cross brace assembly comprising:
  - at least two crosswise arranged struts and left and right seat profiles with substantially horizontal axis, wherein each one of said seat profiles is attached substantially perpendicularly to one of said at least two cross-wise arranged struts, and wherein said at least two struts are pivotally connected one to the other at a central pivot axis;

wherein the wheelchair further comprises a left and right link element, pivotally connecting said side frames with said struts.

[0009] The wheelchair of the present invention has important advantages over wheelchairs of the prior art, as is disclosed in the detailed description herein below.

[0010] According to the invention, each link element comprises a first pivotal connection to one of said side frames and a second pivotal connection to one of said struts, said second pivotal connection being provided at an upper section of said strut. A pivot axis of said second pivotal connection is situated above a plane a, said plane a being the plane defined by the axis of pivoting of said hinge and by said central pivot axis, said plane a extending beyond said central pivot axis.

[0011] Some embodiments are shown in the figures and/or are defined in the appended claims and/or described in the detailed description herein below.

Brief Description of the Drawings

[0012] In the figures:

Figure 1 is a perspective view showing a foldable frame assembly according to a first embodiment of the wheelchair of the present invention in an unfolded position. The left and right castor wheels are not shown.

Figure 2 shows the same view as Figure 1, with the frame assembly being in a completely folded position.

Figure 3 is a front view showing a foldable frame assembly according to the wheelchair of the first embodiment in an unfolded position.

Figure 4 is the same view as Figure 3, with the frame assembly being in a completely folded position.

Figure 5 is a perspective view showing a foldable frame assembly according to a second embodiment of the wheelchair of the present invention in an unfolded position. The left and right castor wheels are not shown.

Figure 6 shows the same view as Figure 5, with the frame assembly being in a completely folded position.

Figure 7 is a front view showing a foldable frame assembly according to the wheelchair of the second embodiment in an unfolded position.

Figure 8 is the same view as Figure 7, with the frame assembly being in a completely folded position.

Figure 9 shows an extract of Figure 3 in an enlarged view.

Figure 10 shows a front view of a third embodiment of the wheelchair of the invention in an unfolded position of use.

[0013] The embodiments shown in the figures are now described in further detail herein below for the purpose of illustrating the present invention by way of example, without limiting its scope.

Detailed Description of the Preferred Embodiments

[0014] The present invention concerns a foldable wheelchair comprising two lateral side frames. Each side frame may be substantially arranged within a plane. The left and right side frames may be arranged in two planes extending substantially vertically and substantially in parallel with each other in a rear-to-front direction.

[0015] For the purpose of the present specification, situations and directions of elements of the wheelchair are determined by the perspective of a user seated in the wheelchair. Accordingly, the left side of the wheelchair corresponds to the right side of Figure 1 and vice versa. 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. The term "substantially longitudinal" indicates a direction of an element, such as a tube, having, as a major direction component, the rear-to-front direction. Such an element may also to some or to a minor extent be skewed laterally and or towards the bottom or the top.

[0016] In the figures some elements of the wheelchair of the present invention have been removed, in order to provide a better view to the frame assembly of the wheelchair. In particular in Figures 1, 2, 5 and 6, the large right drive wheel and the small right castor wheel have been omitted, as well as the seat plate and the back upholstery. A left castor wheel is shown in an isolated manner, at its approximate position when attached to the left side

frame.

[0017] In the figures, most structural elements of the side frames of the wheelchair are shown to be tubes having a circular profile. It is clear to the skilled person that instead of tubes, support structures of any cross-section can be used, not only tubes with circular and/or rectangular cross-section. A "profile", for the purpose of the present invention encompasses any three-dimensional structure having a substantially constant cross-section contour along at least part of its three-dimensional extension. Tubes, struts with circular, rectangular, X-shaped, open or closed cross-sections are examples of typical profiles. Further examples of profiles are rail profiles, rim profiles and U-profiles. One, some or all of the profiles of the wheelchair of the present invention may be selected from the above examples, independently from other profiles of the wheelchair. Preferably, light construction materials and, whenever possible, aluminium instead of steal is used as building material for the profiles.

[0018] As can be seen in the view of Figure 1, the wheelchair of the present invention comprises two lateral, left and right side frames 3, 4, respectively connected to each other by a cross brace assembly comprising at least two cross struts 9, 10. The lateral side frames comprise upper left and right side frame tubes 7, 8 and lower left and right side frame tubes 5 and 6. A pair of upper and lower side frame tubes of one side, for example tubes 5 and 7 of the left side, extend in parallel in a rear-to-front direction. A pair of upper and lower side frame tubes on each side, that is tubes 5 and 7 on the left side, as well as tubes 6 and 8 on the right side, are connected to each other by further lateral frame tubes. In particular, there are left and right rear tubes 15, 16, left and right front tubes 13, 14 and left and right intermediate tubes 17, 18. The rear tubes 15, 16 and intermediate tubes 17, 18 are extending in a substantially vertical direction.

[0019] As can be seen in Figures 1 and 2, said longitudinal upper side frame tube 7, 8, said lower longitudinal side frame tube 5, 6, said rear side frame tube 15, 16 and a front side frame tube 13, 14 form the sides of a quadrilateral. The quadrilateral may more particularly be a trapezoid.

[0020] In the embodiment shown in the figures of the present specification, the left and right front tubes 13, 14, connecting the upper and lower side frame tubes of their respective side at their front end with each other, are shown not to be exactly vertical. With respect to horizontal, the front tubes 13, 14 form an angle of less than 90 ° and are skewed, with their upper end, in a backward direction, towards the rear end of the wheelchair. The skilled person will understand that the exact angle of the front tubes 13 and 14 with respect to horizontal is not relevant for the present invention. In the embodiment shown in the figures, the lower side frame tubes 5 and 6 thus are a bit longer than the upper side frame tubes 7, 8, which means that the castor wheels can be fixed further to the front with respect to the seat.

[0021] In the embodiment of the invention shown in the figures, and as is especially apparent from Figures 3, 4 and 7, 8, the lateral side frames 3, 4 are vertical and in parallel. Similarly, the drive wheels 2, 2' are vertical. Furthermore, in Figure 1, the rear frame tubes 15, 16 and the intermediate frame tubes 17, 18 are vertical and in parallel, and the upper and lower side frame tubes 7, 8 and 5, 6, respectively, are in parallel with each other and parallel to the floor.

[0022] However, as the skilled person is aware, many deviations from exactly parallel, vertical and/or horizontal arrangements can be and actually are routinely produced. For example, in many constructions, the side frames and/or the wheels are not parallel, but skewed with respect to each other. Furthermore, instead of straight tubes, more or less curved profiles can be used.

[0023] In general, side frames have the purpose of providing a chassis and/or the structural support for carrying the seat, for attaching the wheels and for further functions. In the case of foldable wheelchairs, more particularly, the side frames need to provide a structure 5.1, 6.1 for pivotally connecting the cross-struts 9, 10 at lower ends of said cross-struts, and a generally longitudinal support for stabilizing the seat tubes 11, 12 in the deployed position. While these specific supporting functions may impose certain limitations on the form, shape and/or orientation that side frames can assume, there still is room for many variations and creativity. In the last decade, for example, for reasons of design but also for reducing the weight and overall complexity of wheelchairs, constructions with fewer individual tubes and less apparent connection structures were commercialised. Therefore, the present invention is not intended to be limited to any specific embodiment and/or arrangement of side frames. Tubular arrangements, as well as arrangements using other and several different support structures of different forms are encompassed by the present invention and may routinely be used and/or adapted for the purpose of the present invention.

[0024] With respect to the upper and lower side frame tubes 7, 8 and 5, 6, respectively, shown in Figure 1, some wheelchairs use only a single lateral main profile, instead of a pair of an upper and a lower side frame tube on each side, said single lateral main profile extending from a rear to front direction in a substantially longitudinal way, generally close to parallel to the ground, whereby these single profiles may be more or less bent or assume an L-shaped configuration, as disclosed, for example, in EP 0911009. Wheelchairs having frame structures as in EP 0911009 may be adapted for the purpose of the present invention.

[0025] The expression "substantially" is used in the present specification in order to express that a specific orientation is closer to the indicated orientation than to the respective opposed orientation. Accordingly, "substantially vertical" indicates that a respective structural entity is in a position that is closer to vertical than to horizontal. "Substantially horizontal" means closer to hori-

zontal than to vertical. "Substantially parallel" means closer to parallel than to perpendicular, and so forth.

[0026] As mentioned above the embodiments shown in the figures have the rear tubes 15, 16, which extend vertically above the upper side frame tubes 7, 8, and are then referred to as left and right rear upholstery tubes 23, 22, respectively, as they form support for attaching the back upholstery, the latter not being shown in the figures. At their upper ends, the left and right rear upholstery tubes 23, 22 may be bent backwards (not shown) to extend a short distance backwards so as to form left and right handholds or grippers.

[0027] In Figure 1, a pair of left and right drive wheel fixing elements 19, 20 can be seen. The drive wheel fixing elements as shown are arranged so as to allow to adjust the fixing position of the drive wheels to the side frames according to the user's preferences, thereby determining parameters such as the height of the seat surface and the rear-to-front position of the drive wheels.

[0028] The cross brace assembly of the embodiments shown in the figures comprises two crosswise arranged struts 9, 10. As indicated with respect to the term "tube" above, a "strut" may be any profile. The cross-struts 9, 10 are pivotally connected to each other at the central pivot axis 30, which, in the embodiment shown, is located on the vertical axis of symmetry of the wheelchair.

[0029] The central pivot axis 30 maybe arranged exactly in the middle of each cross strut, but does not need to. For example, the axis 30 may be displaced slightly upwardly or downwardly in dependency of preferences. In the embodiment shown in Figures 1-4, the central pivot axis 30 is located slightly below half-way of each cross-strut. In general, however, this displacement remains within a few centimetres, for example, up to 10 cm from the exact mid-point of each cross-strut.

[0030] As can best be seen in Figures 3, 4, 7 and 8, each left and right cross-strut comprises an upper and a lower section 43, 44 and 48, 47, respectively. For the purpose of the present specification, the upper section 43, 44 of each cross-strut 9, 10, is the section starting from the central pivot axis 30 and extending upwardly to the seat tube 11, 12, whereas the lower section 47, 48 is the section starting from the central pivot point 30 and extending downwardly to the pivotal hinge 5.1, 6.1 (indicated in Figures 1 and 5), where each cross-strut is directly pivotally connected to the one of the side frames 3, 4. In the embodiment shown in the figures, the cross-struts are pivotally attached to each side frame at the lower end of each cross-strut 9, 10.

[0031] As can be seen in Figure 1, the left cross strut 9 is pivotally attached, at its lower end, to the right lower frame tube 6, at the right pivotal hinge 6.1, whereas the right cross-strut 10 is pivotally attached to the left lower frame tube 5 at the left pivotal hinge 5.1. The left cross strut 9 is named "left" only for purpose of definition, because it carries, at its upper end, the left seat tube 11, whereas the "right" cross strut 10 carries the right seat tube 12. The left and right seat tubes are attached approximately in the centre of their rear-to-front longitudinal extension in a substantially perpendicular way to the upper end of each respective cross strut, thus forming a shape reminding of the letter "T".

[0032] The above mentioned pivotal connection of the left and right cross-struts 9, 10 at pivot axis 30 to each other forms a scissor like articulation. This articulation is used during the folding and unfolding process as will be described further below, bringing the side frames 3, 4 together and deploying them, respectively. The seat tubes 11 and 12 are provided in a way that allows the attachment of a flexible seat surface on them.

[0033] While the embodiments shown in the figures show a cross brace assembly with two cross-wise arranged struts, 9, 10, the present invention encompasses assemblies comprising a total of three or four, or even more such struts. The number and/or thickness of the struts are variables that may be determined as a function of the weight and/or size of a wheelchair user. Preferably, however, only one pivotal hinge 5.1, 6.1 per side frame is used, with one, two or more cross-struts being part of the same pivotal hinge. In other words, a single pivotal hinge 5.1 and/or 6.1 may be rigidly connected, for example, welded, to more than one cross-struts of one side. According to some prior art (for example, US 4,477,098), complicated arrangements were sometimes used, with two (or more) independent hinges on the same side frame tube, for articulating two cross-struts of two separate pairs of cross-struts on the same axis of pivoting, to one of the side frames. This is a possible way of doing, but not preferred. Preferably, the pivotal hinges 5.1, 6.1 are centred or close to the centre with respect to the rear-to-front extension of the seat tubes 11, 12, thereby enabling essentially central connection of each cross-strut 9, 10 at the respective seat tube, as mentioned above.

[0034] Each left and right cross-strut 9, 10 is pivotally connected, by way of an oblong link element 41, 42 to the respective left and right side frame 3, 4. Compared to the direct connection of the cross-struts to the side frames at hinges 5.1 and 6.1 by way of a single pivoting articulation, the connection via the link element, requiring two pivoting articulations, can be regarded as an "indirect" pivotal connection of a cross-strut with the respective side frame.

[0035] The link elements 41, 42 are oriented perpendicularly with respect to the side frames and thus extend in a lateral-to-central direction. More particularly, the left link element 41 is pivotally attached with its laterally outwardly oriented, distal end to the left upper side frame tube 7, and with the other, proximal end, which is oriented towards the centre of the wheelchair, to the left cross strut 9. Accordingly, the right link element 42 (not visible in Figure 1), is pivotally attached with its laterally outwardly oriented, distal end to the right upper side frame tube 8, and with the other, proximal end, which is directed towards the centre of the wheelchair, to the right cross strut 10.

[0036] The link elements are relevant for the stability

of the wheelchair. If they were absent, the side frames 3, 4 would only be connected to each other by the pivotal attachment of the cross-struts to the lower side frame tubes 5, 6 at pivot axis 5.1 and 6.1, the cross struts being connected at the central pivot axis 30. It is thus clear that without link elements, the side frames would fall apart. They would no longer be maintained in a substantially parallel position. Preferably, each link element is a rigid element, made of a rigid metal, such as aluminium, or of a rigid plastic. In this way, the stability is increased.

[0037] In the wheelchairs of the prior art, the use of rigid link elements entails the problems of increased efforts for folding and unfolding. In the present invention, these efforts are surprisingly reduced by optimising the position of the pivot axis 45, 46 of the second pivotal articulations of the link elements 41, 42 to the respective cross struts 9, 10, as described in more detail further below. More particularly, the pivot axis 45, 46 of the pivotal articulations (or connections) are situated at higher positions than corresponding pivot axis in the prior art, that is, at a position that is closer to the seat, that is, towards the top, of the wheelchair.

[0038] It can be seen in Figure 1 that each of the cross-struts 9 and 10 assumes an S-shaped configuration. In other words, each cross-strut comprises curves along its longitudinal extension. As mentioned above, each cross strut can be divided in two sections, that is, a lower section 47, 48 and an upper section 43, 44. It is noted that the link elements 41, 42 of each left and right side are pivotally attached at pivot axis 45, 46 within the upper sections 43, 44 of each respective cross strut.

[0039] Figure 2 shows the same frame assembly of the wheelchair of the wheelchair as Fig. 1 in a folded position. It can be seen that the left and right cross-struts 9, 10, respectively; are displaced in a rear to front direction so as not to hinder the folding process. Accordingly, the left cross-strut 9 is pivotally attached, on the right lower side frame tube 6 in a position that is more forward than the pivotal attachment of the right cross-strut 10 to the left lower side frame tube 5. The attachment of the cross-struts 9, 10 to the seat tubes 11, 12 is accordingly displaced in a way that said seat tubes 11, 12 are aligned in parallel and also with respect to the rear-to-front position next to each other. The left link element 41 is attached in front of the left cross-strut 9, whereas the right link element 42, is attached behind the right cross-strut 10, so as to avoid interference between the link elements during folding/unfolding.

[0040] In the embodiment of the wheelchair shown in Figures 1 to 4, the S-shaped configuration of each cross-strut 9, 10 is brought by two bends provided in each cross strut. It can be seen in Figs 1 and 3 that each cross strut comprises three sequential straight tube-elements, wherein a bend element is provided between two successive straight tube elements. Each of the two bend elements achieves a change in the direction of the straight elements, thereby creating a bend. The central pivot axis 30 is provided in the central straight tube element. Of course, it could also be envisaged to provide a strut as a single continuous tube, said continuous tube comprising two bends, without the use of bend elements.

[0041] The S-shaped configuration of each cross-strut is such that the orientation of each cross-strut is closer to horizontal towards the distal and lateral parts and/or ends of each cross-strut, if compared to the central part, the latter assuming a more vertical orientation than the distal parts. The distal parts of each cross-strut 9, 10 are the parts including the two ends of the elongated cross-strut. Accordingly, the lower distal part includes the end of the cross-strut where the cross-strut is pivotally attached to the lower side frame tube 5, 6, at pivotal hinge 5.1 and 6.1, respectively, whereas the upper distal part is the part close to the end of the cross-strut where it is rigidly connected to the seat tube 11, 12.

[0042] Through the S-shaped configuration of the cross-struts 9, 10, as shown in Figs. 1-4, the pivot axis 45, 46 of the second pivotal connection, which pivotally connects the link element 41, 42 to the respective cross-strut 9, 10, is displaced upwardly if compared to a pivot axis situated on a (hypothetic) cross strut taking a straight course between the central pivot axis 30 to the seat tube 11.

[0043] This displacement if compared to prior art foldable wheelchairs is illustrated in Figure 3. A straight line referred to with letter "a" can be seen, which actually represents a plane a extending in a direction that is perpendicular to the two- dimensional plane of the figure. Plane a is the plane in which both, the axis of pivoting 9.1 of the right hinge 6.1 (hinge 6.1, not visible in Figure 3, pivotally connects the left cross strut 9 to the right side frame 4) is situated, and, also the axis of the central pivot axis 30 (pivot axis 30 pivotally connects the two cross-struts 9, 10 to each other). In short, plane a is defined by two pivotal axis, pivot axis 9.1 and pivot axis 30. Plane a then extends beyond pivot axis 30. In the front view of Figures 3, 7 and 9, plane a is seen as a line, because the viewer sees plane a as cut by way of a cross-section, said cross-section being provided in a plane that is parallel to the plane of the figures and perpendicular to plane a.

[0044] Now, in prior art foldable wheelchairs, such as those, where the cross-struts are straight tubes, an axis of the respective cross strut would also extend in plane a. In this case, the link element would be pivotally connected to the cross strut at a pivotal connection located on or very close to the line a as seen in Figures 3 and 9. In contrast, according to the present invention, the pivot axis 45 of the second pivotal connection is located at a certain distance above plane a. This distance, in the embodiment shown in Figures 3 and 9, is at least the distance b, wherein b is a distance drawn as a straight line perpendicularly with respect to plane a, and wherein said distance b reaches up to the pivot axis 45 of the second pivotal connection of the link element 41. It is apparent from Figures 3, 7 and 9, that distance b represents a specific, limited distance. In contrast, plane a (and also

line c, length axis e and horizontal line f discussed further below) is a theoretical tool used for illustrating a geometrical configuration or situation in the wheelchair of the present invention.

[0045] According to an embodiment, the distance b is at least 0.5 cm, preferably at least 1 cm, more preferably at least 1.5 cm, even more preferably at least 2 cm. Also distances of ≥ 2.5 cm or even ≥ 3 cm are encompassed by the present invention.

[0046] As mentioned above, in the state of the art, cross-struts are generally straight, but may also be bent. When cross-struts of prior art wheelchairs are bent, they are not bent in the same way as shown in Figures 3 and 4 and the surprising reduction in effort for folding the wheelchair is not obtained. For example, S-shaped cross-struts are as such disclosed in Figs. 1 and 14 of WO 2007/007811. However, in this prior art reference the cross-struts are bent differently from the present inventions and the technical effects disclosed herein are not obtained.

[0047] Again compared to the prior art, the pivot axis 45, 46 of the second pivotal connections of the link elements to the cross-strut according to the present invention is closer to the seat, and the link elements 41, 42 as such extend more horizontally, that is, closer to horizontal. Technically, it could also be horizontally arranged, or even skewed upwardly towards the centre, but care must be taken that the cross-strut and/or the link element does not abut against the bottom side of the seat surface in the deployed position of use, thereby affecting seat comfort.

[0048] The close to horizontal orientation of the link elements 41, 42 in the deployed position of the wheelchair (Figs. 3, 7), is illustrated at the example of the left link element 41 by line e in Figure 3. Line e is co-axial to the link element 41 and, therefore, is referred to herein as length axis e. The length axis e of the link element thus passes through the point, which, in Figures 3 and 9, is given by the pivot axis 61 of the first pivotal connection, which pivotally connects the link element 41 to the side frame 3, in particular at the upper side frame tube 7. Furthermore, length axis e passes through the pivot axis 45 of the second pivotal connection. In Figure 3, a horizontal line f is drawn, also through the pivot axis 61 of the first pivotal connection. The horizontal line f and the length (or longiotudinal) axis of the link element 41, corresponding to length axis e, form an angle β. Angle β therefore illustrates the deviation from horizontal of the length axis e of the link element in a completely deployed position of the wheelchair. It can be seen that in the embodiment shown in Figure 3, the angle β is only a few degrees.

[0049] According to an embodiment of the present invention, at least one link element 41, 42 has a length axis e, wherein, in a position of use, said length axis e is close to horizontal so as to include an angle β of ≤ 20°, preferably ≤ 15°, more preferably ≤ 10° and most preferably ≤ 7° with respect to horizontal. The present invention more particularly also encompasses angles β that are ≤ 6°, ≤ 5°, ≤ 4°, and ≤ 3°. For example, the length axis e may be exactly horizontal, in other words, correspond to line f in Figures 3 and 9. The angle for a specific wheelchair will depend on parameters of the wheelchair, such as seat width, height, for example.

[0050] The S-shaped configuration of the cross-struts 9, 10, and also other configurations such as the one according to the second embodiment described further below, preferably result in the technical effect that the radial distance covered by the link element 41, and in particular by the pivot axis 45, 46 of the second pivotal connection during the folding / unfolding process is smaller than in prior art devices. In particular, line c in Figure 3 illustrates the direction and/or orientation of the length axis e of the left link element 41 when the wheelchair is in the folded position, as shown in Fig. 4 (assuming that the left side frame 3 did not move during folding of the wheelchair of Figure 3). The arc of a circle d indicates the way and/or distance along which the second pivot axis 45 travels during folding. For the purpose of illustration, reference numeral 45' indicates the position of the pivot axis 45 of the second pivotal connection in the folded position, and angle α defines the sector that is designed by the link element during folding and/or unfolding as described above.

[0051] According to an embodiment of the wheelchair of the present invention, said link element 41, 42 has a length axis e, wherein said length axis e pivots upwards with the wheelchair passing from said deployed position to said folded position, thereby rotating about an angle α, said angle being ≤ 90 °, preferably ≤ 80°, more preferably ≤ 75° and most preferably ≤ 70 °. The present invention more particularly encompasses angles α that are ≤ 73°, ≤ 70°, ≤ 68°, ≤ 65 ° and ≤ 62°. The angle may be ≥40°, preferably ≥50° and most preferably ≥55°. The angle α of a specific wheelchair will depend of wheelchair parameters, such as width and height of the wheelchair.

[0052] Preferably, the left and right link elements 41, 42 are, when seen in a front view as shown in Figures 3, 4, 7 and 8, mirror-inverted at a vertical plane, said plane extending in longitudinal, rear-to-front direction and crossing the centre of the wheelchair {pivot axis 30), this vertical plane is also referred to as the axis of symmetry. Therefore, the indications in terms of angles and orientation provided with respect to the left link element (plane a, length axis e, horizontal line f, distance b, angular distance d and angles α and β) preferably also apply to the right link element 42.

[0053] In prior art devices, the link element covers a larger angular distance d during folding in that it starts from a more downwardly inclined situation and ends in a close to vertical or vertical position. In prior art devices, the sector designed by the link element during folding and/or unfolding is generally larger than or equal to about 90°. In contrast, in Figs. 3, 7 and 9, the sector of a circle covered by the left link element 41, when passing from an unfolded to a folded position of the wheelchair and

vice versa, is highlighted. The angle α of the sector is about 60 °.

[0054] The shortness of the circumference of the sector shown in Figs. 3, 7 and 9 (which equals the distance travelled by the pivot axis 45 of the second pivotal connection during folding / unfolding) reduces the efforts for the folding and/or unfolding of the wheelchair.

[0055] Without wishing to be bound by theory, the present inventors observed that the link elements 41, 42 may be arranged in a way that the specific position of compression of the link element, which was so far reported in prior art wheelchairs, is circumvented. In other words, the present inventors surprisingly found that by suitably selecting the pivotal connections 45, 46, 61, 62 of the link element, the link element can be positioned in a way that there is no, or nearly no, compression of the link element any more. In this way, the efforts required for folding and/or unfolding of the wheelchair can be drastically and unexpectedly reduced, while still maintaining the stability advantages of a rigid link element.

[0056] Figures 5-8 show a second embodiment of the wheelchair of the present invention in views corresponding to Figs. 1-4, with the same reference numbers being used in Figs. 5-8 for the elements in common with the first embodiment.

[0057] Accordingly, Figs. 5 and 7 show a perspective and a front view, respectively, of the second embodiment of the wheelchair of the invention in an unfolded position of use. In the second embodiment, the S-shaped configuration of the cross-struts 9, 10 is absent, the latter extending in a substantially straight manner, similar to prior art devices. Different from the prior art, however, the left and right link elements 41, 42 have the same orientation as described above with the first embodiment, in that they are closer to horizontal than comparable prior art link elements pivotally connecting the upper side frame tubes 7, 8 (Fig. 5) to the respective cross strut. In the second embodiment, the position of the link element 41, 42 is not provided by an S-shaped cross-strut, but by a protuberance 51, 52, rigidly attached to the cross-strut, said protuberance extending above the otherwise uniformly extending cross strut and providing an attachment structure for the pivot axis 45, 46 for pivotal attachment of the proximal end of each link element 41, 42. In the precise embodiment shown in Figures 5-8, the protuberances 51, 52 extend in a direction that is perpendicular to the axis of cross-strut above the cross-strut. Of course, the protuberance could have any desired orientation, as long as the aim of the invention with respect to the location of the pivot axis of the second pivotal connection 45, 46 is achieved. Accordingly, as with the first embodiment, the pivot axis 45, 46 of the second pivotal connection is displaced upwardly by a distance b with respect to prior art devices, bringing the link element into a less skewed, close to horizontal position as shown in Figure 7. Since the protuberances 51, 52 are rigidly secured to the respective cross-struts 9, 10, for example by welding, the pivotal attachments of the respective link element 41, 42 at 45, 46 to the respective protuberance corresponds, from the stability point of view, to a pivotal attachment to the cross-strut as such.

[0058] In a variant of the second embodiment, one or both protuberances 51, 52 are a separate piece that is not welded to the respective cross-strut 9, 10, but which can be rigidly and detachably be secured to said cross-struts by way of a screw and a crew nut, for example. According to this embodiment, it is possible to apply the protuberances to the cross-strut of a prior art wheelchair, followed by pivotal attachment of the link elements 41, 42 to the protuberance thereby obtaining the wheelchair of the present invention. In this way, with little adjustment necessary, prior art devices can be conveniently modified so as to achieve the advantages of the invention.

[0059] The elements 51, 52 are generally referred herein as protuberances. Their function and structure can also be described by the terms "elevations" or "elevated structures", which are considered, for the purpose of the present specification, as synonyms of the term "protuberance".

[0060] Figures 6 and 8 show the assembly according to the second embodiment of the invention in a folded position, for storage or transport of the wheelchair.

[0061] Figure 10 shows a front view of a third embodiment of the wheelchair of the invention in an unfolded position of use. It can be seen in Figure 10, that the cross-struts 9, 10 also carry protuberances 51 and 52 as the second embodiment. However, the cross-struts 9, 10 of the third embodiment are not straight as in Figures 5-8, but each cross-strut comprises a single bend in the lower sections 48, 47. Due to the bends in each cross-strut, the upper section 43, 44 of each cross strut 9, 10 is slightly steeper than in the second embodiment, and, as a result, the distance b between plane a and the pivot axis of the second pivotal connection 45 of the left link element is slightly larger than in the second embodiment. The wheelchair of the third embodiment is equally easy to fold as the one of the first and the second embodiment.

[0062] In the two embodiments described in detail herein above, an embodiment with S-shaped cross-struts 9, 10 and another embodiment comprising a protuberance 51, 52 on each cross-strut are shown. Of course, other variations can be conceived for displacing the second pivotal connection 45, 46 in accordance with the invention, thereby achieving the same technical result following the principle of the present invention. An example is the use of a cross-strut having a large surface when seen in a front view. When the cross-strut is sufficiently large, a protuberance is, of course, no longer needed, as the pivot axis 45, 46 of the second pivotal connection can be arranged at any desired position on the large surface of said cross strut. In the same sense, the cross-strut may only locally be enlarged, for example by flattening of the tube, thereby creating a protuberance. It is also possible, for example, that a combination of S-shaped cross-struts further comprising a protuberance is provided in a single foldable wheelchair.

[0063] According to an alternative embodiment of the present invention (shown only in Fig. 7), plane a is the plane defined by the central pivot axis 30 and the axis 63 being the axis of the left seat tube 11, instead of the pivot axis 9.1 of the left cross-strut 9 and the central pivot axis 30. This alternative embodiment does not change anything with respect to the wheelchair shown in Figs. 5-8, because in this wheelchair, the plane a according to the original embodiment as shown in the figures and according to the present alternative embodiment is the same. More particularly, in Figure 7, plane a crosses all points 9.1, 30 and 63. However, in the wheelchairs shown in Figures 3 and 10, this alternative definition of plane a changes the position of plane a in that plane a would be oriented at a slightly steeper angle than shown in these figures. However, also with respect to this alternative embodiment, the pivot axis 45 of the second pivotal connection is above this alternative plane a. This alternative embodiment is thus also encompassed by the present invention and the all the indications given above, in particular those with respect to distance b, length axis e, horizontal line f, angular distance d, and angles α and β remain valid also for this embodiment.

Claims

1. A foldable wheelchair (1), the wheelchair comprising:

- a pair of left and right side frames (3, 4), each side frame comprising:
  - a longitudinal frame profile (7, 8); and,
  - a hinge (5.1, 6.1) with an axis of pivoting (9.1, 10.1) for pivotal connection of each side frame with a cross-strut (9, 10) at a lower section (47, 48) of said cross-strut;

  the wheelchair further comprising:
  - a cross brace assembly coupling the said side frames (3, 4) together for movement between a spaced apart deployed position and a proximate folded position, said cross brace assembly comprising:
    - at least two crosswise arranged struts (9, 10) and left and right seat profiles (11, 12) with substantially horizontal axis, wherein each one of said seat profiles (11, 12) is attached substantially perpendicularly to one of said at least two cross-wise arranged struts (9, 10), and wherein said at least two struts (9, 10) are pivotally connected one to the other at a central pivot axis (30);

characterized in that said wheelchair comprises a left and a right link element (41, 42), each one pivotally connecting one respective side frame (3, 4) to the respective strut (9, 10), wherein each link element comprises a first pivotal connection to one of said side frames (3, 4) and a second pivotal connection (45, 46) to the respective one of said struts (9, 10), said second pivotal connection being provided at an upper section (43, 44) of said respective strut; wherein a pivot axis (45, 46) of each of said second pivotal connections is situated above a plane (a), said plane (a) being on each side of the wheelchair the plane defined by the axis of pivoting (9.1, 10.1) of the respective hinge (5.1, 6.1) of the respective strut and by said central pivot axis (30), said plane (a) extending beyond said central pivot axis (30).

2. The wheelchair of claim 1, wherein said pivot axis (45, 46) of said second pivotal connection is at a distance (b) above said plane (a), wherein said distance (b) is at least 0.5 cm, preferably at least 1 cm, more preferably at least 1.5 cm and most preferably at least 2 cm above said plane (a).

3. The wheelchair of claim 1 or 2, wherein each one of said link elements (41, 42) has a length axis (e), said axis (e) being the line passing through the pivot axis (61, 62) of said first pivotal connection and through the pivot axis (45, 46) of said second pivotal connection of said link element (41, 42), wherein, in a position of use, said length axis (e) is close to horizontal so as to include an angle (β) of $\leq 20°$, preferably $\leq 15°$, more preferably $\leq 10°$ and most preferably $\leq 7°$ with respect to horizontal.

4. The wheelchair of any one of claims 1-3, wherein each one of said link elements (41, 42) has a length axis (e), said length axis (e) being the line passing through the axis (61, 62) of said first pivotal connection and through said axis (45, 46) of said second pivotal connection of said link element, wherein said length axis (e) pivots upwards with the wheelchair passing from said deployed position to said folded position, thereby rotating about an angle (α), said angle being $\leq 90°$, preferably $\leq 80°$, more preferably $\leq 75°$, even more preferably $\leq 70°$ and most preferably $\leq 65°$.

5. The wheelchair of any one of claims 3 and 4, wherein said length axis (e) extends substantially perpendicularly to the longitudinal rear-to-front direction of the wheelchair.

6. The wheelchair of any one of claims 3-5, wherein said length axis (e) is determined from a front view of the wheelchair.

7. The foldable wheelchair of any one of the preceding claims, wherein an axis of pivoting (61, 62) of each one of said link elements (41, 42) at the first pivotal connection of the link element to the side frame (3, 4) coincides with the axis of one of said longitudinal frame profiles (7, 8).

8. The wheelchair of any one of the preceding claims, wherein at least one of said cross struts (9, 10) comprises at least two bends one of which in said upper section (43, 44) and one in a lower section (47, 48) of said cross strut, and/or wherein at least one of said cross struts (9, 10) are S-shaped.

9. The wheelchair of claim 8, wherein the at least two bends of one cross strut are bends in opposite directions.

10. The wheelchair of claim 8 or 9, wherein said two bends divide said cross-strut in three successive substantially straight strut sections, two lateral sections and one central section, wherein said straight strut sections are separated by said two bends, with a bend being provided between two successive straight strut sections, wherein the central pivot point (30) is provided at said central section of the three sections, and/or wherein said central section is closer to vertical than the two lateral sections of the cross-strut (9, 10), the lateral sections being closer to horizontal than the central section.

11. The wheelchair of any one of claims 1-7, wherein a protuberance (51, 52) is rigidly provided on each of said left and right cross-struts (9, 10) and wherein said protuberance provides a support for said second pivotal connection (45, 46).

12. The wheelchair of claim 11, wherein said protuberance (51, 52) is provided on an upper section 43, 44 of said cross-strut.

13. The wheelchair of any one of claims 11 and 12, wherein said protuberance (51, 52) is arranged in a substantially perpendicular manner to the respective cross-strut (9, 10).

14. The wheelchair of any one of claims 11-13, wherein said protuberance (51, 52) displaces in an upward direction said second pivotal connection.

15. The wheelchair of any one of claims 11-14, wherein said protuberance (51, 52) comprises a hole, said hole harbouring an axle for said second pivotal connection.

16. The wheelchair of any one of the preceding claims, wherein each one of said link elements is pivotally attached to said longitudinal side frame profile, in particular to said upper side frame profile (7, 8).

17. The wheelchair of any one of the preceding claims, wherein, said second pivotal connection is at a distance (b) above said plane (a), and wherein on each of said two crosswise arranged struts, said distance (b) between said second pivotal connection (45, 46) and the plane (a) of the respective strut is substantially identical.

18. The wheelchair of any one of the preceding claims, wherein said second pivotal connection between each one of said link elements and said respective strut is neat and/or tight,

19. The wheelchair of any one of the preceding claims, wherein said second pivotal connection is provided at a fixed position of the respective strut and the respective link element and/or wherein, during folding and or unfolding, the pivot axis (45, 46) of said second pivotal connection on said respective strut is at a fixed position with respect to the strut and/or the link element.

20. The wheelchair of any one of the preceding claims, wherein, during folding and or unfolding, the pivot axis (45, 46) of said second pivotal connection is at a fixed position on each one of said link elements, in particular with respect to the longitudinal extension of each one of said link elements.

21. The wheelchair of any one of the preceding claims, wherein each one of said link elements is free of and/or lacks a slot in which said pivot axis (45, 46) of said second pivotal connection is displaced in parallel during folding and/or unfolding of the wheelchair.

22. The wheelchair of any one of the preceding claims, wherein each one of said link elements (41, 42) is pivotally connected, with said first pivotal connection, to said longitudinal frame profiles (7, 8).

23. The wheelchair of any one of the preceding claims, wherein each point or position of one of said struts (9 or 10) is at an equal distance from a vertical plane, which plane is parallel to said side frames (3, 4) and goes through said central pivot axis (30), if compared to a corresponding point or position on the other one of said struts, in the unfolded and/or folded position and when seen in a front view.

24. The wheelchair of any one of the preceding claims, wherein said crosswise arranged struts (9, 10), when seen in a front view and projected to a transversal plane, are symmetrical with respect to a vertical plane of symmetry, said plane of symmetry being substantially parallel to said side frames (3, 4) and

crossing said central pivot axis (30).

25. The wheelchair of claim 24, wherein said link elements (41, 42) and/or said side frames (3, 4) are also symmetrical and have the same plane of symmetry when seen in a front view and projected to a transversal plane.

Patentansprüche

1. Faltbarer Rollstuhl (1), wobei der Rollstuhl Folgendes umfasst:

- ein Paar linker und rechter Seitenrahmen (3, 4), wobei jeder Rahmen Folgendes umfasst:
- ein Längsrahmenprofil (7, 8); und
- ein Gelenk (5.1, 6.1) mit einer Schwenkachse (9.1, 10.1) für die Schwenkverbindung jedes Seitenrahmens mit einer Querstrebe (9, 10) an einem unteren Abschnitt (47, 48) dieser Querstrebe;

wobei der Rollstuhl ferner Folgendes umfasst:

- eine Querstrebenanordnung, welche die Seitenrahmen (3, 4) für eine Bewegung zwischen einer beabstandeten entfalteten Stellung und einer angenäherten gefalteten Stellung miteinander verbindet, wobei diese Querstrebenanordnung Folgendes umfasst:

  - mindestens zwei kreuzweise angeordnete Streben (9, 10) und linke und rechte Sitzprofile (11, 12) mit einer im Wesentlichen horizontalen Achse, wobei jedes dieser Sitzprofile (11, 12) im Wesentlichen senkrecht an einer der mindestens zwei kreuzweise angeordneten Streben (9, 10) befestigt ist, und wobei diese mindestens zwei Streben (9, 10) an einer mittleren Schwenkachse (30) schwenkbar miteinander verbunden sind;

dadurch gekennzeichnet, dass der Rollstuhl ein linkes und ein rechtes Verbindungselement (41, 42) umfasst, von denen jedes einen entsprechenden Seitenrahmen (3, 4) mit der entsprechenden Strebe (9, 10) schwenkbar verbindet, wobei jedes Verbindungselement eine erste Schwenkverbindung mit einem dieser Seitenrahmen (3, 4) und eine zweite Schwenkverbindung (45, 46) mit der jeweiligen Strebe (9, 10) umfasst, wobei die zweite Schwenkverbindung an einem oberen Abschnitt (43, 44) der jeweiligen Strebe vorgesehen ist; wobei eine Schwenkachse (45, 46) von jeder dieser zweiten Schwenkverbindungen oberhalb einer Ebene (a) liegt, wobei diese Ebene (a) auf jeder Seite des Rollstuhls die Ebene ist, die durch die Schwenkachse (9.1, 10.1) des jeweiligen Gelenks (5.1, 6.1) der jeweiligen Strebe und durch die mittlere Schwenkachse (30) definiert wird, wobei sich diese Ebene (a) über diese mittlere Schwenkachse (30) hinaus erstreckt.

2. Rollstuhl nach Anspruch 1, bei dem sich die Schwenkachse (45, 46) der zweiten Schwenkverbindung in einem Abstand (b) über dieser Ebene (a) befindet, wobei dieser Abstand (b) mindestens 0,5 cm, vorzugsweise mindestens 1 cm, bevorzugter mindestens 1,5 cm und am bevorzugtesten mindestens 2 cm über dieser Ebene (a) beträgt.

3. Rollstuhl nach Anspruch 1 oder 2, bei dem jedes der Verbindungselemente (41, 42) eine Längsachse (e) aufweist, wobei diese Achse (e) die Linie ist, die durch die Schwenkachse (61, 62) der ersten Schwenkverbindung und durch die Schwenkachse (45, 46) der zweiten Schwenkverbindung dieses Verbindungselements (41, 42) verläuft, wobei diese Längsachse (e) in einer Gebrauchsstellung nahe der Horizontalen ist, so dass sie mit der Horizontalen einen Winkel (β) $\leq 20°$, vorzugsweise $\leq 15°$, bevorzugter $\leq 10°$ und am bevorzugtesten $\leq 7°$ einschließt.

4. Rollstuhl nach einem der Ansprüche 1 bis 3, bei dem jedes der Verbindungselemente (41, 42) eine Längsachse (e) aufweist, wobei diese Längsachse (e) die Linie ist, die durch die Achse (61, 62) der ersten Schwenkverbindung und durch die Achse (45, 46) der zweiten Schwenkverbindung des Verbindungselements verläuft, wobei diese Längsachse (e) beim Übergang des Rollstuhls von der entfalteten Stellung zur gefalteten Stellung nach oben schwenkt und sich dadurch um einen Winkel (α) dreht, wobei dieser Winkel $\leq 90°$, vorzugsweise $\leq 80°$, bevorzugter $\leq 75°$, noch bevorzugter $\leq 70°$ und am bevorzugtesten $\leq 65°$ ist.

5. Rollstuhl nach einem der Ansprüche 3 und 4, bei dem sich die Längsachse (e) im Wesentlichen senkrecht zur Längsrichtung von hinten nach vorne des Rollstuhls erstreckt.

6. Rollstuhl nach einem der Ansprüche 3 bis 5, bei dem die Längsachse (e) von einer Vorderansicht des Rollstuhls definiert wird.

7. Faltbarer Rollstuhl nach einem der vorherigen Ansprüche, bei dem eine Schwenkachse (61, 62) von jedem der Verbindungselemente (41, 42) an der ersten Schwenkverbindung des Verbindungselements mit dem Seitenrahmen (3, 4) mit der Achse von einem der Längsrahmenprofile (7, 8) zusammenfällt.

8. Rollstuhl nach einem der vorherigen Ansprüche, bei dem mindestens eine der Querstreben (9, 10) mindestens zwei Bögen, davon einen im oberen Abschnitt (43, 44) und einen im unteren Abschnitt (47, 48) der Querstrebe, umfasst, und/oder bei dem mindestens eine der Querstreben (9, 10) S-förmig ist.

9. Rollstuhl nach Anspruch 8, bei dem die mindestens zwei Bögen von einer Querstrebe Bögen in entgegengesetzte Richtungen sind.

10. Rollstuhl nach Anspruch 8 oder 9, bei dem die zwei Bögen die Querstrebe in drei aufeinanderfolgende im Wesentlichen gerade Strebenabschnitte, zwei seitliche Abschnitte und einen mittleren Abschnitt, unterteilen, wobei diese geraden Strebenabschnitte durch diese zwei Bögen getrennt werden, wobei ein Bogen zwischen zwei aufeinanderfolgenden geraden Strebenabschnitten vorgesehen ist, wobei der mittlere Schwenkpunkt (30) an dem mittleren Abschnitt der drei Abschnitte vorgesehen ist, und/oder wobei der mittlere Abschnitt näher an der Vertikalen als die zwei seitlichen Abschnitte der Querstrebe (9, 10) ist, wobei die seitlichen Abschnitte näher an der Horizontalen als der mittlere Abschnitt sind.

11. Rollstuhl nach einem der Ansprüche 1 bis 7, bei dem ein Vorsprung (51, 52) starr an jeder der linken und rechten Querstreben (9, 10) vorgesehen ist und bei dem dieser Vorsprung eine Abstützung für die zweite Schwenkverbindung (45, 46) bereitstellt.

12. Rollstuhl nach Anspruch 11, bei dem der Vorsprung (51, 52) an einem oberen Abschnitt (43, 44) der Querstrebe vorgesehen ist.

13. Rollstuhl nach einem der Ansprüche 11 und 12, bei dem der Vorsprung (51, 52) im Wesentlichen senkrecht zur entsprechenden Querstrebe (9, 10) angeordnet ist.

14. Rollstuhl nach einem der Ansprüche 11 bis 13, bei dem der Vorsprung (51, 52) die zweite Schwenkverbindung nach oben verschiebt.

15. Rollstuhl nach einem der Ansprüche 11 bis 14, bei dem der Vorsprung (51, 52) ein Loch umfasst, wobei dieses Loch eine Welle für die zweite Schwenkverbindung beherbergt.

16. Rollstuhl nach einem der vorherigen Ansprüche, bei dem jedes der Verbindungselemente schwenkbar an dem Längsseitenrahmenprofil und insbesondere am oberen Seitenrahmenprofil (7, 8) befestigt ist.

17. Rollstuhl nach einem der vorherigen Ansprüche, bei dem sich die zweite Schwenkverbindung in einem Abstand (b) oberhalb der Ebene (a) befindet, und wobei bei jeder der zwei kreuzweise angeordneten Streben dieser Abstand (b) zwischen der zweiten Schwenkverbindung (45, 46) und der Ebene (a) der entsprechenden Strebe im Wesentlichen gleich ist.

18. Rollstuhl nach einem der vorherigen Ansprüche, bei dem diese zweite Schwenkverbindung zwischen jedem der Verbindungselemente und der entsprechenden Strebe eng und/oder fest ist.

19. Rollstuhl nach einem der vorherigen Ansprüche, bei dem die zweite Schwenkverbindung an einer unveränderlichen Stelle der entsprechenden Strebe und des entsprechenden Verbindungselements vorgesehen ist, und/oder bei dem sich die Schwenkachse (45, 46) der zweiten Schwenkverbindung auf der entsprechenden Strebe während des Faltens oder Entfaltens an einer unveränderlichen Stelle bezogen auf die Strebe und/oder das Verbindungselement befindet.

20. Rollstuhl nach einem der vorherigen Ansprüche, bei dem sich die Schwenkachse (45, 46) der zweiten Schwenkverbindung während des Faltens oder Entfaltens an einer unveränderlichen Stelle auf jedem der Verbindungselemente insbesondere bezogen auf die Längsausdehnung von jedem dieser Verbindungselemente befindet.

21. Rollstuhl nach einem der vorherigen Ansprüche, bei dem jedes der Verbindungselemente ohne einen Schlitz ist und/oder keinen Schlitz hat, in dem die Schwenkachse (45, 46) der zweiten Schwenkverbindung während des Faltens und/oder Entfaltens des Rollstuhls parallel verschoben wird.

22. Rollstuhl nach einem der vorherigen Ansprüche, bei dem jedes der Verbindungselemente (41, 42) mit der ersten Schwenkverbindung schwenkbar mit den Längsrahmenprofilen (7, 8) verbunden ist.

23. Rollstuhl nach einem der vorherigen Ansprüche, bei dem sich jeder Punkt oder jede Stelle von einer der Streben (9 oder 10) verglichen mit einem entsprechenden Punkt oder einer entsprechenden Stelle auf der anderen dieser Streben in der entfalteten und/oder gefalteten Stellung und von vorne gesehen in einem gleichen Abstand zu einer vertikalen Ebene befindet, wobei diese Ebene parallel zu den Seitenrahmen (3, 4) ist und durch die mittlere Schwenkachse (30) verläuft.

24. Rollstuhl nach einem der vorherigen Ansprüche, bei dem die kreuzweise angeordneten Streben (9, 10) von vorne gesehen und auf eine Querebene projiziert symmetrisch zu einer vertikalen Symmetrieebene sind, wobei diese Symmetrieebene im Wesentlichen parallel zu den Seitenrahmen (3, 4) ist und die

mittlere Schwenkachse (30) kreuzt.

25. Rollstuhl nach Anspruch 24, bei dem die Verbindungselemente (41, 42) und/oder die Seitenrahmen (3, 4) ebenfalls symmetrisch sind und dieselbe Symmetrieebene haben, wenn sie von vorne betrachtet und auf eine Querebene projiziert werden.

Revendications

1. Fauteuil roulant (1) pliable, le fauteuil roulant comprenant :

- une paire de cadres latéraux (3, 4) gauche et droit, chaque cadre latéral comprenant :
- un profil de cadre longitudinal (7, 8) ; et
- une charnière (5.1, 6.1) avec un axe de pivotement (9.1, 10.1) pour le raccordement pivotant de chaque cadre latéral à une traverse transversale (9, 10) à une partie inférieure (47, 48) de ladite traverse transversale ;

le fauteuil roulant comprenant en outre :

- un assemblage d'entretoisement transversal couplant lesdits cadres latéraux (3, 4) ensemble pour le déplacement entre une position déployée écartée et une position proximale pliée, ledit assemblage d'entretoisement transversal comprenant :

  - au moins deux traverses (9, 10) disposées en croix et des profils de siège (11, 12) gauche et droit avec un axe sensiblement horizontal, chacun desdits profils de siège (11, 12) étant fixé de manière sensiblement perpendiculaire à l'une desdites au moins deux traverses (9, 10) disposées en croix, et lesdites au moins deux traverses (9, 10) étant raccordées de manière pivotante l'une à l'autre au niveau d'un axe de pivot central (30) ;

caractérisé en ce que ledit fauteuil roulant comprend un élément de liaison (41, 42) gauche et droit, chacun raccordant de manière pivotante un cadre latéral respectif (3, 4) à la traverse respective (9, 10), chaque élément de liaison comprenant un premier raccordement pivotant à un desdits cadres latéraux (3, 4) et un deuxième raccordement pivotant (45, 46) à ladite une respective desdites traverses (9, 10), ledit deuxième raccordement pivotant étant réalisé à une partie supérieure (43, 44) de ladite traverse respective ; un axe de pivot (45, 46) de chacun desdits deuxièmes raccordements pivotants étant situé au-dessus d'un plan (a), ledit plan (a) étant, sur chaque côté du fauteuil roulant, le plan défini par l'axe de pivotement (9.1, 10.1) de la charnière respective (5.1, 6.1) de la traverse respective et par ledit axe de pivot central (30), ledit plan (a) s'étendant au-delà dudit axe de pivot central (30).

2. Fauteuil roulant selon la revendication 1, ledit axe de pivot (45, 46) dudit deuxième raccordement pivotant étant à une distance (b) au-dessus dudit plan (a), ladite distance (b) se situant d'au moins 0,5 cm, de préférence d'au moins 1 cm, plus préférablement d'au moins 1,5 cm et le plus préférablement d'au moins 2 cm au-dessus dudit plan (a).

3. Fauteuil roulant selon la revendication 1 ou 2, chacun desdits éléments de liaison (41, 42) présentant un axe longitudinal (e), ledit axe (e) étant la ligne passant à travers l'axe de pivot (61, 62) dudit premier raccordement pivotant et à travers l'axe de pivot (45, 46) dudit deuxième raccordement pivotant dudit élément de liaison (41, 42), ledit axe longitudinal (e), dans une position d'utilisation, étant proche de l'horizontale de manière à inclure un angle (β) $\leq 20°$, de préférence $\leq 15°$, plus préférablement $\leq 10°$ et le plus préférablement $\leq 7°$ par rapport à l'horizontale.

4. Fauteuil roulant selon l'une quelconque des revendications 1 à 3, chacun desdits éléments de liaison (41, 42) présentant un axe longitudinal (e), ledit axe longitudinal (e) étant la ligne passant à travers l'axe (61, 62) dudit premier raccordement pivotant et à travers ledit axe (45, 46) dudit deuxième raccordement pivotant dudit élément de liaison, ledit axe longitudinal (e) pivotant vers le haut quand le fauteuil roulant passe de ladite position déployée à ladite position pliée, tournant ainsi d'environ un angle (α), ledit angle étant $\leq 90°$, de préférence $\leq 80°$, plus préférablement $\leq 75°$, de manière encore plus préférée $\leq 70°$ et le plus préférablement $\leq 65°$.

5. Fauteuil roulant selon l'une quelconque des revendications 3 et 4, ledit axe longitudinal (e) s'étendant de manière sensiblement perpendiculaire à la direction de l'arrière vers l'avant longitudinale du fauteuil roulant.

6. Fauteuil roulant selon l'une quelconque des revendications 3 à 5, ledit axe longitudinal (e) étant déterminé à partir d'une vue frontale du fauteuil roulant.

7. Fauteuil roulant pliable selon l'une quelconque des revendications précédentes, un axe de pivotement (61, 62) de chacun desdits éléments de liaison (41, 42) au premier raccordement pivotant de l'élément de liaison au cadre latéral (3, 4) coïncidant avec l'axe d'un desdits profils de cadres longitudinaux (7, 8).

8. Fauteuil roulant selon l'une quelconque des revendications précédentes, au moins une desdites tra-

verses transversales (9, 10) comprenant au moins deux coudes dont un se situe dans ladite partie supérieure (43, 44) et un dans une partie inférieure (47, 48) de ladite traverse transversale et/ou au moins une desdites traverses transversales (9, 10) étant en forme de S.

9. Fauteuil roulant selon la revendication 8, lesdits au moins deux coudes d'une traverse transversale étant des coudes dans des directions opposées.

10. Fauteuil roulant selon la revendication 8 ou 9, lesdits deux coudes divisant ladite traverse transversale en trois parties de traverse sensiblement droites successives, deux parties latérales et une partie centrale, lesdites parties de traverses droites étant séparées par lesdits deux coudes, un coude étant réalisé entre deux parties de traverse droites successives, le point pivot central (30) étant réalisé au niveau de ladite partie centrale des trois parties et/ou ladite partie centrale étant plus proche de la verticale que les deux parties latérales de la traverse transversale (9, 10), les parties latérales étant plus proches de l'horizontale que la partie centrale.

11. Fauteuil roulant selon l'une quelconque des revendications 1 à 7, une protubérance (51, 52) étant réalisée de manière rigide sur chacune desdites traverses transversales (9, 10) gauche et droite et ladite protubérance fournissant un support pour ledit deuxième raccordement pivotant (45, 46).

12. Fauteuil roulant selon la revendication 11, ladite protubérance (51, 52) étant réalisée sur une partie supérieure 43, 44 de ladite traverse transversale.

13. Fauteuil roulant selon l'une quelconque des revendications 11 et 12, ladite protubérance (51, 52) étant agencée de manière sensiblement perpendiculaire à la traverse transversale (9, 10) respective.

14. Fauteuil roulant selon l'une quelconque des revendications 11 à 13, ladite protubérance (51, 52) déplaçant dans une direction vers le haut ledit deuxième raccordement pivotant.

15. Fauteuil roulant selon l'une quelconque des revendications 11 à 14, ladite protubérance (51, 52) comprenant un trou, ledit trou hébergeant un axe pour ledit deuxième raccordement pivotant.

16. Fauteuil roulant selon l'une quelconque des revendications précédentes, chacun desdits éléments de liaison étant fixé de manière pivotante audit profil de cadre latéral longitudinal, en particulier audit profil de cadre latéral (7, 8) supérieur.

17. Fauteuil roulant selon l'une quelconque des revendications précédentes, ledit deuxième raccordement pivotant se situant à une distance (b) au-dessus dudit plan (a) et sur chacune desdites deux traverses disposées en croix, ladite distance (b) entre ledit deuxième raccordement pivotant (45, 46) et le plan (a) de la traverse respective étant sensiblement identique.

18. Fauteuil roulant selon l'une quelconque des revendications précédentes, ledit deuxième raccordement pivotant entre chacun desdits éléments de liaison et ladite traverse respective étant étroit et/ou serré.

19. Fauteuil roulant selon l'une quelconque des revendications précédentes, ledit second raccordement pivotant étant situé à une position fixe de la traverse respective et de l'élément de liaison respectif et/ou, pendant le pliage et ou le dépliage, l'axe de pivot (45, 46) dudit deuxième raccordement pivotant sur ladite traverse respective se situant à une position fixe par rapport à la traverse et/ou à l'élément de liaison.

20. Fauteuil roulant selon l'une quelconque des revendications précédentes, l'axe de pivot (45, 46) dudit deuxième raccordement pivotant se situant, pendant le pliage et ou le dépliage, à une position fixe sur chacun desdits éléments de liaison, en particulier par rapport à l'extension longitudinale de chacun desdits éléments de liaison.

21. Fauteuil roulant selon l'une quelconque des revendications précédentes, chacun desdits éléments de liaison étant exempt de et/ou sans une fente dans laquelle ledit axe de pivot (45, 46) dudit deuxième raccordement pivotant est déplacé parallèlement pendant le pliage et/ou le dépliage du fauteuil roulant.

22. Fauteuil roulant selon l'une quelconque des revendications précédentes, chacun desdits éléments de liaison (41, 42) étant raccordé de manière pivotante, par ledit premier raccordement pivotant, auxdits profils de cadres longitudinaux (7, 8).

23. Fauteuil roulant selon l'une quelconque des revendications précédentes, chaque point ou position d'une desdites traverses (9 ou 10) se situant à égale distance d'un plan vertical, lequel plan étant parallèle auxdits cadres latéraux (3, 4) et passant à travers ledit axe de pivot central (30), si on le compare à un point ou une position correspondant(e) sur l'autre desdites traverses, dans la position non pliée et/ou pliée et en vue frontale.

24. Fauteuil roulant selon l'une quelconque des revendications précédentes, les traverses (9, 10) agen-

cées en croix, en vue frontale et projetées sur un plan transversal, étant symétriques par rapport à un plan vertical de symétrie, ledit plan de symétrie étant sensiblement parallèle auxdits cadres latéraux (3, 4) et traversant ledit axe de pivot central (30).

25. Fauteuil roulant selon la revendication 24, lesdits éléments de liaison (41, 42) et/ou lesdits cadres latéraux (3, 4) étant également symétriques et présentant le même plan de symétrie en vue frontale et projetés sur un plan transversal.

FIG.1

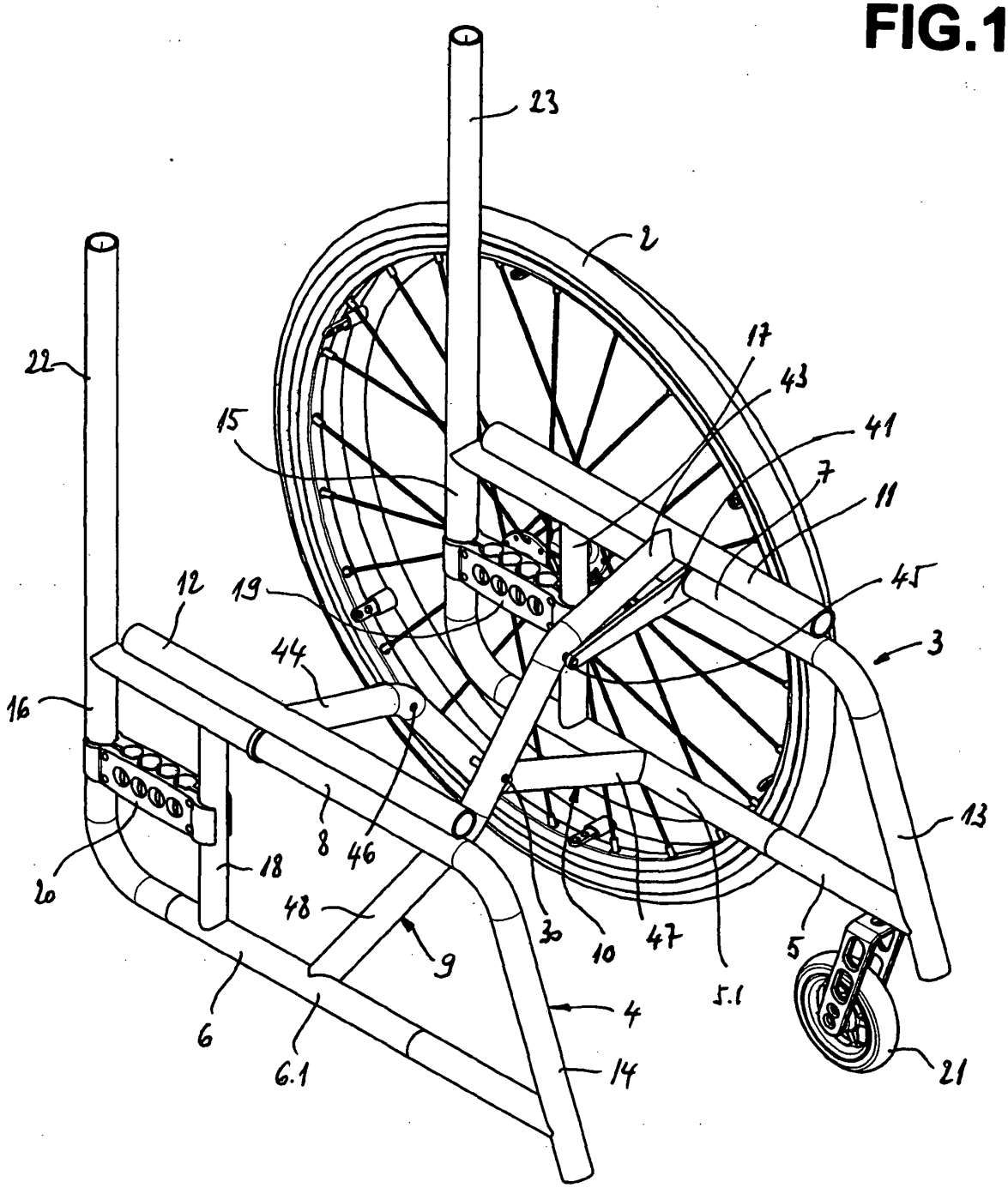
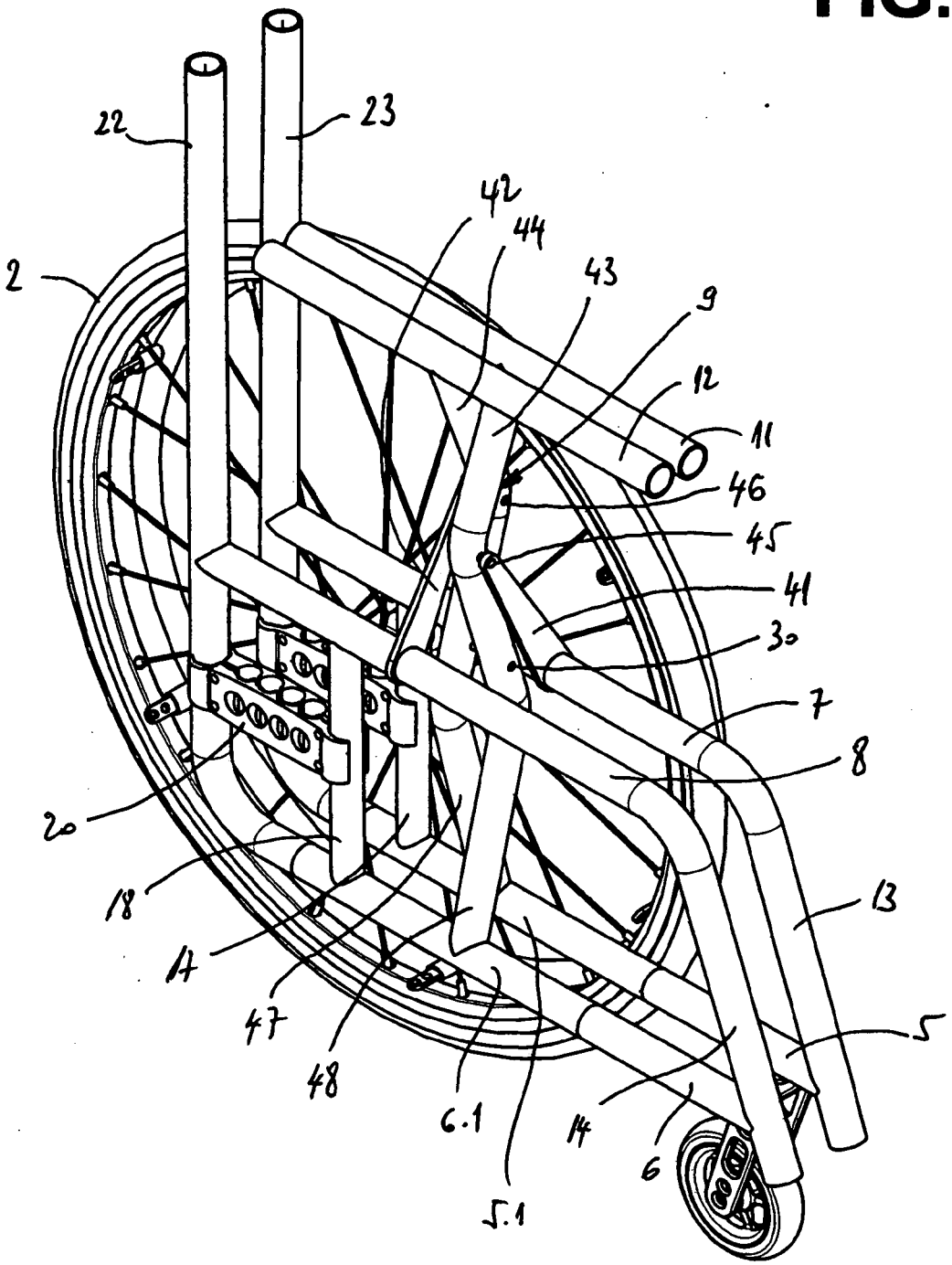

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FIG.2



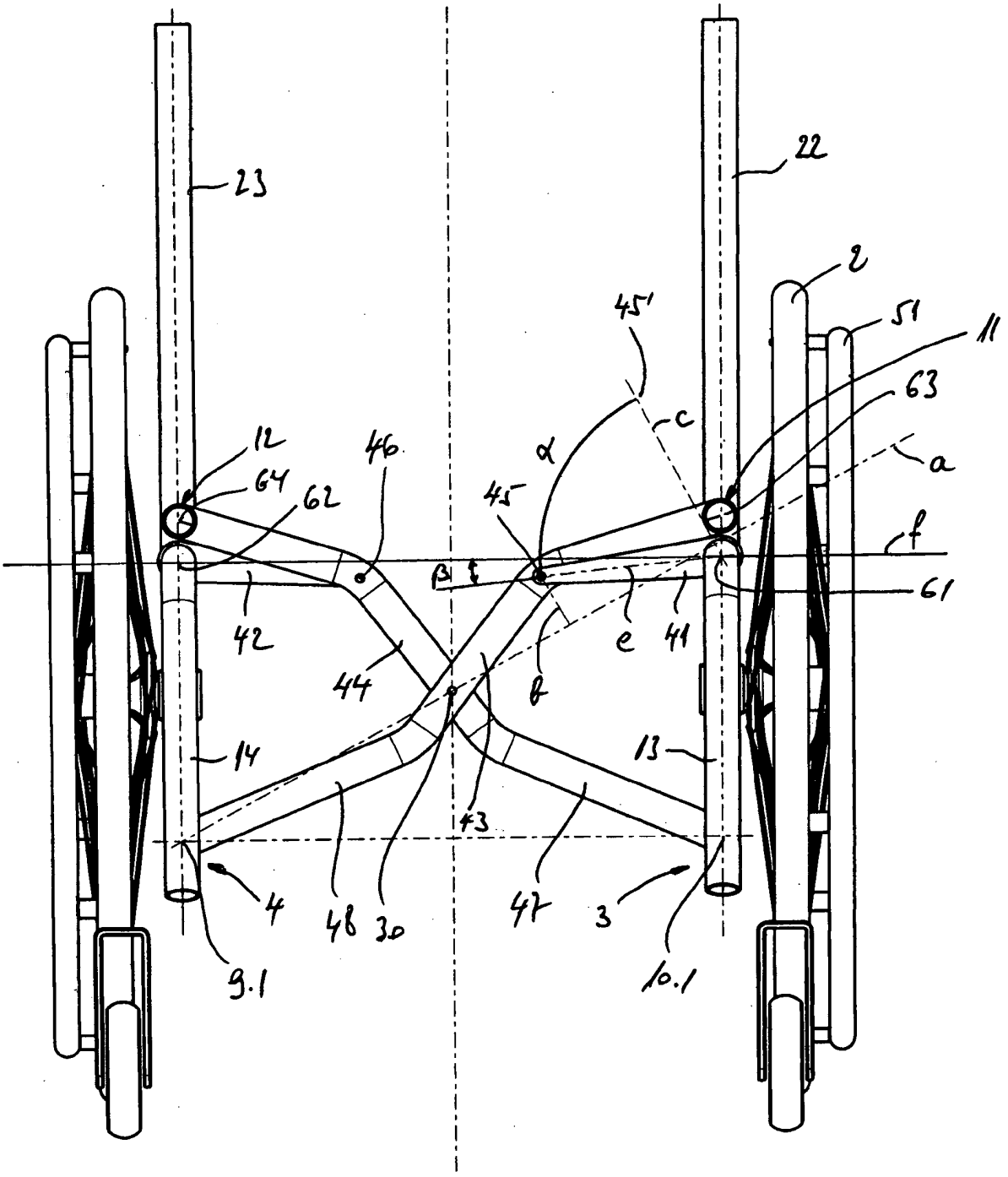

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FIG.3

FIG.4

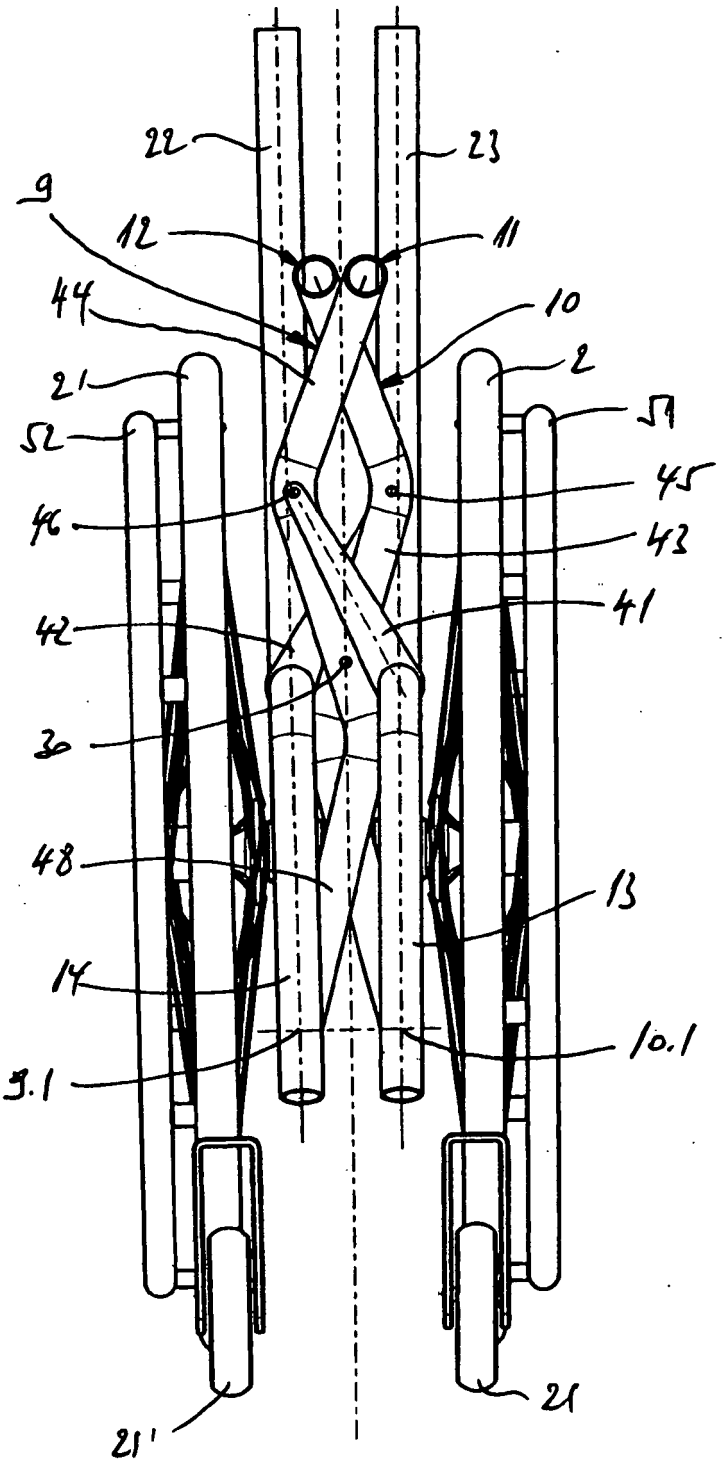


FIG.5

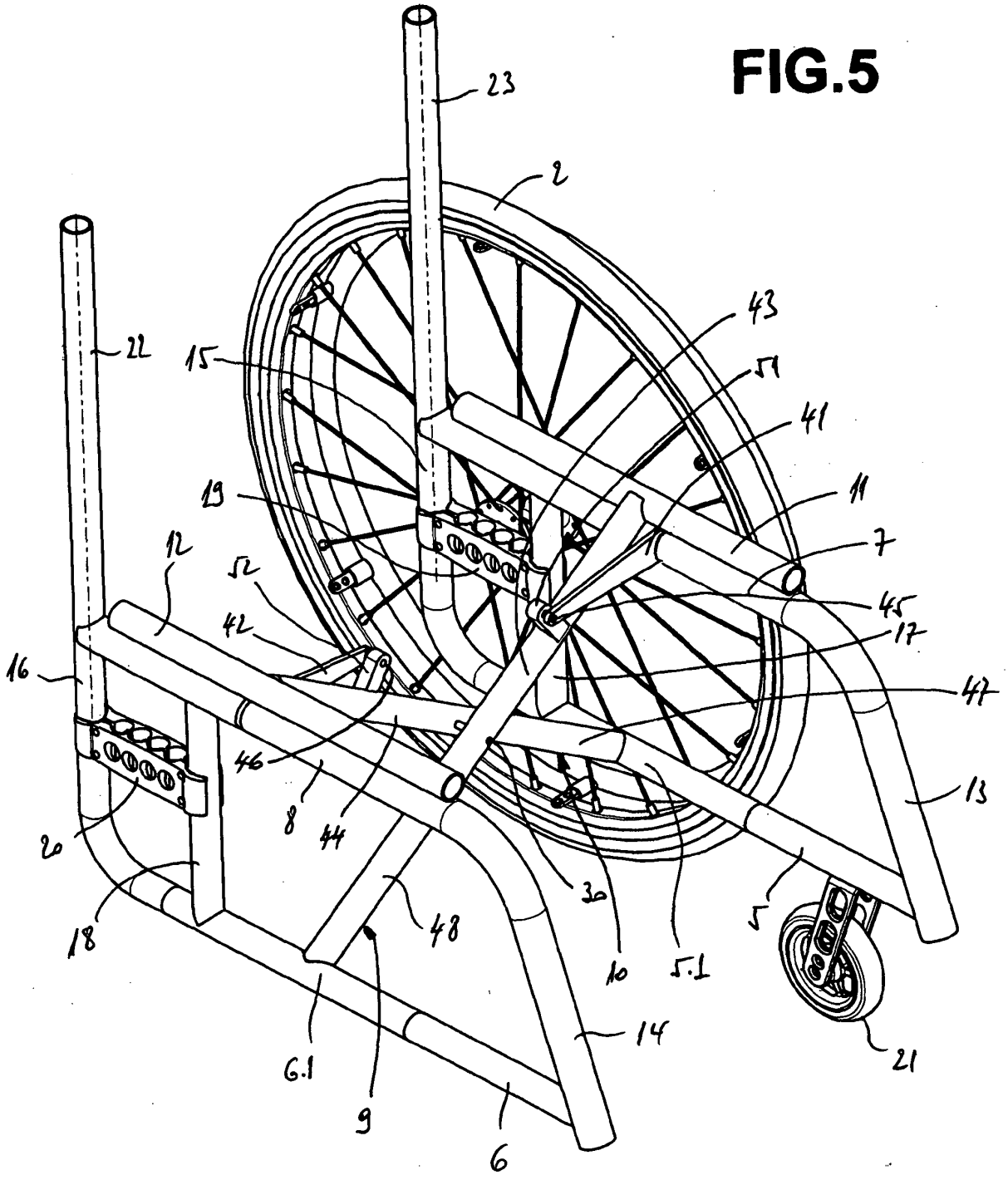
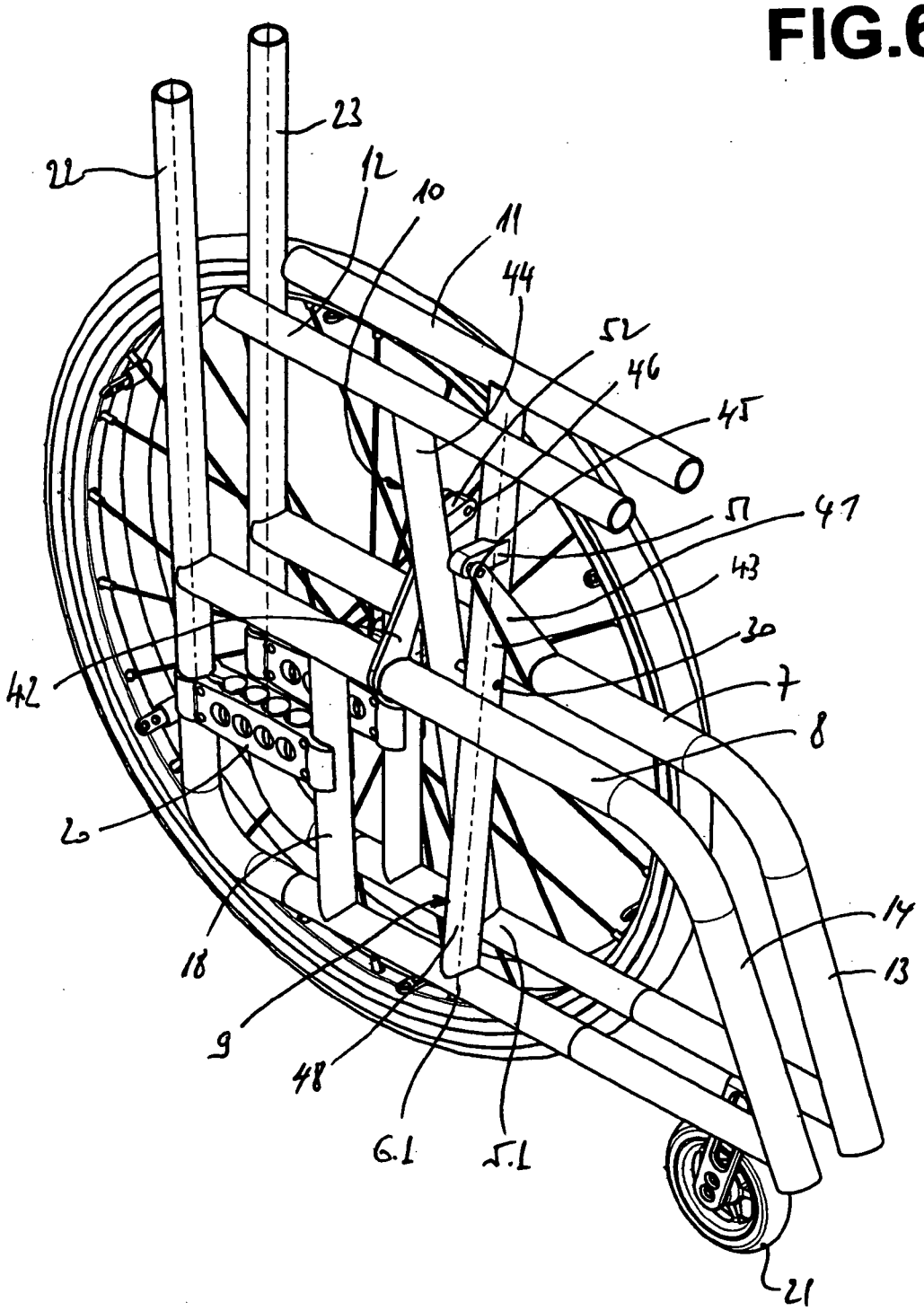

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FIG.6



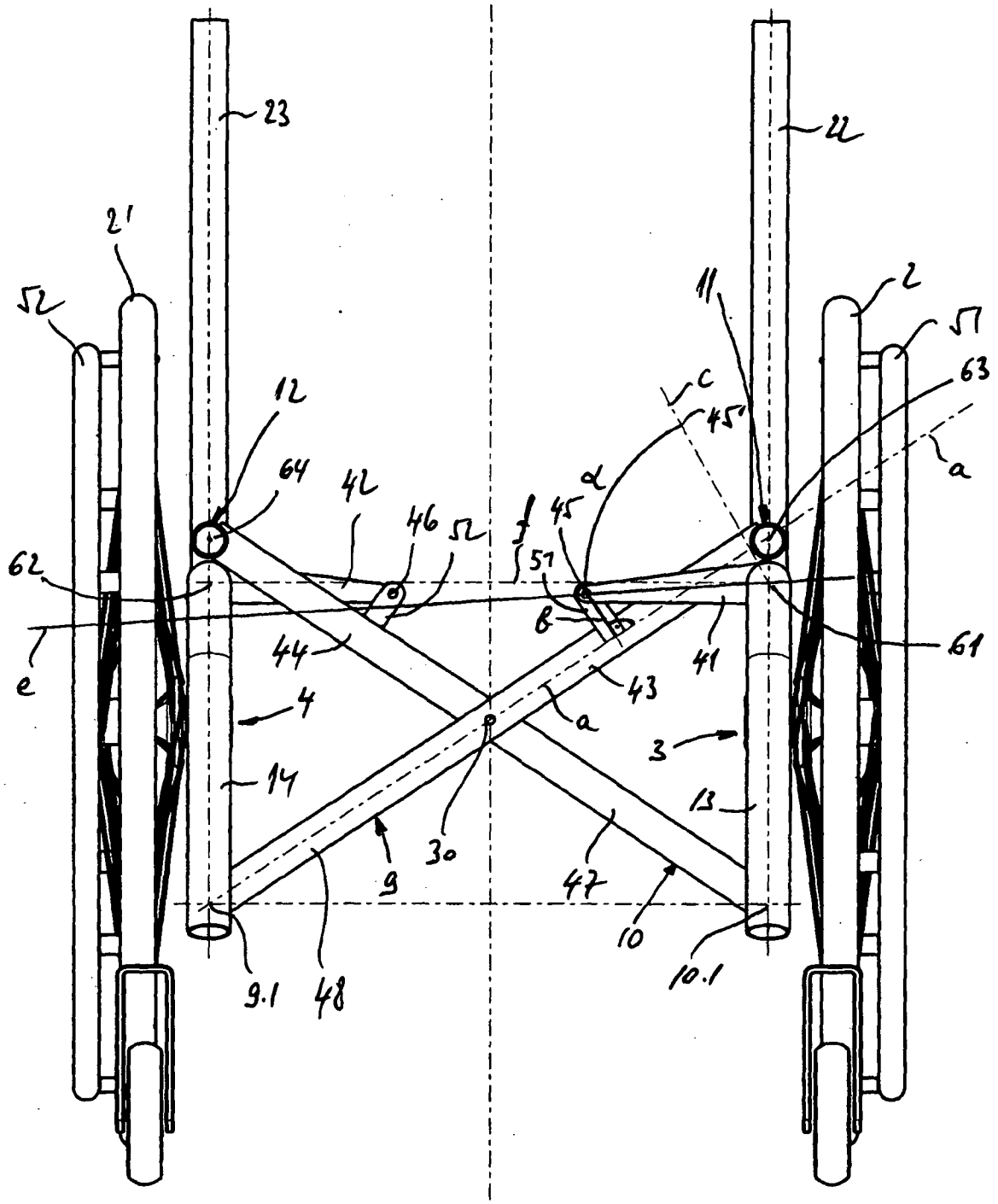

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FIG.7

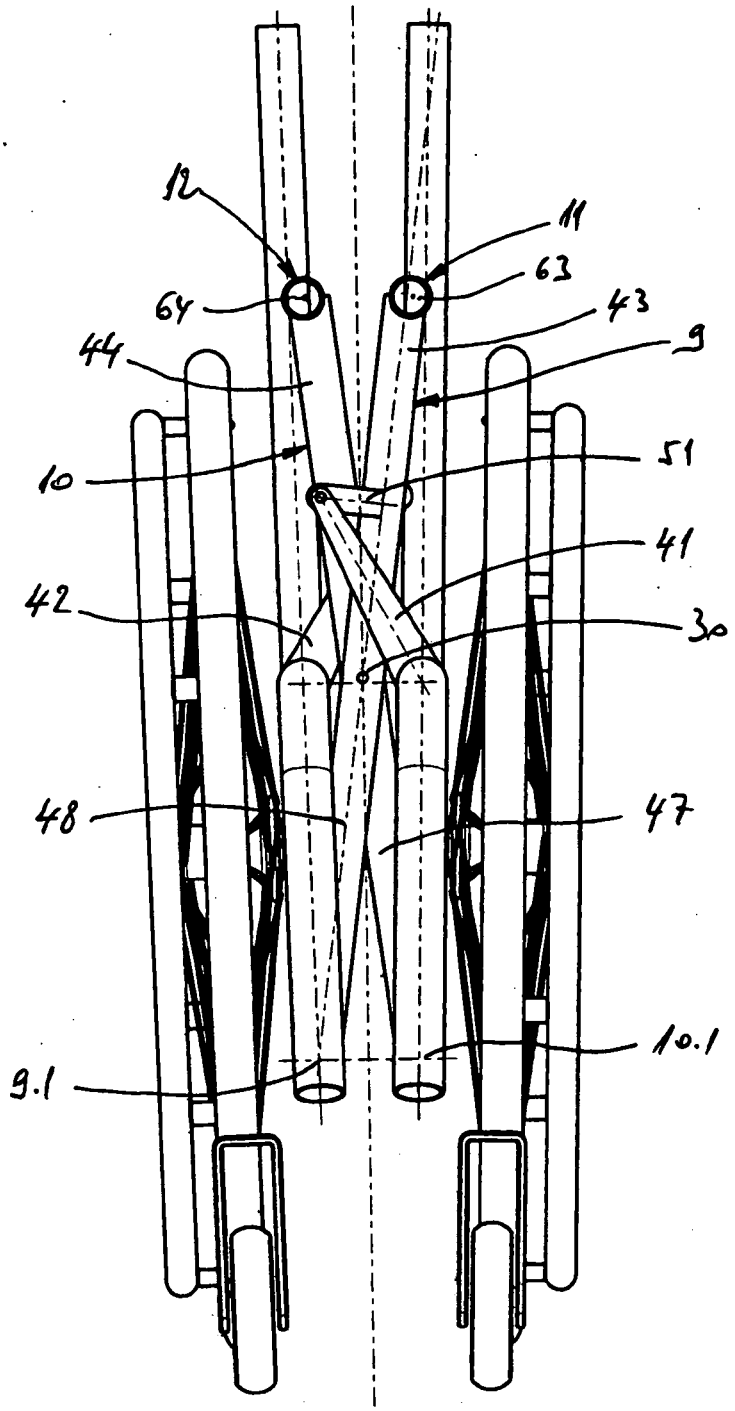
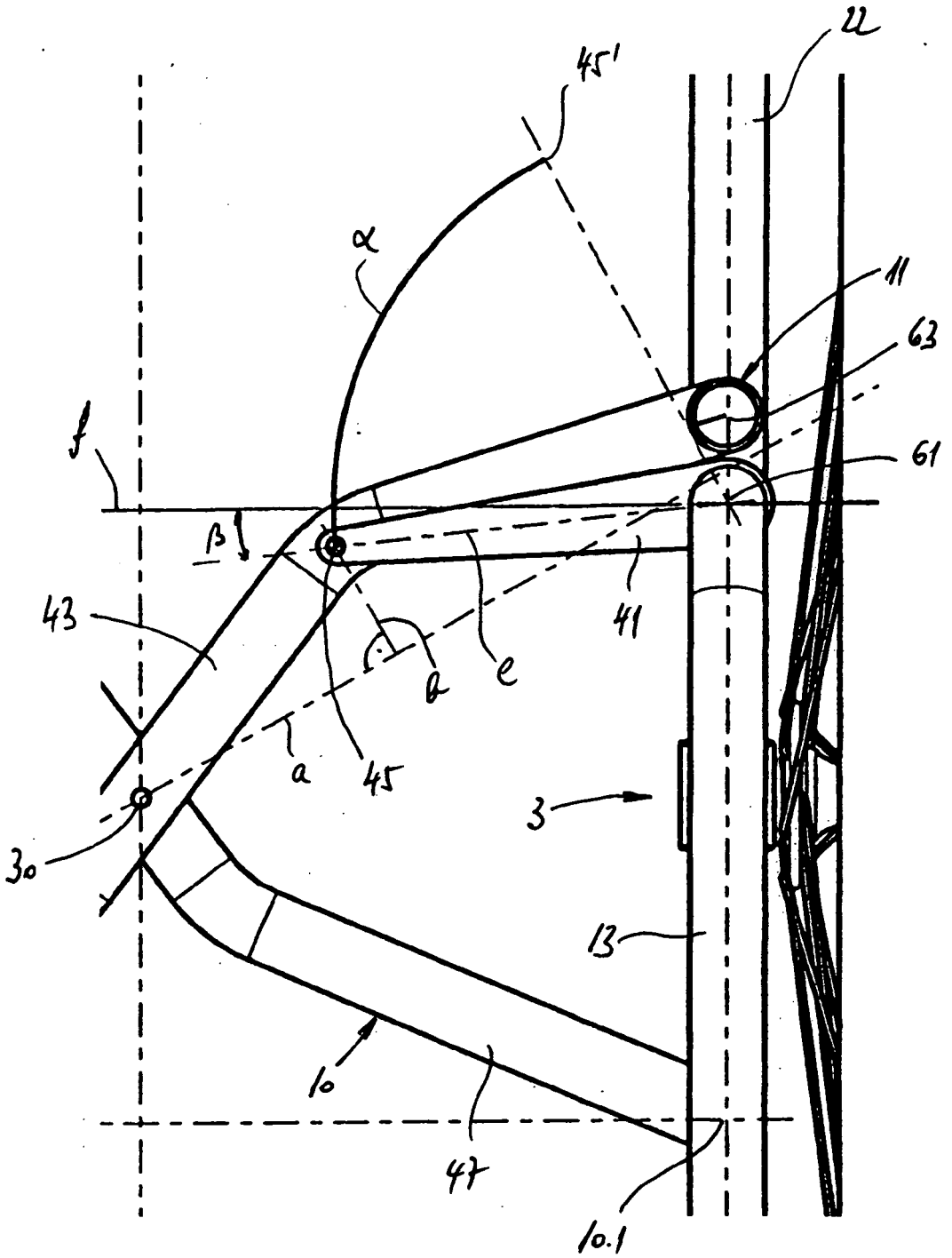


FIG.8

FIG.9



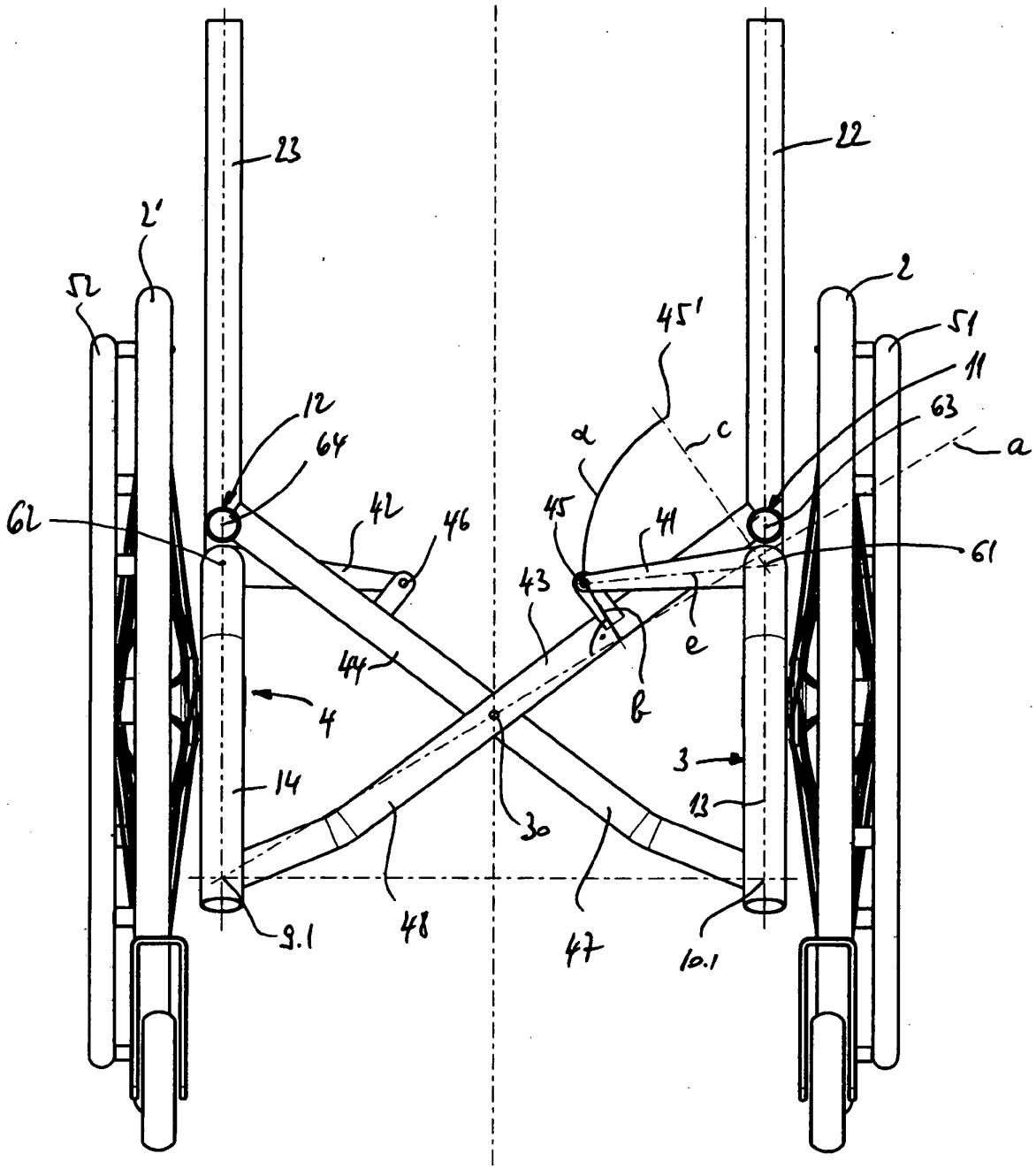

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FIG.10

REFERENCES CITED IN THE DESCRIPTION

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