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(54) **WHEELCHAIR WITH THREAD-BASED ADJUSTEMENT OF THE WHEELBASE AND/OR HEIGHT**

ROLLSTUHL MIT GEWINDEBASIERTER EINSTELLUNG DES RADSTANDS UND/ODER DER
HÖHE

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• **BRENNER, Simon**
CH-4054 Basel (CH)

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(74) Representative: **Ganguillet, Cyril et al**
ABREMA

Agence Brevets & Marques Ganguillet
Avenue du Théâtre 16

P.O. Box 5027

1002 Lausanne (CH)

(73) Proprietor: **Invacare International Sàrl**
1196 Gland (CH)

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(72) Inventors:

• **KÜSCHALL, Rainer**
CH-4123 Allschwil (CH)

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Description

Technical Field

[0001] The present invention relates to a wheelchair that can be adjusted to the size and/or according to preferences of a user. More particularly, the invention concerns a wheelchair with a thread-based adjustment of various wheelchair characteristics, such as the position of a wheel with respect to a frame horizontally and/or vertically, the distance between the drive wheel and a castor wheel and/or the vertical distance between a frame of the wheelchair and the ground level.

Prior Art and the Problem Underlying the Invention

[0002] The present invention generally addresses problems associated with the adjustment of a wheelchair.

[0003] The position of attachment of a wheel with respect to the frame of a vehicle has important consequences on the drivability and manoeuvrability of the vehicle. For example, in wheelchairs and other vehicles, the distance between the drive wheels and the castor wheels has an important impact. The shorter this distance, the smaller the turning radius and, consequently, the easier it is to turn the wheelchair around. Furthermore, this distance generally affects the rear-to-front position of the point of gravity of the wheelchair with the user placed in it. When the point of gravity is more to the rear, there is a greater risk of backward skipping. At the same time, it is easier to manoeuvre the wheelchair, for example to lift the castor wheels from the ground level so as to mount an obstacle in the driving direction. It is thus up to the user to decide how she/he wishes the wheelchair characteristics to be adjusted. The size of a wheelchair user, in particular the length of the thighs and/or calves, is advantageously also taken into account. There is thus an interest of having wheelchair in which the position of a wheel with respect to a frame, and thereby, for example, the distance between the drive wheel and the castor wheel of a wheelchair - the wheelbase - can be adjusted.

[0004] It is noted that in wheelchairs where the seat is placed itself in a non-adjustable manner to the frame, the adjustment of said wheelbase is the only possibility of adjusting the position of the seat with respect to the drive wheel axis and thus controlling the easiness of backward skipping of the wheelchair.

[0005] In a similar way, the adjustment of the distance of the frame structure with respect to the ground level is advantageously adjustable. This adjustment again has an impact on characteristics of a wheelchair and is preferably adaptable to the body size of a user. If the seat of the wheelchair is itself fixed in a non-adjustable manner to the frame of the wheelchair, the vertical adjustment of the drive wheel with respect to the frame (carrying the seat) is the only possibility of seat height adjustment.

[0006] Presently, there are two general approaches used in the industry to position the wheel with respect to

the frame and thus to adjust the above-mentioned characteristics in a wheelchair.

[0007] One well-known approach is based on adaptor plates, also referred to as wheel mounting plates, generally comprising a plurality of holes, or equivalent drive-wheel axle holding structures. The plate is generally fixed to the frame of the wheelchair, for example by way of screws and nuts. The holes are spaced apart in the vertical and/or horizontal direction. The axle of the drive wheel may be placed in any one of the holes and, in this way, the position of attachment of a wheel with respect to the frame can be adjusted on a horizontal and vertical scale. However, adaptor plates have several disadvantages. First, they look clumsy and heavy and thus go against the trend of having light, simple and sports like wheelchairs. This clumsy appearance is due to the mechanism needed to attach the plate to the frame, for example screws and nuts, but also due to the presence of the non-used holes in the adaptor plate, since only one hole is needed for the adjustment of the drive wheel axle.

[0008] The adaptor plates thus also directly increase the weight of the wheelchair. Furthermore, the distance between holes of the adaptor plate limits the adjustment possibilities. A fine-tuned adjustment on the millimetre scale is generally not possible with an adaptor plate.

[0009] There are adaptor plates that can be fixed at any position along a substantially vertical frame element, thereby enabling a continuous, stepless adjustment, as disclosed, for example, in EP0585197. However, in such devices the stepless adjustment generally is possible only in one direction, horizontal or vertical, but not in a stepless or nearly stepless manner in both, the vertical and horizontal direction independently. Furthermore, several screws are still necessary for fixing the adaptor plate to the frame, increasing weight and giving the "heavy"-looking aspect mentioned above.

[0010] Another approach is revealed in US 2008/143172, wherein two means are used for adjusting the position of the drive wheels with regard to the frame. A first one consists in a bolt screwed into a camber body. This bolt defines an angle with the vertical so that the drive wheels of the wheelchair are cambered or angled with respect to a vertical plane. Therefore, this means does not adjust the position of the drive wheels on a horizontal or vertical scale. The second means consists in an eccentric hole formed in an axle receiver insert inserted into the camber body, said hole receiving the drive wheel axle. Thus, an adjustment of the position of the drive wheels is possible in a vertical plane. However, this adjustment is very limited.

[0011] Another approach is to have a custom-made wheelchair. In this case, the measurements are taken directly from a patient, generally by a trained medical person, such as a physiotherapist, and the measurements are sent to the wheelchair manufacturer, where the wheelchair is fabricated made-to-measure. The advantage of a custom made wheelchair is, of course, that wheelchairs of very light weight can be produced, having

a simple, unfussy and unostentatious design, since adjustment mechanisms are absent altogether. Wheelchairs used in sports events are often custom-made.

[0012] However, custom-made wheelchairs are not only difficult to fabricate, but often the custom made wheelchair does not meet the expectations. For example, although measurements have been correctly taken, once placed in the custom-made wheelchair, the wheelchair user does not feel comfortable in the particular wheelchair due to inherent characteristics of the wheelchair. More often, however, errors have been made during the taking of measurements on the patient. In this case, although the wheelchair is supposed to be custom-made, it actually turns out not to be. This is, of course, very problematic given the high costs of preparing a custom-made wheelchair, which becomes totally useless. For this reason, medical personnel actually hesitates prescribing custom made wheelchairs, fearing accountability due to incorrect taking of measurement on the wheelchair user. It is also an objective of the invention to address this hesitation. In all instances, wheelchairs providing no room at all for the adjustment of wheelchair characteristics, as is generally the case in custom-made wheelchairs, bear important drawbacks.

[0013] Ideally, a mechanism for adjusting important wheelchair characteristics such as, for example, position of attachment of a wheel axle to the frame, the wheelbase, the distance between the axis of the drive wheel with respect to the axis of the castor wheel, the vertical distance of the frame with respect to ground level and/or with respect to the axis of the drive wheel and the like is thus provided on a wheelchair.

[0014] It is an objective of the invention to provide such a mechanism, which does not require additional attachment structures, such as screws and the like, for attaching it to the frame of the wheelchair. It is an objective to provide an adjustment mechanism that does not look clumsy and that adds only a minimal weight to the wheelchair. It is also an objective to allow for adjustment of important wheelchair characteristics at a very fine scale, preferably in a stepless, continuous manner or nearly so.

[0015] The present invention addresses the problems depicted above.

Summary of the Invention

[0016] Remarkably, the inventors provide a novel mechanism, which is essentially based on a thread extending at least partly in the direction in which adjustment is desired. Interestingly, the mechanism can be combined so as to allow for thread-based adjustment of a wheel, in particular a drive wheel on both, the horizontal and the vertical scale.

[0017] The adjustment mechanisms do not require additional screws for attachment to the frame and/or the wheel and thus a wheelchair with a simple, light aspect can be realised. Advantageously, the adjustment of the position of the wheel with respect to the frame can be

made at a very fine scale in the millimetre range in any direction independently.

[0018] Accordingly, the invention provides a thread-based adjustment mechanism and/or assembly.

[0019] In an aspect, the present invention provides a mechanism for adjusting, on a horizontal scale, the attachment of a wheel with respect to a frame of the vehicle.

[0020] In another aspect, the invention provides a mechanism for adjusting, on a vertical scale the attachment of a wheel with respect to the frame of the vehicle.

[0021] In an aspect, the invention provides a thread-based adjustment assembly for adjusting a distance between a drive wheel and a castor wheel and/or the position of attachment of a wheel to a frame on a horizontal scale.

[0022] In an aspect, the invention provides a thread-based adjustment assembly for adjusting the position of attachment of a wheel to a frame of a vehicle on a vertical scale.

[0023] In an aspect, the invention provides an adjustment mechanism and/or assembly for adjusting a distance between a drive wheel and a castor wheel of a vehicle.

[0024] In an aspect, the invention provides an adjustment assembly for adjusting the wheelbase of a vehicle.

[0025] In an aspect, the invention provides an adjustment assembly for adjusting the height of the frame of a vehicle with respect to the ground level.

[0026] In an aspect, the invention provides an adjustment assembly for adjusting the a vertical distance of the height of the frame with respect to a ground level

[0027] In an aspect, the invention provides a vehicle, in particular a wheelchair, comprising any mechanism and/or assembly as disclosed herein.

[0028] In an aspect, the invention provides a vehicle, in particular a wheelchair comprising a thread-based adjustment assembly for adjusting a position of a wheel with respect to a frame of the vehicle on a horizontal scale and/or a thread-based adjustment mechanism for adjusting the position of a wheel with respect to said frame on a vertical scale.

[0029] In an aspect, the invention provides a wheelchair comprising a thread-based adjustment mechanism for adjusting a distance between a drive wheel and a castor wheel and/or a thread-based adjustment mechanism for adjusting a vertical distance of the height of the frame with respect to a ground level.

[0030] Further aspects and preferred embodiments of the invention are defined herein below and in the appended claims.

[0031] Further features and advantages of the invention will become apparent to the skilled person from the description of the preferred embodiments given below.

Brief Description of the Drawings

[0032]

Figure 1 is a view to the left side of a wheelchair frame equipped with drive and castor wheels comprising the thread-based adjustment mechanism according to an embodiment of the invention.

Figure 2 is a perspective closer view of the thread-based adjustment mechanism according to an embodiment of the invention.

Figure 3 is a perspective exploded view the thread-based adjustment mechanism shown in Figure 2.

Detailed Description of the Preferred Embodiments

[0033] The present invention provides a vehicle comprising a thread-base adjustment mechanism for positioning a wheel on a frame of the vehicle. Since the invention particularly concerns wheelchairs and since the advantages of the invention are most relevant with respect to are wheelchairs, the invention is described in further detail herein below at the example of a wheelchair. This example is not intended to limit the scope of the present invention, which is applicable to vehicles moving by the aid of rotating wheels in general.

[0034] For the purpose of the present specification, situations and directions of structures and elements of the vehicle of the present invention are determined by the perspective of a user seated in the completely assembled vehicle. Accordingly, in Figure 1, the left side of the wheelchair frame is seen. 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 principle.

[0035] Figure 1 shows a frame 3 of a wheelchair 1 with a large drive wheel 2, and a castor wheel 6 attached to the frame. The entire assembly shown in Figure 1 is designated with reference numeral 1, referring to a wheelchair, although several elements have been omitted for reasons of clarity. In particular, a seat is not shown. The seat is to be attached on lateral frame profiles 4 extending on a longitudinal, rear-to-front direction of the wheelchair.

[0036] Figure 1 shows the left side of a wheelchair 1, which has a plane of symmetry, which extends vertically and centrally on the rear-to-front (and front-to-rear) axis of the wheelchair. Many elements are thus present in pairs, such as the drive wheels 2, the castor wheels 6 and said lateral frame profiles 3, for example. Figure 1 only shows the left side of the wheelchair, the description generally referring to the left side only, taking into account that the skilled person is aware of the symmetry of wheelchairs, and can deduce the entire structure of the wheelchair from the description of the left side only.

[0037] The frame 3 shown in Figure 1 has a simple, light design, and substantially comprises or consists of a pair of lateral frame profiles, each of which comprising an upper, longitudinal frame profile 4 and a frontal, substantially vertical profile 5, which are connected by a bend 13. In the embodiment shown, the upper longitudinal pro-

file 4 and the frontal profile 5 are provided as one single, bent profile.

[0038] For the purpose of the present specification, the expression "longitudinal" generally means that the respective element extends at least to some extent, but preferably to a substantial, more preferably a major extent, in the rear-to-front or front-to-rear (or vice versa) direction. In this way, the term "longitudinal" does not distinguish between rear-to-front and front-to-rear, but encompasses both possibilities likewise.

[0039] The kind of frame 3 shown in Figure 1 is frequently used for custom-made wheelchairs, which do, in the prior art, not provide for the possibility of an adjustment of the position, in particular the vertical and/or horizontal, longitudinal position of the wheels, in particular the drive wheels. It is considered helpful, for the understanding, to illustrate the invention at the example of such a basic frame structure. However, the invention is applicable to other vehicles and other frame structures. For example, the invention also applies to wheelchairs having a pair of an upper and lower longitudinal frame element on each left and right side, as frequently found with foldable wheelchairs, for example.

[0040] For the purpose of the present specification, the term "frame" generally refers to the structural element of a vehicle that fulfils the purpose of support and/or carrying structure. In particular, the frame preferably is the structural element to which at least one pair of left and right wheels, but preferably two pairs, rear and front, of left and right wheels are directly or indirectly connected. The frame is thus connected to the axle bearing structure of a wheel.

[0041] In wheelchairs, the frame is generally also the support structure for a seat, a seat chassis or for a structure carrying the seat chassis. Also the footrest is generally connected to the frame.

[0042] In some vehicles, the term "chassis" would be more appropriate than "frame". Generally, a chassis fulfils the same or similar functions as the frame as referred to herein and the terms chassis and frame are thus considered generally equivalent for the purpose of the present specification. For example, in motorized wheelchairs, the term "chassis" is more frequently used. The present invention applies to hand-propelled wheelchairs (as shown in the figures) but also to motorized wheelchairs, for example.

[0043] The present invention provides a mechanism, also referred to herein as assembly, for connecting a wheel to a frame and more particularly, for adjusting the position of attachment. More specifically, the invention provides a mechanism for adjusting the vertical position of attachment of a wheel to a frame and/or the rear-to-front position. The adjustment mechanism of the invention is thread-based.

[0044] A wheel is attached to a frame by way of an axle holding structure or element, which harbours the axle of the wheel so as to allow for rotatable attachment of the wheel to the frame. For example, either the wheel-axle

holding element or the wheel holds a bearing, in which the axle or, respectively, on which the wheel is rotatably harboured.

[0045] For the purpose of the present specification, "attachment (and/or connection) of a wheel to a frame" thus generally means "rotatable attachment of the wheel with respect to the frame". The expression "adjusting the position of attachment of a wheel to a frame" can also be understood, in certain cases, as "adjusting the position of a wheel axle holding structure with respect to the frame". In some instances, the wheel axle or the wheel axle holding structure may form a unit with the wheel, and the adjustment thus can be understood as adjusting the position of attachment of the wheel axle and/or of the wheel axle holding structure, generally also including a bearing of the wheel.

[0046] The invention thus preferably encompasses a mechanism for adjusting the position of a wheel-axle holding structure and/or a wheel axle with respect to the horizontal and/or vertical position to the frame.

[0047] On a horizontal, rear-to-front axis, the adjustment of a wheel to a frame generally determines and/or adjusts at the same time the wheelbase of a vehicle, for example a wheelchair, in particular if the position of the respective other wheel on the same side of the vehicle remains unchanged. The wheelbase is the horizontal, exactly rear-to-front (or vice versa) distance component of the distance between the axis of a rear and a front wheel. For the wheelchair in Figure 1, the wheelbase is indicated with a small letter w, and is obtained by dropping a perpendicular from the axis of each, the front 6 and of the rear wheel 2 on one side of the wheelchair to the ground and determining the distance between the two points where the perpendicular of each wheel contacts the (horizontal) ground level. In this case it is assumed that the rear and front wheels for which the wheelbase is determined are situated in the same vertical, rear-to-front plane. If the latter is not the case, the length of the wheelbase encompasses only the length of the distance in the exact rear-to-front direction.

[0048] The wheelbase is an important characteristic for vehicles and in particular for wheelchairs. In wheelchairs, the wheelbase is the horizontal distance between the drive wheel 2 and the castor wheel 6, as shown in Figure 1.

[0049] A structure (a fork) harbouring the axle of the castor wheels is arranged so that is rotatable around a vertical axis, as is known in castor wheels of wheelchairs and described in more detail below. In this way, the wheelchair can be turned in either direction and curves can be driven. The wheelbase determines the minimum radius, with which the wheelchair can be turned. In other words, the shorter the wheelbase, the higher the manoeuvrability of the wheelchair, the easier it is to turn the wheelchair and, depending also on other factors, the smaller the space required to turn the wheelchair.

[0050] With respect to the impact on turning radius it is noted that this applies in particular to situations where

one pair of wheels cannot be steered, that is, rotate on a fixed axis and/or rotate within one single plane, which cannot be changed. In wheelchairs, in particular in hand-driven wheelchairs, the plane in which the drive wheels rotate cannot be rotated, in other words, the drive wheels do not assist in the steering of the wheelchair.

[0051] In wheelchairs, the attachment of the drive wheel 2 in the horizontal, in the rear to front axis determines a further important characteristic, which is the easiness of the wheelchair tilting backwards.

[0052] With a seat, including a seat surface and a seat back being attached to the frame (not shown), the point of gravity of the wheelchair is determined with the user having taken place in the seat. The horizontal, left-to-right axis of the axles of the drive wheels is situated more or less behind said point of gravity. The closer this axis is to the point of gravity, the easier it is for the wheelchair to tilt or skip backwards. Easy but controlled backward skipping is an advantage with respect to the mounting of an obstacle with the castor wheels first. This is necessary, for example, for mounting a step of a staircase or a road kerb. However, uncontrolled backward skipping results in the wheelchair skipping completely and the user falling down, which needs to be prevented. Accordingly, the easiness of backward skipping is a wheelchair characteristic that is preferably adjustable in accordance with the preferences of a user. In custom-made wheelchairs, the preferences of the user with respect to the easiness of backward skipping may be determined on the basis of an adjustable wheelchair used by the user for whom the custom-made wheelchair is prepared.

[0053] In the assembly 1 shown in Figure 1, the seat, including a seat chassis (not shown) will generally be attached to the upper, longitudinal frame profiles 4, and the seat back may be stabilised by the back profile 9. The seat is thus generally attached on a seat chassis, the seat chassis being attached to the frame 4. The seat chassis may or may not allow for further adjustment of the rear-to-front and/or of the vertical position of the seat with respect to the frame. If adjustment of the position of a seat with respect to the frame 4 is possible, such adjustment cannot encompass adjustment of the wheelbase or of the height of the frame from the ground level.

[0054] Reference numeral 14 designates a transversal profile, transversally connecting the two lateral, left and right back profiles 9. Together with the transversal footrest 7 and the transversal drive-wheel axle holding structure 20 (described further below), the transversal profiles fix and stabilise the lateral, left and right frames 3.

[0055] The adjustment, on a vertical scale, of the position of the attachment of a wheel with respect to the frame is also an important characteristic of a wheelchair. It may be used to adjust the height of the seat, which is attached to the frame, with respect to the ground level. The size of the wheelchair user plays an important role for determining this characteristic.

[0056] In the embodiment shown in Figure 1, the vertical position of attachment of the drive wheel to the frame

also determines the angle of the longitudinal frame profile 4, of the vertical frame profile 5 and/or of the back frame profile 9 with respect to the ground level, which, in the embodiment shown, are all rigidly connected one with respect to the other.

[0057] The wheelchair frame assembly 1 shown in Figure 1 further comprises a castor wheel assembly 12, which is harboured in a bearing provided in a housing 8, which, in the embodiment shown, is welded to the vertical profile 5 of the frame 3, but which could also be fixed by way of screws or another suitable attachment mechanism. The castor wheel assembly 12 comprises the castor wheel 6, the axle thereof and the castor wheel axle holding fork. Figure 1 also shows the footrest 7, which, in the embodiment shown, is provided in the form of a single, transversal element, connecting the left frame part 3 with the corresponding right frame part at the lower end of the vertical frame profiles 5 of each side, respectively. It would also be possible, of course, to use a pair of two separate, left and right footrests, each attached to the respective left and right lateral vertical frame profile 5 for example.

[0058] In the overview-type Figure 1, the mechanism for adjustment of the drive wheel 2 with respect to the frame 4 is designated generally with reference numeral 10. Clearly, the assembly 10 does not substantially distinguish over other profiles or tubes of the general wheelchair frame assembly 1, the latter thus keeping a light, elegant appearance, in spite of the adjustment mechanism. In particular, no attachment screws as used for fixing typical adaptor plates to the frame can be seen. The adjustment mechanism thus integrates harmonically in a wheelchair frame conceived generally for a custom-made wheelchair, in which, normally, one or more of relevant characteristics such as the vertical and/or horizontal (longitudinal) position of the drive wheel 2 with respect to the frame 3, the wheelbase *w* and the height of the frame 3, 4 with respect to the ground level cannot be adjusted.

[0059] Figure 2 is a closer view to the thread-based adjustment mechanism 10 according to the invention, and Figure 3 shows the individual pieces of the adjustment assembly laid apart.

[0060] The adjustment assembly 10 links and/or connects the frame 3 of the wheelchair at the upper longitudinal frame profile 4 to the transversal drive-wheel axle-holding structure 20, which harbours the axle of the drive wheel 2. Figure 2 is a closer detail view of an extract of the wheelchair shown in Figure 1, with the drive wheel being removed and only a short, left-side section of the transversal profile 20 forming said drive-wheel axle holding structure being shown. Similarly, only a short section of the upper, longitudinal frame profile 4 being shown.

[0061] In the embodiment shown, the transversal drive-wheel axle-holding structure 20 is provided in the form of a tube 20, which horizontally extends from left-to-right of the wheelchair, perpendicular to the longitudinal axis and to the vertical axis, and which carries the

axle of both, the left and right drive wheel, by way of a wheel-attachment structure 28 present in the distal tube openings.

[0062] The adjustment assembly 10 comprises a longitudinal connection piece 21, which comprises an attachment portion 22, 24, for attaching the longitudinal connection piece 21 to the tube 20. The longitudinal connection piece 21 further comprises a longitudinal portion 23 extending in the longitudinal, rear-to-front (or front-to-rear) direction, generally horizontally. The longitudinal portion 23 comprises an external screw thread, which can be seen in Figure 2 and which is used, as described below, for adjusting the horizontal position of the drive wheel 2 with respect to the frame of the wheelchair.

[0063] A vertical connection piece 30, which could also be described as a "T-element" and is also referred to herein as a "matching element", comprises a (horizontal) hollow cylindrical portion 31 and a vertical portion 33 (which, actually, is also of an overall hollow cylindrical configuration).

[0064] The hollow cylindrical portion 31 comprises an internal screw thread and functions thus as a nut, which thread fits with or matches the external screw thread of the longitudinal portion 23 of the longitudinal connection piece 21, so that the hollow cylindrical portion 31 of the vertical connection piece 30 can be engaged in a screwed manner with said longitudinal element 21 by way of their corresponding, female and male threads.

[0065] According to the invention, said thread-based adjustment assembly thus comprises a longitudinal element 21 comprising a thread extending along a substantially longitudinal and/or horizontal axis and a matching element 30 comprising a thread matching the thread of said longitudinal element 21. In principle any one of said longitudinal element 21 and said matching element 30 could be connected to a wheel-axle bearing structure 20 and the respective other of said longitudinal and matching elements being connected to said frame 3 of said wheelchair.

[0066] According to the invention, said thread-based adjustment assembly thus comprises a vertical element 11 comprising a thread extending along a substantially vertical axis and a matching element 30 comprising a thread matching the thread of said longitudinal element 21. In principle, any one of said vertical element 11 and said matching element 30 could be connected to a wheel-axle bearing structure 20 and the respective other of said vertical and matching elements being connected to said frame 3.

[0067] As shown in Figure 2, the vertical portion 33 comprises an external thread extending in vertical direction. The thread of the hollow cylindrical element 31 is oriented perpendicularly to the thread of the vertical portion 33. In Figure 3, the internal thread in the (horizontal) hollow cylindrical element 31 of the vertical connection piece 30, matching the external thread of the longitudinal portion 23, can be recognized.

[0068] The adjustment assembly 10 further comprises

two lock nuts 27 and 32. Lock nut 27 is screwed onto the thread of the longitudinal portion 23 of the longitudinal connection piece 21 so as to be adjacent to the vertical connection piece 30 and thus blocking rotation and unscrewing of the latter in the direction towards the lock nut, in Figure 2 this would be towards the left, that is the front of the wheelchair.

[0069] While this is not shown in Figure 2, a further lock nut could be provided to the other, left side of the vertical connection piece 30 on the thread of the longitudinal portion 23, the further lock nut thus blocking the rotation and screwing of the vertical connection piece 30 on the longitudinal portion 23 towards the right in Figure 2, that is towards the rear of the wheelchair.

[0070] The lock nut 32 is screwed onto the thread of the vertical portion 33 of the vertical connection piece 30. The thread of the vertical portion 33 is actually screwed into a corresponding and fitting internal thread provided in the vertical frame element 11, said internal thread not being visible in the figures. The lock nut 32 thus blocks any further screwing of the vertical connection piece 30 into the vertical frame element 11.

[0071] The functioning of the adjustment mechanism should be understandable to the skilled person from the figures.

[0072] The connection piece 30, using the internal thread of the (horizontal) hollow cylindrical portion 31 can be screwed to any desired extent onto the external thread of the longitudinal portion 23 of the longitudinal connection piece 21. Of course, at least the entire hollow cylindrical portion 31 and also locknut 27 should be screwed onto the thread of portion 23, for ensuring a firm connection and thus stability of the overall mechanism. Once a firm connection is present, further screwing can be used to adjust the position of the drive wheel along an axis of adjustment corresponding to the axis of the longitudinal portion 23 of the longitudinal connection piece 21. In other words, the axis of adjustment is coaxial with the axis of the threaded part of the generally cylindrical or hollow cylindrical form of the longitudinal portion 23.

[0073] The farther said internal thread of the (horizontal) hollow cylindrical portion 31 is screwed onto the external thread of the longitudinal portion 23 of the longitudinal connection piece 21, the closer said connection piece 30 will be to the tube 20 harbouring the axles of the drive wheel, the shorter the wheelbase, the closer the castor and drive wheels will be to each other, and the easier it will be for the wheelchair to be tilted backwards, or to lift the castor wheels from the ground, for example, to mount an obstacle.

[0074] The longitudinal portion 23 extends along a horizontal, longitudinal axis and the position of the wheel can thus be adjusted along an axis that is parallel to the axis of the longitudinal portion 23 by screwing and unscrewing the internal thread of portion 31 with respect to longitudinal portion 23.

[0075] Adjustment can be made on a millimetre scale. It is noted, that one can screw either longitudinal piece

21 with respect to vertical piece 30 or vice versa. The longitudinal piece 21 can be fixed in two different positions to the axle holding tube 2, namely at 180° turns one with respect to the other. In other words, the clamp mechanism comprising the first clamp part 22 and second clamp part 24 may be fixed to tube 20 with either clamp part 22, 24 towards the top, and the respective other clamp part towards the bottom, thereby giving rise to said two different positions (In Figure 2, the first clamp part 22 is the upper clamp part and the second clamp part 24 is fixed below the tube 20). Therefore, the adjustment of the wheel position in the longitudinal direction with respect to the frame may be accomplished on a millimetre scale, at distinct intervals or distances corresponding to a 180° screw-turn of the internal thread of the vertical element 30 on the external thread of said longitudinal element 21.

[0076] Independently, the threaded vertical portion 33 of the vertical connection piece 30 can be screwed to any desired extent into the internal thread present in the vertical frame element 11. Of course, a minimum number of turns are necessary so as to assure a stable connection between piece 30 and the frame, further stabilised by locknut 32. Once the stable connection established, further screwing can be used to adjust the position of the drive wheel along an axis of adjustment corresponding to the axis of the (internal thread of the) vertical frame element 11 and of the (external thread of the) vertical portion 33, which are coaxial, as the thread of a nut screwed on a screw are coaxial by definition.

[0077] The farther said threaded vertical portion 33 of the vertical connection piece 30 is screwed into the internal thread present in the vertical frame element 11, the closer the rear end of the longitudinal frame profile 4 will be to the ground, the lower a rear end of a seat fixed on said frame profile 4 will be to the ground level, the larger the angle of the longitudinal frame profile 4 with respect to horizontal. Adjustments as mentioned in more detail hereinabove can thus be made.

[0078] The axis of adjustment is coaxial with the axis of the threaded part of the generally cylindrical or hollow cylindrical form of the vertical frame element 11, and, correspondingly, with the axis of the matching threaded part of the vertical portion 33 of the vertical connection piece 30.

[0079] In the embodiment shown, the generally cylindrical or hollow cylindrical form of the external thread of the vertical portion 33 (and the vertical frame element 11 with a matching internal thread) extends along a vertical axis and the position of the wheel can thus be adjusted along an axis that is parallel to the axis of the vertical portion 33 by screwing and unscrewing the external thread of portion 33 with respect to vertical frame element 11.

[0080] It is noted that, in the embodiment shown, adjustment along a vertical scale can be made on a millimetre scale. By turning the connection piece 30 by 180° (half a turn), the orientation of the hollow cylindrical ele-

ment 31 is the same as the one of the longitudinal connection piece. The possibilities of adjustment correspond thus to intervals determined by the 180° screw-type turns of the thread on vertical portion 33 in the internal thread of the vertical frame element 11.

[0081] As is thus clear from the description of the embodiment shown in the figures, the thread-based adjustment of the horizontal position of the wheel with respect to the frame is accomplished by adjusting the position of the vertical connection piece 30 on the longitudinal thread of the longitudinal connection piece 21. Since the two elements are in a screwed relationship with each other, the horizontal position can be adjusted by screwing and unscrewing the two elements relative with each other. Adjustment is possible on a fine scale in the millimetre range, as determined at least partially by the pitch of the threads.

[0082] The thread-based adjustment of the vertical position of the wheel with respect to the frame is accomplished by adjusting the vertical position of the vertical connection piece 30 with respect to the vertical frame element 11. Again, the vertical connection piece 30 is screwed into the vertical frame element and the vertical position on with respect to the other can be adjusted by screwing and unscrewing the two elements relative with each other.

[0083] Practically, the adjustment may be conducted by detaching the longitudinal connection piece 21 from the tube 20 by un-screwing the screws fitting into bores 26 (Figure 3), thereby opening the clamp comprising a first clamp part 22 and a second clamp part 24. It is noted that the first clamp part comprises matching internal threads so that clamp part 24 can be fixed to clamp part 22 using screws (not shown). As can be seen in Figure 3, the first clamp part 22 is formed in one piece with the longitudinal portion 23 comprising the external thread. The screws used to rigidly but detachably connect said first and second clamp parts 22 and 24 extend vertically in a bottom-up direction so that the visible parts of the screws, when fixed are hidden and thus not visible to a wheelchair user or to an observing person situated next to the wheelchair. Due to the bores comprising internal threads in clamp part 22 (not shown), separate screw nuts are not required.

[0084] Once the longitudinal connection piece 21 is detached from the tube 20, adjustments can be easily made by screwing and/or unscrewing independently the varying parts for horizontal, longitudinal and/or vertical adjustment, respectively, one to the other. Lock nuts 27 and 32 may be brought in their final, locking position once the position of the vertical connection piece 30 within vertical frame element 11 and/or the position of the vertical connection piece 30 on the longitudinal portion 23 is adjusted by screwing/unscrewing to the desired position.

[0085] Some considerations are hereby made with respect to the way the thread-based adjustment assembly 10 connects the frame and the wheel axle holding structure 20. The adjustment assembly has thus a first and a

second attachment within the wheelchair, one attachment being to the frame, the other to the wheel axle, or the structure carrying the wheel axle. In particular, it is preferred that at least one of said first and second attachments is detachable. Thus, one of the elements of the assembly 10 is attached in a detachable way to either wheel axle holding structure or to the frame, respectively. Accordingly, adjustments by screwing the threaded pairs of the thread-based adjustment assembly may be effected once said detachable element has been detached from its element of attachment, the frame or the wheel-axle holding structure. The other of said first and second attachment may be a fixed, un-detachable attachment, for example attached by welding. Both said first and second attachments are preferably rigid attachments, whether or not detachable.

[0086] The skilled person will observe that the embodiment shown in the figures is particularly advantageous, because both, the longitudinal (horizontal) position as well as the vertical position of the drive wheel with respect to the frame can be adjusted independently. Therefore, according to an embodiment of the invention, the position of a wheel 2 with respect to said frame 3 is adjustable independently along a horizontal and/or longitudinal axis and along a vertical axis.

[0087] This is due to some extent thanks to the vertical connection piece (or matching element) 30, which comprises two threads, which extend at an angle one with respect to the other, preferably along a perpendicular axis one with respect to the other. Generally, as said two threads extend along two different axis, said position of said wheel 2 with respect to said frame 3 can be adjusted independently along any one of said axis.

[0088] The expressions "extending at an angle" or "perpendicular one with respect to the other", as used in this specification preferably also encompasses the situation where two axis do not intersect, but do intersect at any angle or in perpendicular manner, respectively, when projected to a plane, which is parallel to at least one of the two axis, and preferably both of the two axis. Preferably, said plane of projection is laid so that one of the two axes extends in said plane, and, more preferably, the other axis is parallel to said plane.

[0089] The combination of the vertical connection piece 30 with two further threads, for example, one of which extending at least to some extent in the longitudinal and the other at least to some extent in vertical direction, when fixed on the wheelchair, permits independent adjustment in both directions (or along both axis) in a particularly light- or simple-looking assembly devoid of additional screws and bolts.

[0090] In accordance with the invention, the adjustment of the position of the attachment of the axle of the wheel to the frame is thread-based, as will be generally explained below.

[0091] The skilled person will note that the terms "longitudinal" and "vertical" in the expressions "longitudinal connection piece", "longitudinal portion", "vertical con-

nection piece" and "vertical portion" are used in consideration of the arrangement and orientation of these entities on the frame of the embodiment shown in the figures. However, by changing the directions of these entities, it is possible to create an axis of adjustment in any desired direction. In this case, the expressions above may not be an accurate description, but are still considered to encompass different axis of adjustment than those along a longitudinal and vertical axis. The thread-based adjustment assembly of the invention can thus be used to adjust the position of a wheel with respect to a frame along any desired axis of adjustment.

[0092] The expressions "a first element" and "second element", instead of "longitudinal connection piece" and the "connection piece", for example, may be used herein for expressing that the elements of the thread-based assembly 10 of the invention may be oriented in any direction and along any axis along which adjustment is to be enabled. For example, it is also possible to use the thread-based adjustment principle of the present invention for adjusting the position of a wheel with respect to a frame along a horizontal, left-to-right (transversal) axis of adjustment.

[0093] The expression "thread-based adjustment" may thus be defined in a more general manner.

[0094] Accordingly, thread-based adjustment means that there are at least two threaded parts fitting one to the other as a screw and the according nut. One threaded part, for example a "first" element or part 21; 30, is connected to the structural element that supports or carries the (axle of the) wheel to be adjusted, the other threaded part, a "second" element or part 30; 11, is connected to the frame. By screwing and unscrewing the two elements one with respect to the other, the position of the wheel with respect to the frame can be adjusted at a fine scale in the millimetre range.

[0095] In accordance with the above said, at least one of said first and second elements is connected in a detachable manner to the structural element that supports (the axle of) the wheel and/or to the frame. Detachment of at least one of said two elements of the assembly 10 allows said first and second elements to be screwed and/or unscrewed with respect to each other for the purpose of adjustment. The clamps 22 and 24, which can be fixed using screws fitting into bores 26 as shown in Figure 3 are an example of a detachable connection of one of said elements to the wheel axle holding structure.

[0096] In other words, said first element 21; 30 preferably comprises, besides at least one thread, means for connecting the element to the frame or to the structural element that supports (the axle of) the wheel. Said second element 30; 11 preferably comprises means for connecting the second element to the structural element that supports (the axle of) the wheel or the frame, respectively. Said means for connecting or attaching preferably allow a rigid, but possibly detachable connection. Examples are the clamps as mentioned above, but other means of connection can be envisaged, such as thread-

based connections, welded connections, connections using screws, and combination of these, for example. The invention is not intended to be limited to a specific means for connecting said first and/or second elements to the frame and/or the structural element that supports (the axle of) the wheel.

[0097] According to an embodiment, said first element 21; 30 comprises a thread extending along an axis of adjustment and said second element 30; 11 comprises a thread matching the thread of said first element. Said thread of said first element 21; 30 is thus an external or internal thread and said thread of said second element 30; 11 is an internal or external thread, respectively, said threads of said first and second elements forming a pair of matching threads.

[0098] According to an embodiment, a position of said wheel 2 with respect to said frame 3 is adjustable along said axis of adjustment by screwing or unscrewing of said first element 21; 30 with respect to said second element 30; 11.

[0099] The direction where adjustment is possible depends on the orientation of the threaded parts. When the threads of said first and second elements are extending at least to some extent, in a rear-to-front (or vice versa), longitudinal axis, the position of the wheel can be adjusted along this axis or scale. Preferably, in this case, the threads extend along a substantially horizontal axis from rear-to-front (or vice versa). As mentioned above, the wheelbase can be adjusted in this way, but also the tendency of the wheelchair to skip back.

[0100] Alternatively, when the matching threads of a first part and of second part extend at least to some extent from bottom-to-top or top-to-bottom with respect to the wheelchair, the position of the wheel with respect to the frame can be adjusted along this axis. In this way, the height of the frame with respect to the ground level can be adjusted, the height of the seat placed on the frame can be adjusted, and, of course, the vertical position of the wheel with respect to the frame can be adjusted, possibly all independently.

[0101] According to the invention, said axis of adjustment extends substantially horizontally or substantially vertically.

[0102] The invention as illustrated at the embodiment shown in the figures advantageously enables adjustment independently along the vertical and along the horizontal, rear-to-front axis.

[0103] Adjustment on the vertical as well as on the longitudinal, horizontal scale are both possible by way of a single, combined mechanism as shown in the figures, preferably involving at least one piece 30 having two threads extending in different, preferably two perpendicular directions of adjustment.

[0104] While the figures show a preferred embodiment, it is believed that the invention may be realised in many different ways. For example, it seems not to be very relevant that two parts with matching threads represent external and internal threads as shown in the fig-

ures. The threads may well be inversed and the invention is expected to be functional as well.

[0105] Furthermore, the way of attachment of the mechanism to the wheel on the one hand and/or to the frame may be realised in different ways, which the skilled person may chose with respect to the design of any specific vehicle or wheelchair. This also applies to the direction in which any thread extends. For example, as shown in Figures 1 and 2, the longitudinal connection piece 21 is attached to the axle holding structure 20 and extends on a horizontal axis in the rear-to-front direction. The invention can as well be put in place by orienting the longitudinal connection piece 21 on a horizontal axis in the front-to-rear direction, for example, or by placing a vertical connection piece to the axle holding structure 20, and, if present, a longitudinal connection piece to the frame of the wheelchair.

[0106] Similarly, the vertical connection piece 30 is screwed into an opening at the bottom end of the vertical frame element 11. It is as well possible to provide a frame in which the vertical connection piece 30 is connected, in particular screwed, in a top-down manner into the top opening of a vertical frame element.

[0107] Many further designs are possible while adhering to the principle of thread-based adjustment, which is one of the novel concepts presented herein.

[0108] It is noted that the invention is illustrated, in the figures, at the example of the hand-propelled drive wheels of a non-motorized wheelchair frame. The invention encompasses the adjustment of other wheels than main or drive wheels in the same manner, and can conveniently be applied to other wheeled vehicles.

[0109] The threads used for the purpose of the present invention are preferably straight threads. Preferably, they are V-threads. Preferably, the threads are single start threads. Preferably, the threads are fine threads with a comparatively small pitch (more threads per axial distance) taking the thickness of the thread into account.

[0110] Matching external and internal threads form a pair of threads and are also designated, in the art, as male and female threads, respectively.

[0111] In an embodiment of the invention, the position of a wheel with respect to the frame, can be adjusted, independently, at distinct intervals of a given length, wherein the length of an interval corresponds to a complete turn of a first element 21; 30 in a threaded engagement with respect to a second element 30; 11, respectively, or to a partial turn wherein a partial turn corresponds to a fraction of said complete turn.

[0112] According to an embodiment, said fraction is selected from $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, one fifth, one sixth, one seventh or $\frac{1}{8}$ of a turn of a first element with respect to a second element, and/or, independently, of said second element with respect to said third element. A fraction of $\frac{1}{4}$ may be obtained, for example, if said any element comprises a four identical (both internal or external) threads extending perpendicularly, in overall cross-like manner, and any one opening of any one of the two threads can be en-

gaged with a matching thread that determines the axis of adjustment. In this case, three threads remains empty.

[0113] According to an embodiment, said position of the wheel with respect to the frame can be adjusted, independently, at distinct intervals of a given length, wherein the distance of an interval is determined by the pitch of a respective of a thread, preferably of a pair of matching threads of said thread-based adjustment mechanism or assembly.

[0114] It is noted that the adjustment assembly 10 as shown in the figures can be easily adapted to enable completely stepless, continuous adjustment, at least along one axis of adjustment. This is described below at the example of the horizontal, longitudinal adjustment. Accordingly, one could, for example, conceive the longitudinal connection piece 21 as a single external thread, thus lacking the clamp parts 22 and 24. This connection piece would thus just comprise an external thread corresponding to longitudinal portion 23, but possibly being a bit longer. This external thread could be connected to the tube 20 by way of an element comprising an internal thread matching said external thread, said internal thread being, for example, welded to the tube 20. Lock nuts may be provided again for locking the screwed position of said external thread to the internal thread welded to tube 20. The skilled person will note that in this case, the connection of the thread-based adjustment assembly to the tube 20 is itself thread-based. This means that the position of matching element 30 on said external thread can be adjusted at any desired distance from the tube 20, and is not limited by the two possibilities of attaching the longitudinal connection piece 21 to the tube 20 (clamp part 22 or 24 towards top, corresponding to half turns of the threaded portion 23 with respect to horizontal hollow cylindrical portion 31).

Claims

1. A wheelchair (1) comprising a thread-based adjustment assembly (10) for adjusting a position of a wheel (2) with respect to a frame (3) of the wheelchair on a horizontal scale and on a vertical scale, wherein said thread-based adjustment assembly comprises a longitudinal element (21) comprising a thread extending along a substantially horizontal axis, a vertical element (11) comprising a thread extending along a substantially vertical axis and a matching element (30) comprising a thread matching the thread of said horizontal element (21) and a thread matching the thread of said vertical element (11), wherein a position of said wheel (2) with respect to said frame (3) is adjustable along a substantially horizontal axis of adjustment and along a substantially vertical axis of adjustment by screwing or unscrewing, respectively, said longitudinal element (21) with respect to said matching element (30) and said matching element (30) with respect to said vertical

element (11), **characterised in that** said horizontal axis of adjustment extends, at least to some extent, from rear-to-front or front-to-rear with respect to the wheelchair and said vertical axis of adjustment extends, at least to some extent, from bottom-to-top or top-to-bottom with respect to the wheelchair.

2. The wheelchair of any one of the preceding claims, wherein said thread of said longitudinal or vertical elements (11; 21) is an external or internal thread and said thread of said matching element (30) is an internal or external thread, respectively, said threads of said first and second elements forming a pair of matching threads.
3. The wheelchair of any one of the preceding claims, wherein said longitudinal and/or said vertical element (21; 11) is connected to a wheel-axle bearing structure (20) and said matching element (30) being connected to said frame (3) of said wheelchair, or vice versa.
4. The wheelchair of any one of the preceding claims, wherein the position of a wheel (2) with respect to said frame (3) is adjustable independently along a horizontal axis and along a vertical axis.

Patentansprüche

1. Rollstuhl (1), umfassend eine gewindebasierte Verstellanordnung (10) zum Verstellen einer Position eines Rads (2) bezüglich eines Rahmens (3) des Rollstuhls in einem horizontalen Maßstab und in einem vertikalen Maßstab, wobei die gewindebasierte Verstellanordnung ein Längselement (21), das ein sich entlang einer im Wesentlichen horizontalen Achse erstreckendes Gewinde umfasst, ein vertikales Element (11), das ein sich entlang einer im Wesentlichen vertikalen Achse erstreckendes Gewinde umfasst, und ein passendes Element (30) umfasst, das ein Gewinde umfasst, das zum Gewinde des horizontalen Elements (21) passt, sowie ein Gewinde, das zum Gewinde des vertikalen Elements (11) passt, wobei eine Position des Rads (2) bezüglich des Rahmens (3) entlang einer im Wesentlichen horizontalen Verstellachse und entlang einer im Wesentlichen vertikalen Verstellachse verstellbar ist, indem das Längselement (21) bezüglich des passenden Elements (30) und das passende Element (30) bezüglich des vertikalen Elements (11) verschraubt bzw. losgeschraubt wird, **dadurch gekennzeichnet, dass** sich die horizontale Verstellachse mindestens in gewissem Maße von hinten nach vorne oder von vorne nach hinten bezüglich des Rollstuhls erstreckt und sich die vertikale Verstellachse mindestens in gewissem Maße von unten nach oben oder von oben nach unten bezüglich des Rollstuhls er-

streckt.

2. Rollstuhl nach Anspruch 1, wobei das Gewinde des Längs- oder des vertikalen Elements (21; 11) ein Außen- oder ein Innengewinde ist und das Gewinde des passenden Elements (30) ein Innen- bzw. ein Außengewinde ist, wobei die Gewinde des ersten und des zweiten Elements ein Paar passende Gewinde bilden.
3. Rollstuhl nach einem der vorhergehenden Ansprüche, wobei das Längs- und/oder das vertikale Element (21; 11) mit einer Radachsentragstruktur (20) verbunden ist und das passende Element (30) mit dem Rahmen (3) des Rollstuhls verbunden wird oder umgekehrt.
4. Rollstuhl nach einem der vorhergehenden Ansprüche, wobei die Position eines Rads (2) bezüglich des Rahmens (3) entlang einer horizontalen Achse und entlang einer vertikalen Achse unabhängig verstellbar ist.

Revendications

1. Fauteuil roulant (1) comprenant un ensemble de réglage (10) à base de filetages pour régler une position d'une roue (2) par rapport à un cadre (3) du fauteuil roulant sur une échelle horizontale et sur une échelle verticale, ledit ensemble de réglage à base de filetages comprenant un élément longitudinal (21) comprenant un filetage s'étendant le long d'un axe sensiblement horizontal, un élément vertical (11) comprenant un filetage s'étendant le long d'un axe sensiblement vertical et un élément correspondant (30) comprenant un filetage correspondant au filetage dudit élément horizontal (21) et un filetage correspondant au filetage dudit élément vertical (11), une position de ladite roue (2) par rapport audit cadre (3) étant réglable le long d'un axe sensiblement horizontal de réglage et le long d'un axe sensiblement vertical de réglage en vissant ou en dévissant, respectivement, ledit élément longitudinal (21) par rapport audit élément correspondant (30) et ledit élément correspondant (30) par rapport audit élément vertical (11), **caractérisé en ce que** ledit axe horizontal de réglage s'étend, au moins dans une certaine mesure, de l'arrière vers l'avant ou de l'avant vers l'arrière par rapport au fauteuil roulant et ledit axe vertical de réglage s'étend, au moins dans une certaine mesure, du bas vers le haut ou du haut vers le bas par rapport au fauteuil roulant.
2. Fauteuil roulant selon la revendication 1, dans lequel ledit filetage desdits éléments longitudinal ou vertical (21; 11) est un filetage intérieur ou extérieur et ledit filetage dudit élément correspondant (30) est un fi-

letage intérieur ou extérieur, respectivement, lesdits filetages desdits premier et deuxième éléments formant une paire de filetages correspondants.

3. Fauteuil roulant selon l'une quelconque des revendications précédentes, dans lequel ledit élément longitudinal et/ou ledit élément vertical (21 ; 11) est relié à une structure de support d'axe de roue (20) et ledit élément correspondant (30) étant relié audit cadre (3) dudit fauteuil roulant, ou vice versa. 5 10
4. Fauteuil roulant selon l'une quelconque des revendications précédentes, dans lequel la position d'une roue (2) par rapport audit cadre (3) est réglable indépendamment le long d'un axe horizontal et le long d'un axe vertical. 15

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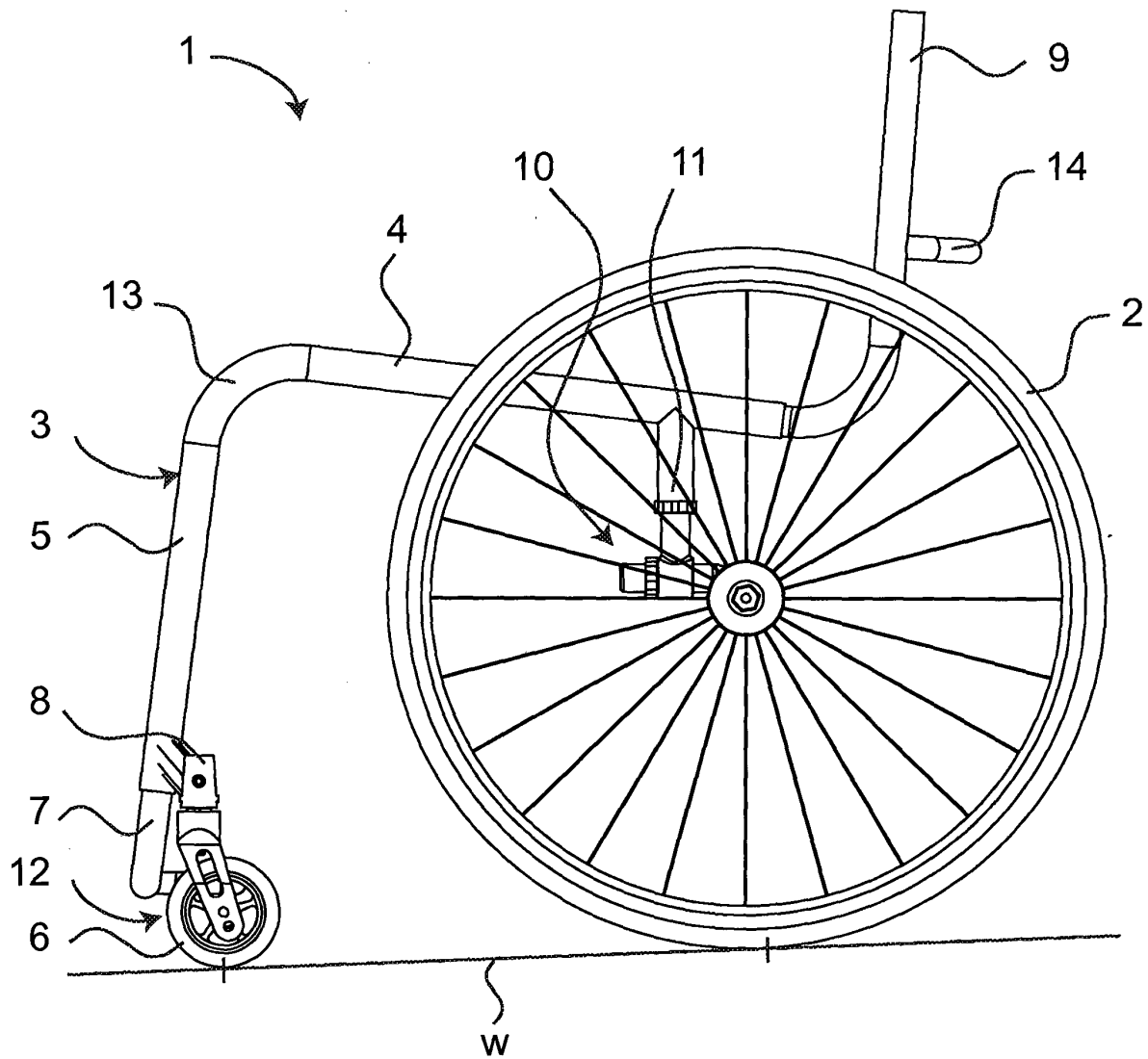


Figure 1

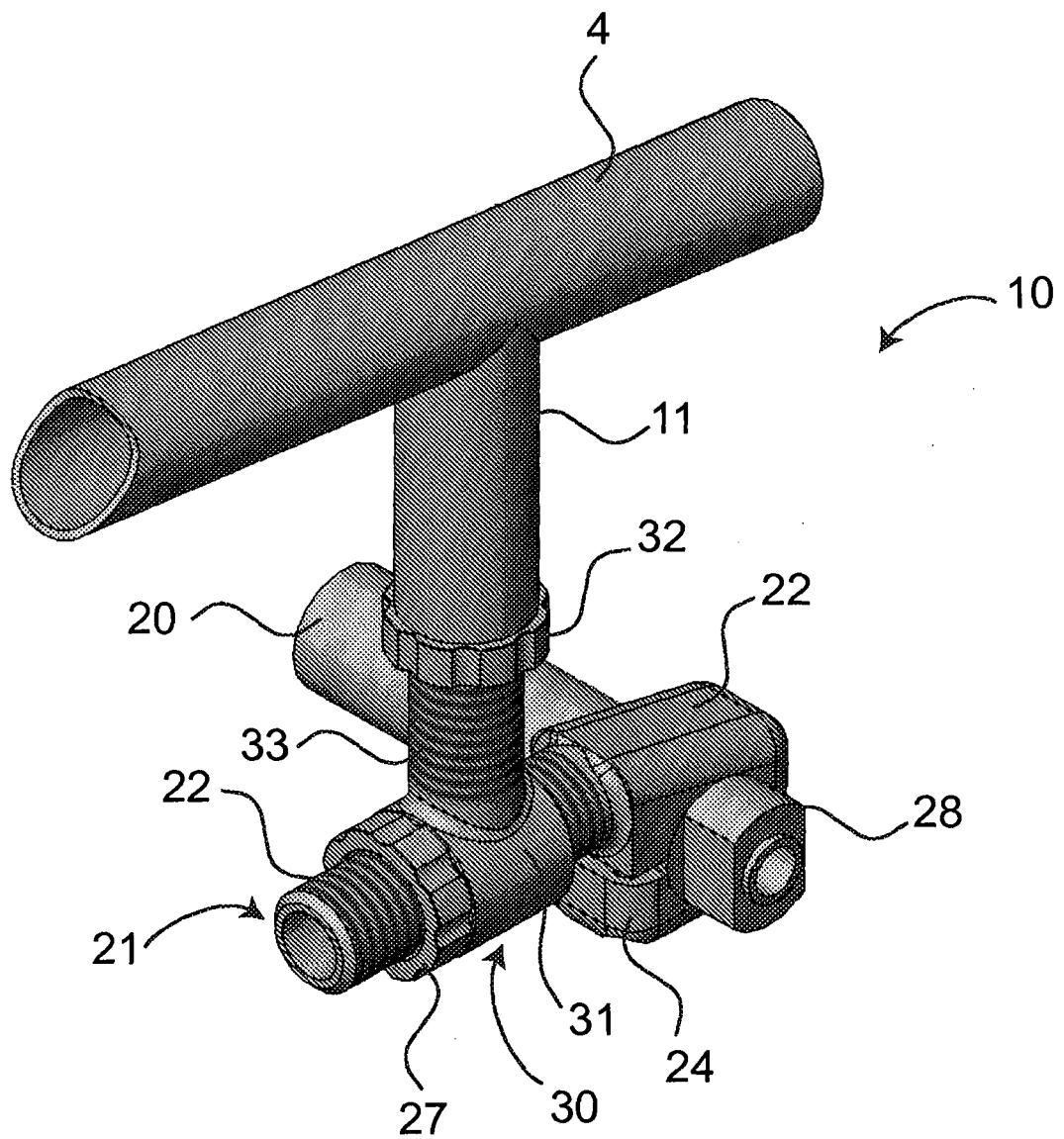


Figure 2

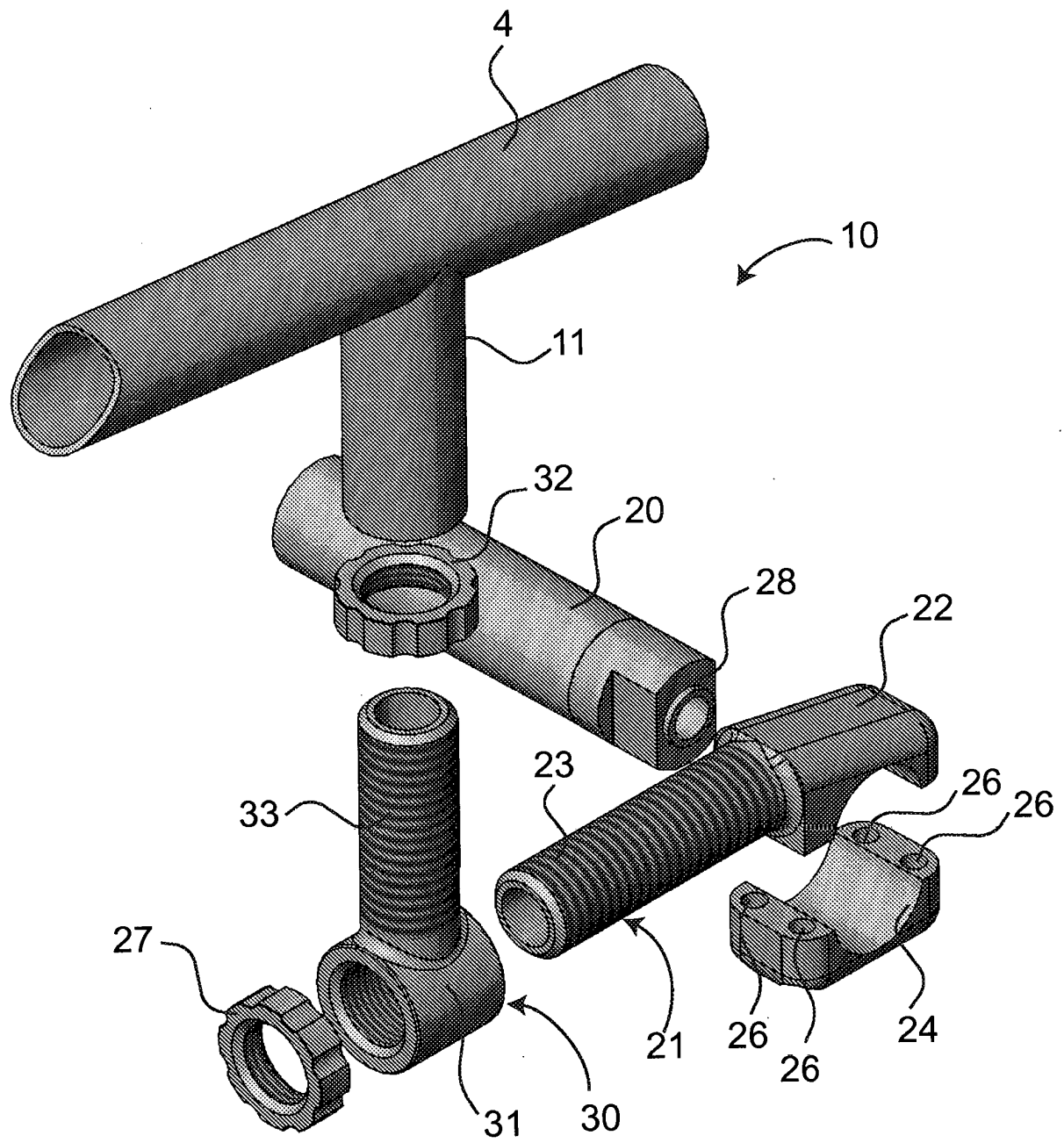


Figure 3

REFERENCES CITED IN THE DESCRIPTION

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