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(54) WHEELCHAIR WITH A COMPACT SEAT TRAVEL SYSTEM

ROLLSTUHL MIT EINEM KOMPAKTEN SITZBEWEGUNGSSYSTEM

FAUTEUIL ROULANT AVEC UN SYSTÈME DE MOUVEMENT D'ASSISE COMPACT

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WO-A1-2007/113395

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Description

Summary

[0001] The object of the invention concerns a compact travel system for the movement of the seat or its verticalisation.

Prior art

[0002] Also in the field of aids for the disabled, wheelchairs are subject to continuous revisions and refinements to bring their bulk, weight and performance to ever greater levels.

[0003] All without sacrificing features and reliability.

[0004] An example of wheelchair with an hinged structure for seated position, upright position and semi-extended position is shown in EP1864637. WO 2007/113395 discloses a wheelchair with a seat travel mechanism which employs a quadrilateral and a lifting actuator.

[0005] It is now known that the highest quality wheelchairs are those that allow the user to move in total autonomy and that can vary the height of the seat, and which can also be brought to an upright position and even be tilted.

[0006] Today, such types of wheelchairs are rather cumbersome and heavy. For this reason, manufacturers are trying to provide customised wheelchairs based on the size of the user, for example for children and adults. This, however, forces users to buy two wheelchairs of the same type over time, depending on their growth. In fact, if the height travel of the wheelchair for an adult requires very long actuators, and very long levers and special devices against tipping over, everything is much simpler for wheelchairs for children.

[0007] What the object of the invention proposes is a new type of wheelchair, with all possible configuration modes, which is compact, which is extremely stable even with the seat raised and in an vertical position, without any play or possible loose connections in particular due to the positioning of the actuators at their limit positions, which carry out an alignment of the application point of the stress between the fulcrum and the resistant point.

[0008] In fact, it would also be very easy with undersized actuators to reach large angle travels or elevated movements, for example by applying the point of application of the force of an actuator to a lever near its fulcrum, but the result would be precarious, subject to being loose and not so resistant to heavy loads, and therefore creating in the user a sense of uncertainty that the position can be maintained securely and firmly.

[0009] In fact, it is crucial that one actuator not only operates and moves the various parts of the wheelchair, but that it also can keep the position reached stable and safe. In the eventuality that said actuator acts on lever or kinematic mechanisms, its point of application on a lever must create between the actuator itself and the lever on which it acts a minimum angle of 45 -30 degrees, thereby being able to efficiently compensate for and resist not only the normal component, but also the tangent of the external stresses.

[0010] Finally, bearing in mind the size of wheelchairs, which are becoming increasingly more compact, also the relative actuators need to be very small.

[0011] Obviously, also due to the high costs, very expensive special, dual-action or telescopic actuators, which are much more delicate and difficult to maintain than simple pneumatic or electrical actuators, are not economically viable

Objects of the invention

[0012] The object of the present invention is therefore to overcome one or more drawbacks of the prior art.

[0013] An essential object of the present invention is to make available a wheelchair with a compact travel system for verticalisation.

[0014] An important object of the present invention is to make available a wheelchair with a compact travel system that is resistant to stress over time and that is inexpensive.

[0015] A different object of the present invention is to make available a wheelchair with a compact travel system employing actuators that can easily be found on the market.

[0016] Another object of the present invention is to make available a wheelchair with a compact travel system whose structural configuration provides a high degree of stability.

[0017] All of the aforesaid purposes and others that will best be described in the description are obtained from a wheelchair with a compact seat travel system as set out in the characterising part of the attached claims.

Explanation of the invention

[0018] The present invention concerns a wheelchair with a compact travel system employing a quadrilateral linkage system positioned between a base and a seat, which is raised by a first lifting actuator hinged to the base and deformed by a second displacement actuator with a point of application outside the quadrilateral by means of an actuation lever hinged on a first side of the quadrilateral and acting through a tie rod on the side adjacent to the first side.

[0019] Specifically said quadrilateral linkage consists of a first side, to which the second and fourth sides are hinged spaced out, said first side extends from the part opposite the hinging to the second side, and beyond the hinging to the fourth side, towards the base to which it is hinged. A first lifting actuator acts on said first side to raise the quadrilateral.

[0020] The first and third sides are hinged spaced apart on the second side. To said second side is joined directly or by the interposition of a frame, the seat of the wheel-

chair.

[0021] The second and fourth sides are hinged on the third side in a spaced apart manner.

[0022] The third and the first side are hinged on the fourth side in a spaced apart manner. In an intermediate position between the two hinges acts a first end of the tie rod, joined at the second opposite end to the actuating lever.

Advantageous features of the invention

[0023] Advantageously, the hinging of the extension of the first side with the base is in the rear of the wheelchair, so that the raising of the quadrilateral linkage by means of the lifting actuator takes place towards the centre of gravity of the quadrilateral making the front of the seat retract, increasing stability both during the raising of the seat and during the verticalisation of the wheelchair. Advantageously, the hinging of the displacement actuator on the base is carried out either on the same axis as the hinging of the extension of the first side with the base or directly on the highest and most retracted part of the base, promoting a stabilising effect for lowering of the masses and obtaining an angle of application between the stem and the actuation lever of not less than 30° and preferably not less than 45°, thus maintaining a good reaction to the peak load on the actuator stem.

[0024] Advantageously, the displacement of the quadrilateral linkage is carried out with an actuator, which while maintaining a peak load in the actuation lever, allows the variation of the inclination of the position from -45°, tilting stage, to 90°, verticalised phase for a total travel of 135°

[0025] Advantageously, said total travel is achieved with an actuator whose stem has a maximum travel of 20 cm and preferably of 15 cm.

Brief description of the drawings

[0026] The technical features of the invention, according to the aforesaid aims, can clearly be seen in the content of the claims below, and its advantages will become more readily apparent in the detailed description that follows, made with reference to the accompanying drawings, which illustrate a preferred embodiment, which is purely exemplary and not limiting, in which:

Fig. 1 shows a perspective view of an electronic wheelchair that adopts a quadrilateral linkage seat travel system that is the object of the invention.

Fig. 2 shows what is set out in fig. 1 from a plan view of a vertical section that makes it easy to see the deformable quadrilateral between the base and the seat.

Fig. 3 shows a perspective view of the wheelchair in fig. 1 with the seat raised.

Fig. 4 shows what is set out in fig. 3 according to a plan view of a vertical section showing in detail the components of the deformable quadrilateral and its hinging.

Fig. 5 shows a perspective view of the wheelchair in fig. 1 in a vertical configuration.

Fig. 6 shows what is shown in fig. 5 according to a plan view of a vertical section that highlights the seat retraction with respect to the front wheels.

Fig. 7 shows a perspective view of the wheelchair of fig. 1 tilting backward for the complete extension of the lifting actuator of the quadrilateral.

Fig. 8 shows what is set out in fig. 7 according to a plan view of a vertical section highlighting the backward retraction of the entire seat.

Fig. 9 shows a perspective view of the wheelchair of fig. 1 tilting forward for the complete extension of the displacement actuator of the quadrilateral, where it is possible to check in detail the various components of the quadrilateral linkage system.

Fig. 10 shows what is set out in fig. 9 according to a plan view of a vertical section that highlights the inclination of the seat forwards without any appreciable displacement of the masses outside the perimeter of stability.

Detailed description of an example of a preferred embodiment

[0027] The object of the present invention refers particularly to a type of electric or electronic verticalising wheelchair 8 or with the seat 5 whose height can vary to obtain a wheelchair with a raised seat 21.

[0028] This type of wheelchair generally allows tilting, hence the inclination of the seat, the variation in height and the verticalisation by means of several actuators and with complicated, expensive and bulky systems. The travel system that is the object of the invention for the operating modes described above is simple, economical and compact.

[0029] Other advantages of the travel system of the invention lie in the fact that it acts by stabilising the configuration under critical stability conditions, i.e. with the seat 5 raised and in the verticalised mode 8.

[0030] The wheelchair of the invention shown in the drawings is an electronic wheelchair with multiple configurations with a tilting position 22, with a seat 5 that can have various heights or raised 21 and the capacity to assume a vertical configuration 8.

[0031] Referring specifically to the travel system, hinged on a base 9 supported by the wheels 10 there is an overhanging extension of the quadrilateral linkage 11.

[0032] In particular, said extension 12 is hinged at the back of the base 9 of the wheelchair so that during the raising for rotating around the hinging fulcrum 13, the quadrilateral linkage 11 is made to draw back with respect to the front verticalisation side, thereby acquiring stability.

[0033] Said first side 1 of the quadrilateral linkage 11 is hinged to the second side 2 and the fourth side 4 respectively at the fulcrums 14 and 17 at the ends.

[0034] Equally, for the other sides 2, 3 and 4 hinged to the ends of the contiguous sides, respectively 1 and 3, 2 and 4, 3 and 1, with fulcrums in 14 and 15, 15 and 16, 16 and 17 respectively. Effectively, the second side 2 can be identified with a frame supporting the seat 5 or with the seat 5 itself.

[0035] The elevating or lifting actuator 6 is hinged on the base 9 with its end 18, while the opposite end acts on side 1 or its extension 12.

[0036] The displacement actuator 7 of the quadrilateral 11 is also hinged to the base 6, or on the same hinging axis 13 of the extension 12 of side 1, in any event always at the rear and higher part of the base 6 in such a way as to maintain a sufficient peak angle with respect to the actuation lever 19 on which it acts. In fact, said second actuator 7 does not directly act on the deformable quadrilateral 11 but on a first end of a lever, said actuation lever 19, which is hinged to the opposite end on side 1. In an intermediate position between the two ends of the actuation lever 19, a tie rod 20 is hinged connected to the fourth side 4.

[0037] The action of the displacement actuator 7 therefore, with its stem applied to the end of the actuation lever 19 and the drive operated by the tie rod 20, moves and deforms the quadrilateral linkage 11 as needed for moving the seat 5 or for the verticalisation of the wheelchair.

[0038] For illustrative purposes we see that after the single movement of the elevation actuator 6, the seat 5 of the wheelchair tilts backward by about 45°.

[0039] With the joint movement of the elevating actuator 6 and the displacement actuator 7 there is an upward movement relative to the bottom of the seat 5, a further movement can allow the wheelchair to reach the vertical configuration 8.

[0040] We can see, during the movement of the lifting actuator 6, that in any situation the seat 5 draws back with respect to the front wheels 10, bringing the centre of gravity of the whole, the user and wheelchair, towards a more central position inside the stability perimeter.

[0041] This benefit is especially significant with a substantial raising of the seat 5, but it becomes very advantageous during verticalisation 8, since this wheelchair does not have to adopt bulky stabilisers overhanging on the outside in front of the front wheels.

[0042] In fact, even in fully verticalised mode 8, of both the user and the wheelchair, there is a centre of gravity that always falls within the stability perimeter.

[0043] As can also be seen in the drawings, the configuration of the various adjacent parts up against each other when the wheelchair is lowered, allows you to appreciate the compactness of the assembly and to evaluate the enormous benefit of adopting an actuator 7 for the displacement of the quadrilateral 11 that, with a travel of 15 cm, obtains an travel of 135°, an ideal situation for the verticalisation of a person with a height even up to 200 cm.

Claims

1. Wheelchair with a compact seat travel system that employs an articulated quadrilateral (11) consisting of a base (9) and a seat (5), that is elevated by a first lifting actuator (6) hinged to the base (9) **characterised in that** it is displaced by a second displacement actuator (7), with the point of application outside the quadrilateral (11), using an actuating lever (19) hinged on a first side (1) of the quadrilateral (11) and acting by means of a tie rod (20) on the side adjacent (4) to the first side (1).

2. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact second (2) and 1 a fourth side (4), are hinged to the first side (1) in a spaced apart manner , said first side (1) extends with an extension (12) extending from the side opposite to 1 a first hinge (14) with the second side (2), and beyond a second hinge (17) with the fourth side (4), towards the base (9) to which is hinged (13); acting on said first side (1) a first lifting actuator (6) for the lifting of the quadrilateral (11).

3. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that said articulated quadrilateral (11) comprises a second side (2), to which are hinged in a spaced apart manner the first (1) and a third side (3); to said second side (2) is connected directly, or by the interposition of a frame, the seat (5) of the wheelchair.

4. Wheelchair with a compact seat travel system according to claim 3, **characterised by** the fact that said second side (2) and the seat (5) are coinciding.

5. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that said articulated quadrilateral (11) comprises a third side (3) to which are hinged in a spaced apart manner a second (2) and a fourth side (4).

6. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that said articulated quadrilateral (11) comprises a fourth side (4) to which are hinged in a spaced apart manner a third side (3) and the first side (1); in an intermediate position between a third hinge (16) and a second hinge (17) , with the third side (3) and the first side (1), operates a first end of the tie rod (20) joined, at the opposite second end, to the actuating lever (19).

7. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that the hinging (13) of the extension (12) of the first side (1) with the base (9) is in the rear part of the wheelchair, so that the raising of the quadrilateral (11) by means of the lifting actuator (6) takes place by having the

quadrilateral (11) move towards the centre of gravity of the wheelchair and pulling back the front part of the seat (5), increasing stability both during the raising of the seat (21) as well as during the verticalisation (8) of the wheelchair.

8. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that the hinging of the displacement actuator (7) on the base (9) is made either on the same hinging axis (13) of the extension (12) of the first side (1) with the base (9) or directly on the highest and most rearward part of the base (9), favouring a stabilising effect for lowering the height of the mass and obtaining an angle of application of action between the rod and the actuating lever (19) not less than 30° and preferably not less than 45°, thereby maintaining on the actuator stem (7) an effective peak load reaction.

9. Wheelchair with a compact seat travel system according to claim 1 **characterised by** the fact that the displacement of the quadrilateral (11), is implemented using said displacement actuator (7), which, while maintaining a peak load in the actuating lever (19), allows a variation in the inclination of the seat (5) by -45°, in the tilting phase (22), at 90°, in the verticalisation phase (8), for a total travel of 135°

10. Wheelchair with a compact seat travel system according to the previous claim **characterised by** the fact that the aforesaid total travel is obtained with a displacement actuator (7) whose rod has a maximum travel of 20 cm and preferably 15 cm.

Patentansprüche

1. Rollstuhl mit einem kompakten Sitzbewegungssystem, das ein Gelenkviereck (11) verwendet, das aus einer Basis (9) und einem Sitz (5) besteht, der durch einen ersten Hubantrieb (6) angehoben wird, der mittels Scharnieren an der Basis (9) befestigt ist, **dadurch gekennzeichnet, dass** er durch einen zweiten Verschiebeantrieb (7) verschoben wird, wobei der Angriffspunkt außerhalb des Vierecks (11) liegt, und zwar unter Verwendung eines Betätigungshebels (19), der an einer ersten Seite (1) des Vierecks (11) an einem Scharnier befestigt ist und mittels einer Zugstange (20) auf der Seite wirkt, die an die erste Seite (1) angrenzt (4).

2. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** eine zweite (2) und eine vierte Seite (4) in einem Abstand voneinander an der ersten Seite (1) an Scharnieren befestigt sind, wobei sich die erste Seite (1) mit einer Verlängerung (12) von der Seite, die einem ersten Scharnier (14) mit der zweiten Seite (2) gegenüberliegt, und über ein zweites Scharnier (17) mit der vierten Seite (4) hinaus in Richtung der Basis (9) erstreckt, an der ein Scharnier (13) befestigt ist; wobei auf die erste Seite (1) ein erster Hubantrieb (6) zum Anheben des Vierecks (11) wirkt.

3. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gelenkviereck (11) eine zweite Seite (2) umfasst, an der die erste (1) und eine dritte Seite (3) in einem Abstand voneinander an Scharnieren befestigt sind; mit der zweiten Seite (2) ist der Sitz (5) des Rollstuhls direkt oder unter Zwischenlage eines Rahmens verbunden.

4. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 3, **dadurch gekennzeichnet, dass** die zweite Seite (2) und der Sitz (5) zusammenfallen.

5. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gelenkviereck (11) eine dritte Seite (3) umfasst, an der im Abstand voneinander eine zweite Seite (2) und eine vierte Seite (4) an Scharnieren befestigt sind.

6. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** das Gelenkviereck (11) eine vierte Seite (4) umfasst, an der in einem Abstand voneinander eine dritte Seite (3) und die erste Seite (1) an Scharnieren befestigt sind; wobei die dritte Seite (3) und die erste Seite (1), in einer Zwischenstellung zwischen einem dritten Scharnier (16) und einem zweiten Scharnier (17), ein erstes Ende der Zugstange (20) betätigt, die an dem gegenüberliegenden zweiten Ende mit dem Betätigungshebel (19) verbunden ist.

7. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** sich das Scharnier (13) der Verlängerung (12) der ersten Seite (1) mit der Basis (9) im hinteren Teil des Rollstuhls befindet, sodass das Anheben des Vierecks (11) mittels des Hubantriebs (6) durch Bewegen des Vierecks (11) in Richtung des Schwerpunkts des Rollstuhls und Zurückziehen des vorderen Teils des Sitzes (5) erfolgt, wodurch die Stabilität sowohl beim Anheben des Sitzes (21) als auch bei der Vertikalisierung (8) des Rollstuhls erhöht wird.

8. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** das Scharnier des Verschiebeantriebs (7) auf der Basis (9) entweder auf der gleichen Scharnierachse (13) der Verlängerung (12) der ersten Seite (1) mit der Basis (9) oder direkt auf dem höchsten und hintersten Teil der Basis (9) erfolgt, wodurch ei-

ne stabilisierende Wirkung zur Verringerung der Höhe der Masse begünstigt wird und ein Einwirkungswinkel zwischen der Stange und dem Betätigungshebel (19) von nicht weniger als 30° und vorzugsweise nicht weniger als 45° erzielt wird, wodurch auf der Antriebsstange (7) eine wirksame Spitzenlastreaktion aufrechterhalten wird.

9. Rollstuhl mit einem kompakten Sitzbewegungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verschiebung des Vierecks (11) unter Verwendung des genannten Verschiebeantriebs (7) durchgeführt wird, der, unter Beibehaltung einer Spitzenlast im Betätigungshebel (19), eine Veränderung der Neigung des Sitzes (5) um -45° in der Neigungsphase (22) um 90° in der Vertikalisierungsphase (8) für einen Gesamtweg von 135° ermöglicht.

10. Rollstuhl mit einem kompakten Sitzbewegungssystem nach dem vorstehenden Anspruch, **dadurch gekennzeichnet, dass** der vorstehend genannte Gesamtweg mit einem Verschiebeantrieb (7) erzielt wird, dessen Stange einen maximalen Weg von 20 cm und vorzugsweise 15 cm aufweist.

Revendications

1. Fauteuil roulant avec un système compact d'amplitude du siège, qui utilise un quadrilatère articulé (11), qui comprend une base (9) et un siège (5), porté en élévation par un premier actionneur de levage (6) articulé à la base (9), **caractérisé par le fait qu'**il soit déformé par un deuxième actionneur de déformation (7), avec point d'application à l'extérieur du quadrilatère (11), au moyen d'un levier d'actionnement (19) articulé sur un premier côté (1) du quadrilatère (11) et agissant par l'intermédiaire d'un tirant (20) du côté contigu (4) au premier côté (1).

2. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait qu'**un deuxième (2) et un quatrième côté (4) soient articulés sur le premier côté (1) à distance, ledit premier côté (1) s'étend avec un prolongement (12) s'étendant du côté opposé à une première articulation (14) avec le deuxième côté (2), et au-delà d'une deuxième articulation (17) avec le quatrième côté (4), vers la base (9) à laquelle il est articulé (13); agissant sur ledit premier côté (1) d'un premier actionneur de levage (6) pour l'élévation du quadrilatère (11).

3. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** ledit quadrilatère articulé (11) comprenne un deuxième côté (2), sur lequel le premier (1) et un troisième côté (3) sont articulés de manière espacée ; le siège (5) du fauteuil roulant est associé directement audit deuxième côté (2), ou par interposition d'un châssis.

4. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 3, **caractérisé par le fait que** ledit deuxième côté (2) et le siège (5) coïncident.

5. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** ledit quadrilatère articulé (11) comprenne un troisième côté (3) sur lequel un deuxième (2) et un quatrième côté (4) sont articulés de manière espacée.

6. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** ledit quadrilatère articulé (11) comprenne un quatrième côté (4) auquel un troisième côté (3) et le premier côté (1) sont articulés de manière espacée ; dans une position intermédiaire entre une troisième articulation (16) et une deuxième articulation (17), avec le troisième côté (3) et le premier côté (1), agit une première extrémité du tirant (20) jointe à la deuxième extrémité opposée, au levier d'actionnement (19).

7. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** l'articulation (13) du prolongement (12) du premier côté (1) avec la base (9) soit placée dans la partie arrière du fauteuil roulant, de telle sorte que l'élévation du quadrilatère (11) au moyen de l'actionneur de levage (6) s'effectue en faisant revenir le quadrilatère (11) vers le centre de gravité du fauteuil roulant, et en reculant la partie avant du siège (5), augmentant la stabilité durant la montée du siège (21) comme pendant la verticalisation (8) du fauteuil roulant.

8. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** l'articulation de l'actionneur de déformation (7) sur la base (9) se fasse soit sur le même axe que la articulation (13) du prolongement (12) du premier côté (1) avec la base (9) ou directement sur la partie la plus haute et la plus en arrière de la base (9), favorisant un effet stabilisateur pour l'abaissement en quota des masses et obtenant un angle d'application de l'action entre tige et levier d'actionnement (19) non inférieur à 30° et de préférence non inférieur à 45°, maintenant ainsi une réaction valide à la charge de pointe sur la tige d'actionnement (7).

9. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication 1 **caractérisé par le fait que** la déformation du quadrilatère (11)

soit réalisée avec ledit actionneur de déformation (7), qui tout en maintenant une charge de pointe sur le levier d'actionnement (19), permette une variation de l'inclinaison de la position du siège (5) de -45°, en phase de basculement (22), à 90°, en phase verticalisée (8), pour une amplitude totale de 135°

10. Fauteuil roulant avec un système compact d'amplitude du siège selon la revendication précédente **caractérisé par le fait que** l'amplitude totale précitée soit obtenue avec un actionneur de déformation (7) dont la tige a une amplitude maximale de 20 cm et de préférence de 15 cm.

Fig. 1

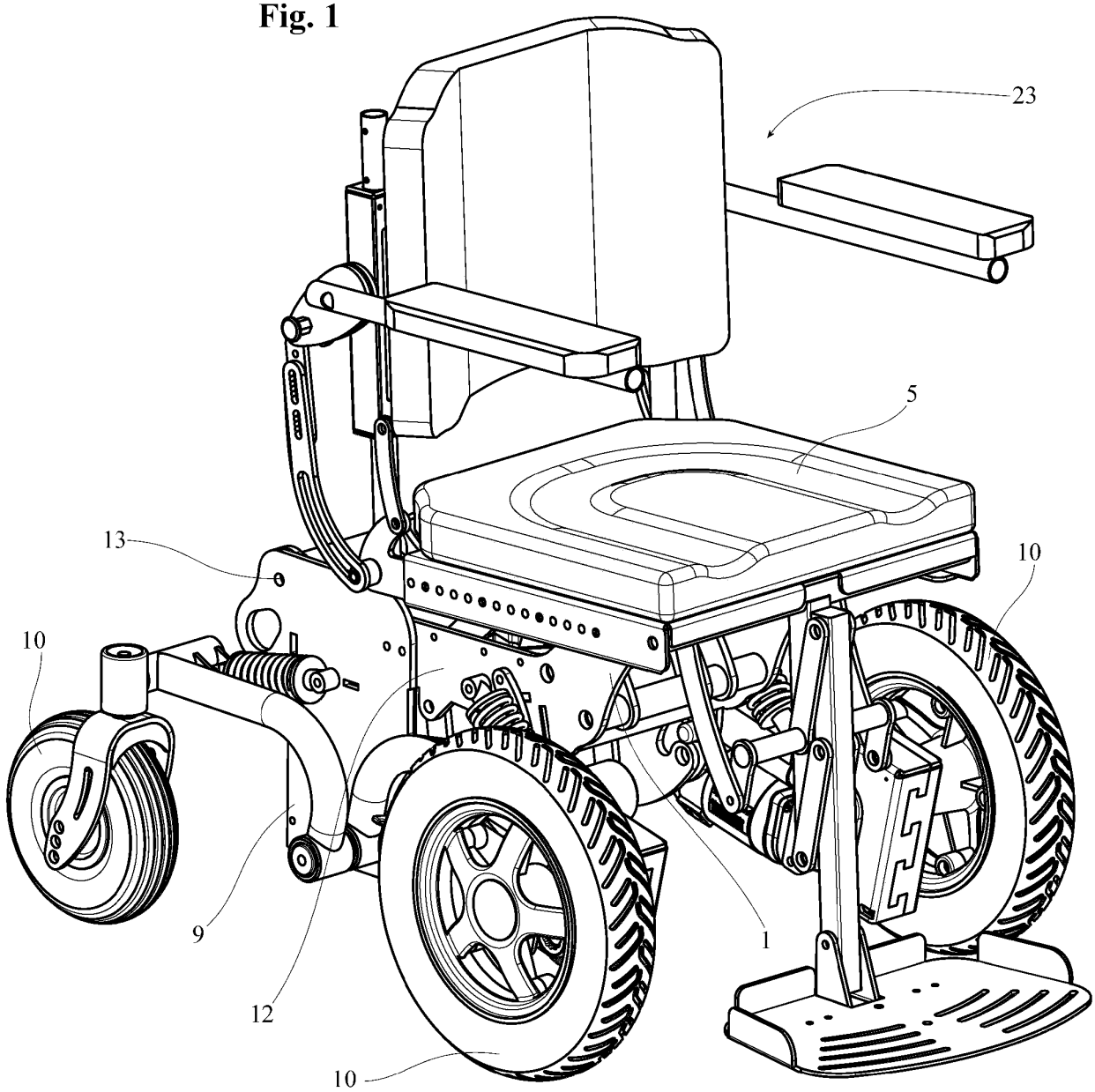


Fig. 2

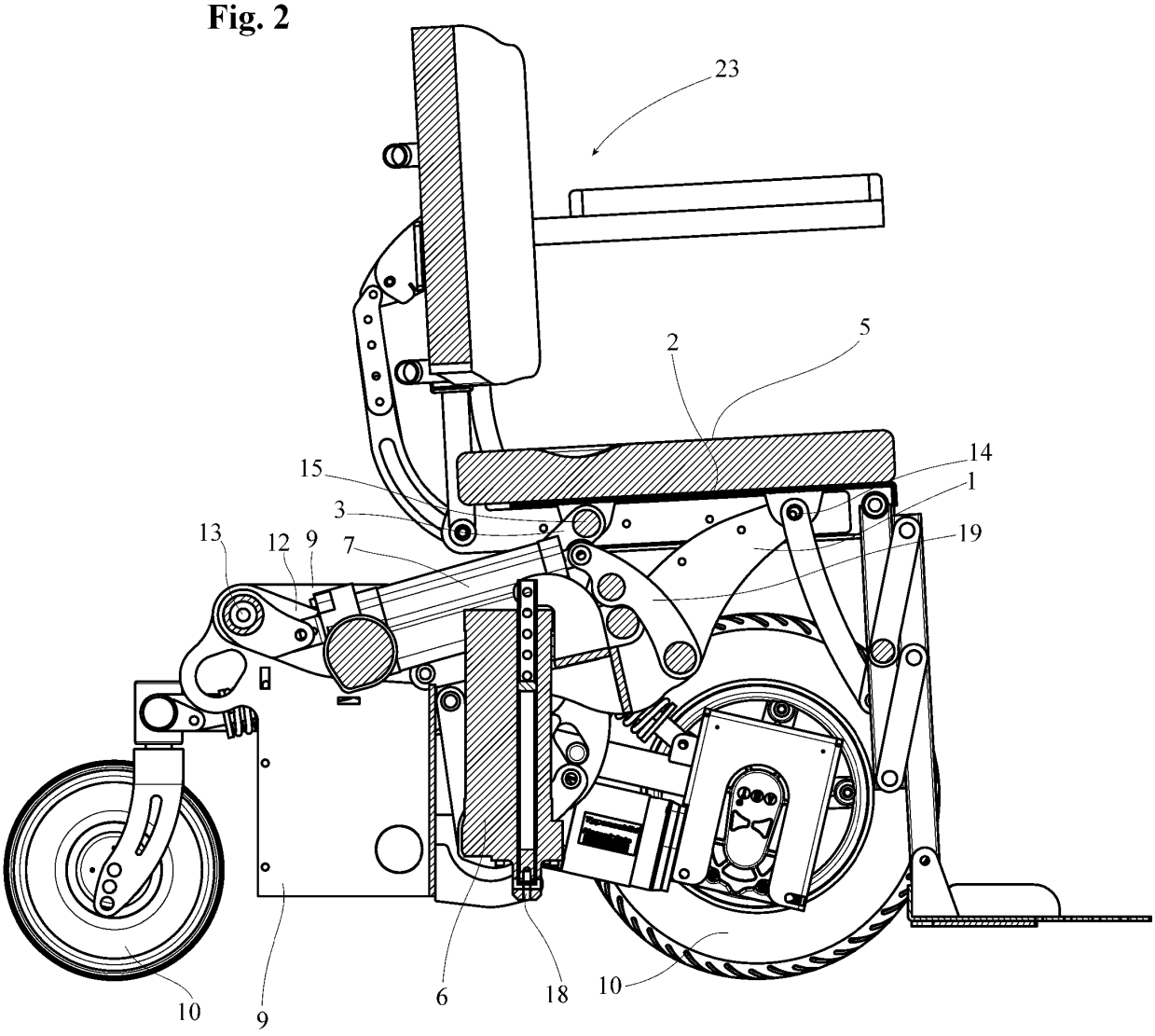


Fig. 3

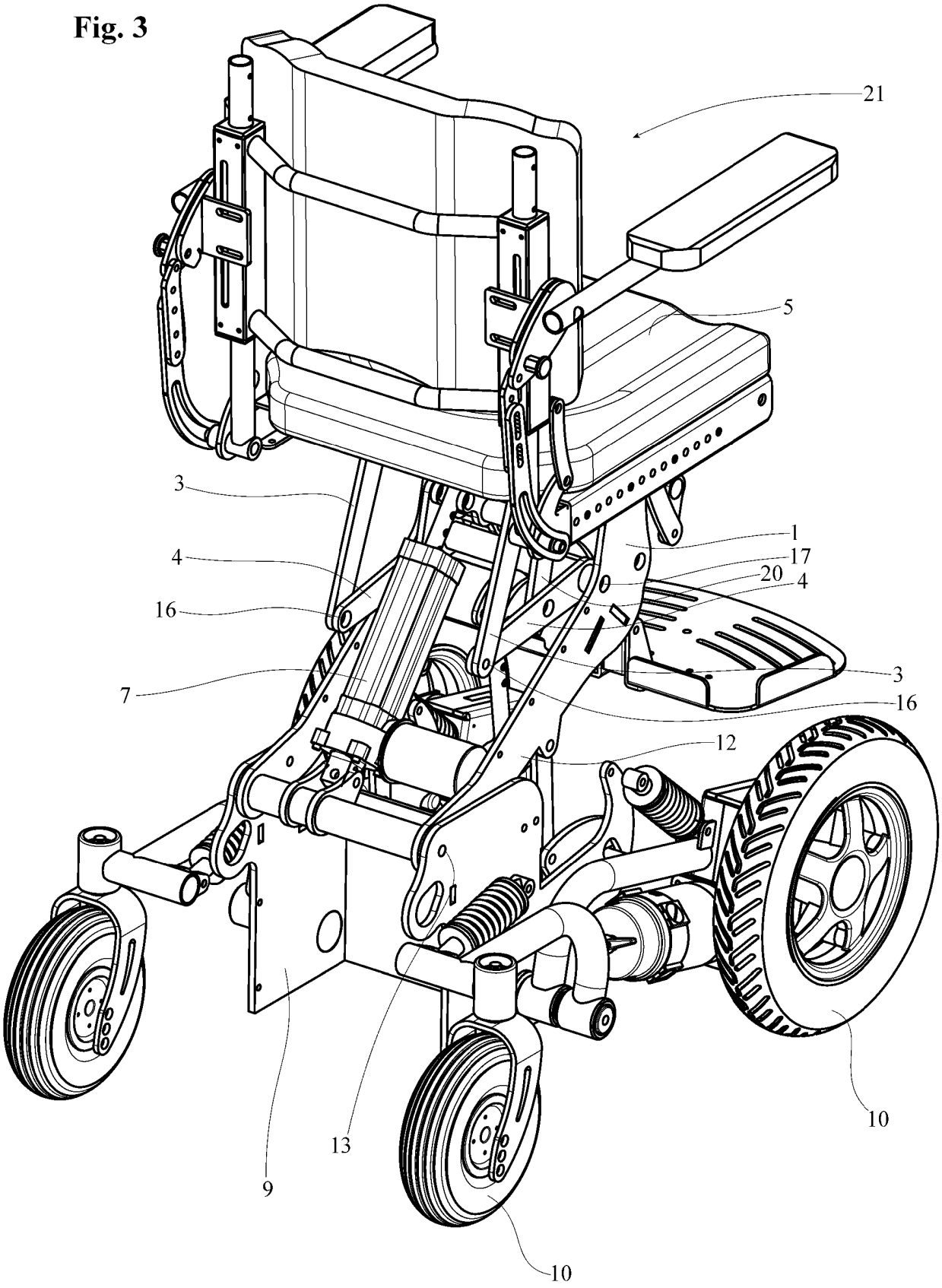


Fig. 4

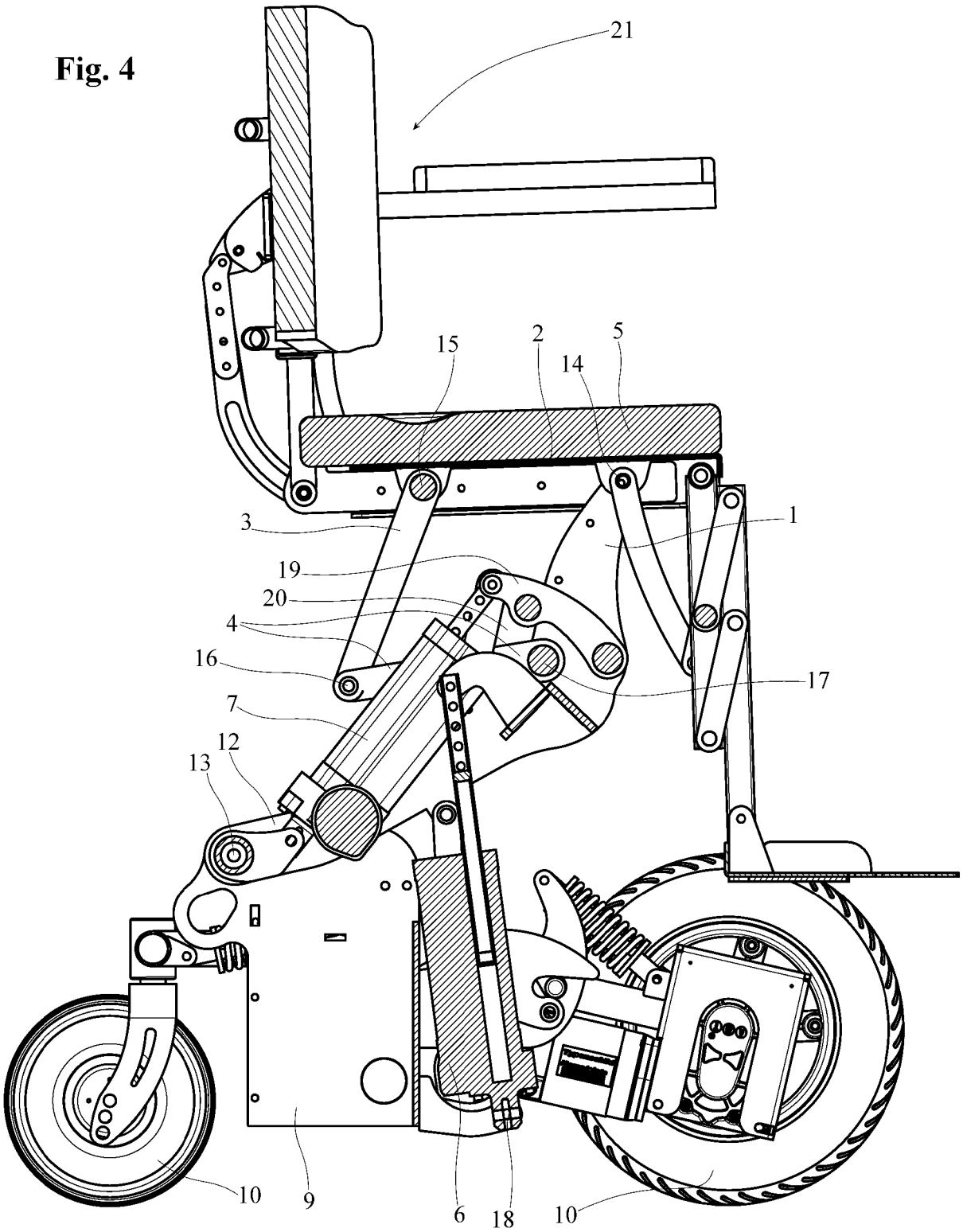


Fig. 5

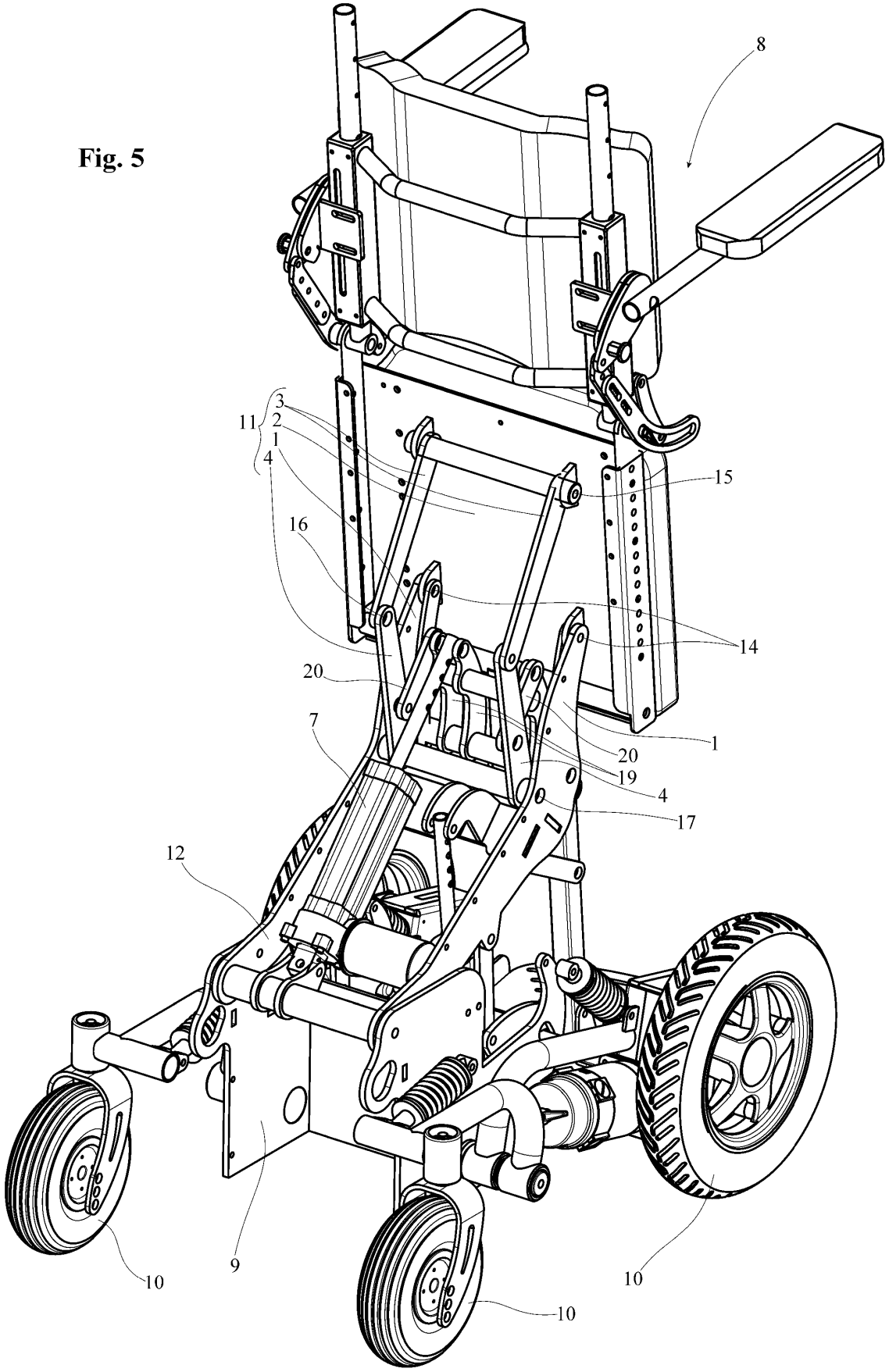


Fig. 6

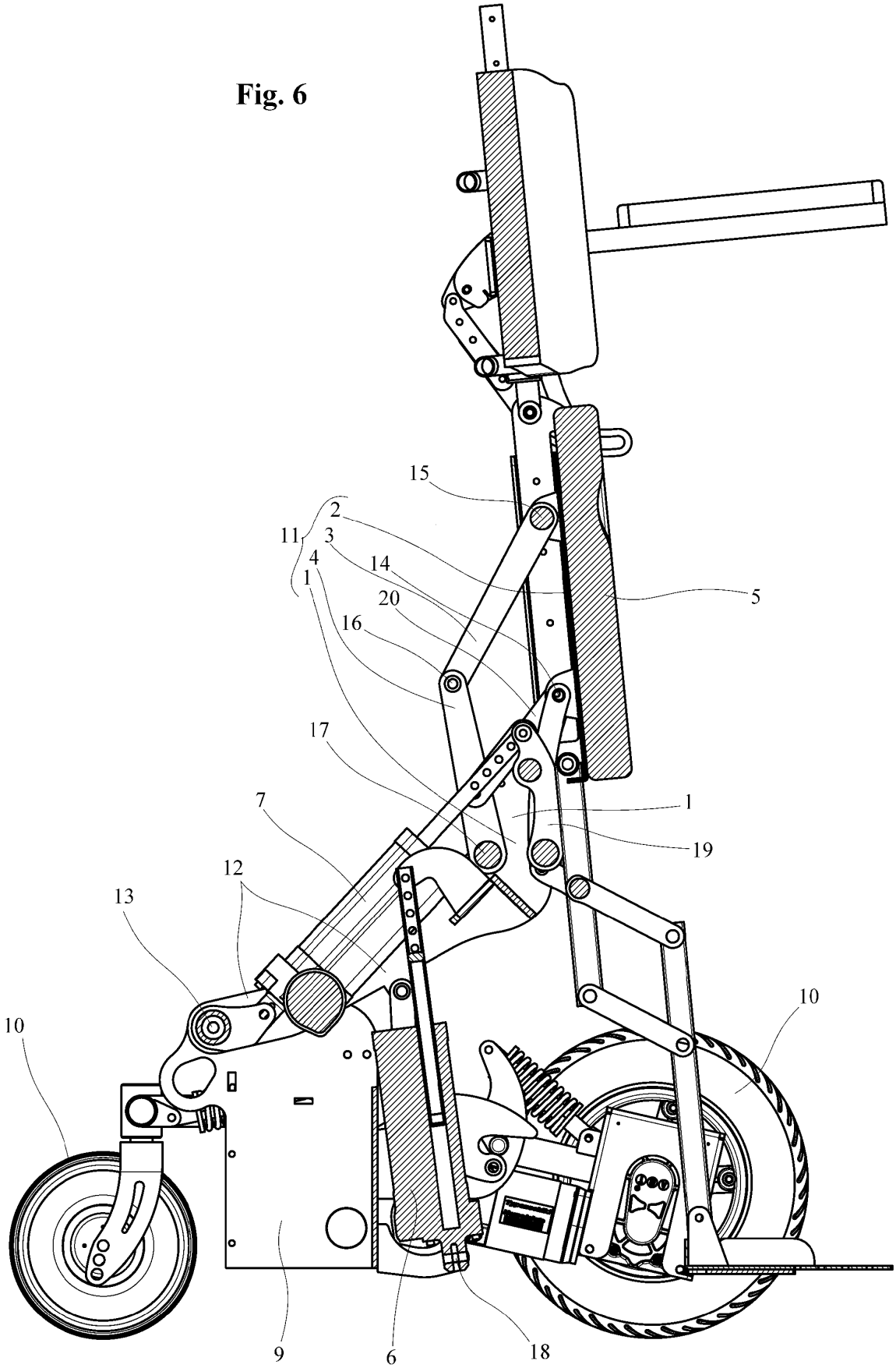


Fig. 7

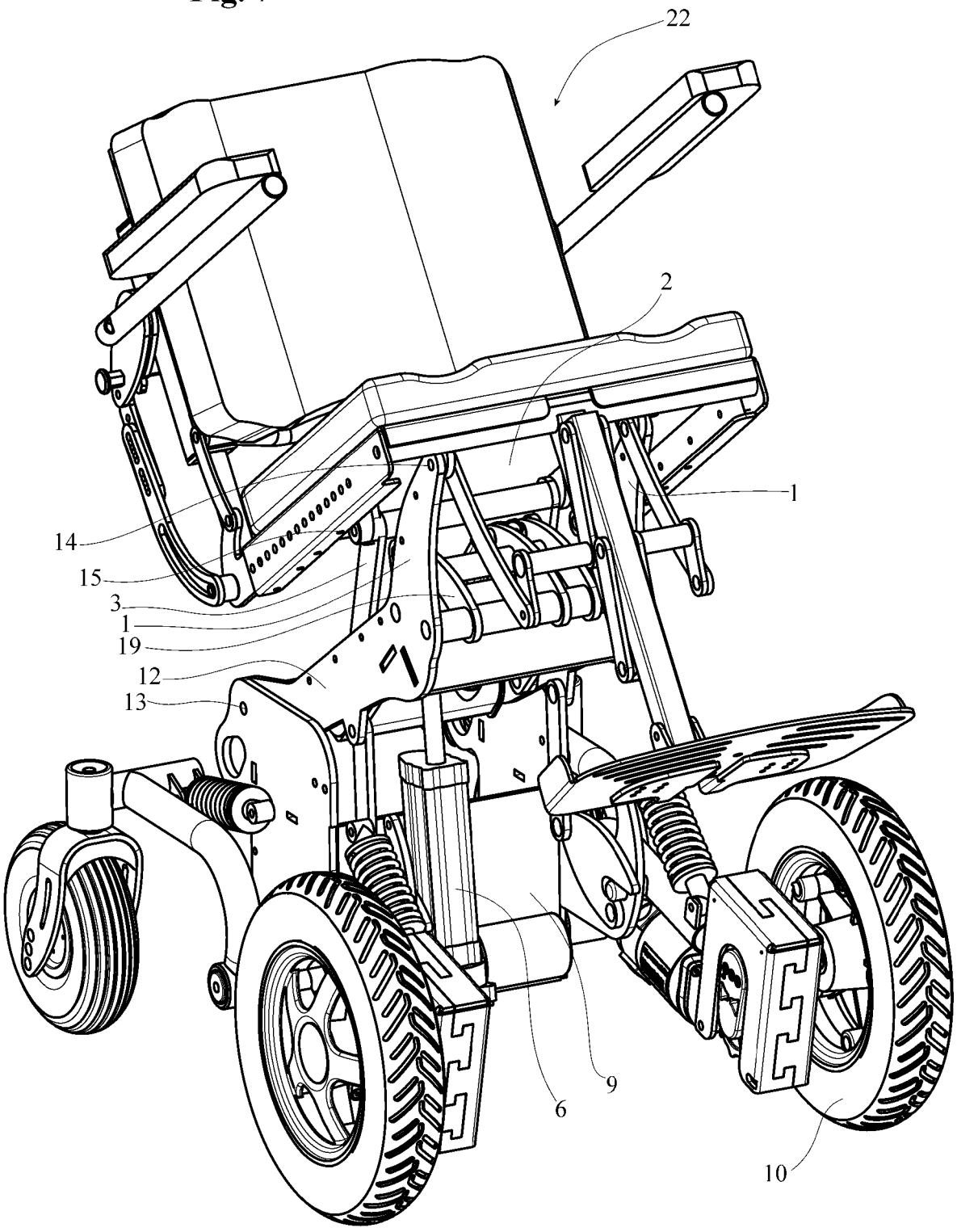


Fig. 8

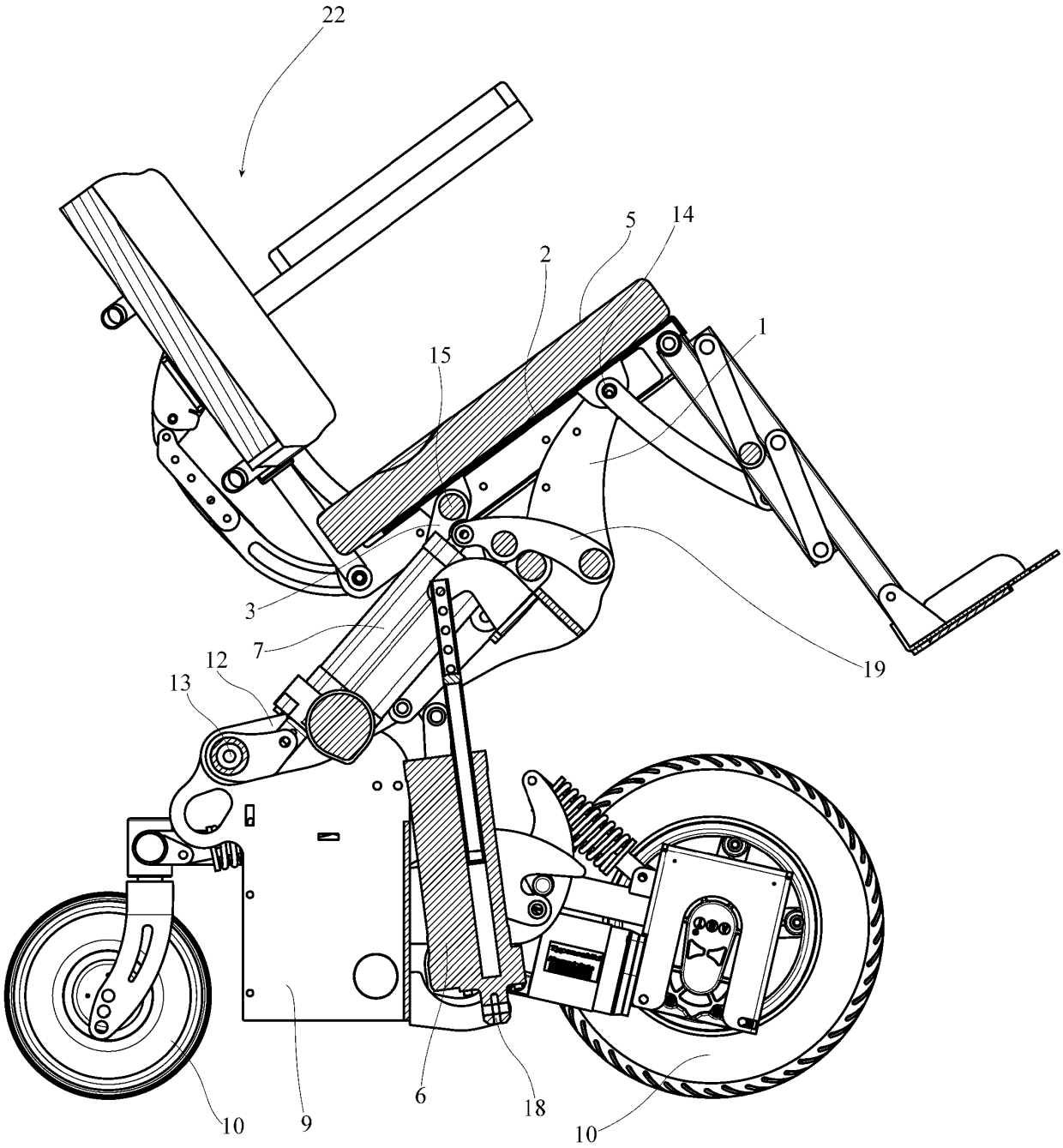


Fig. 9

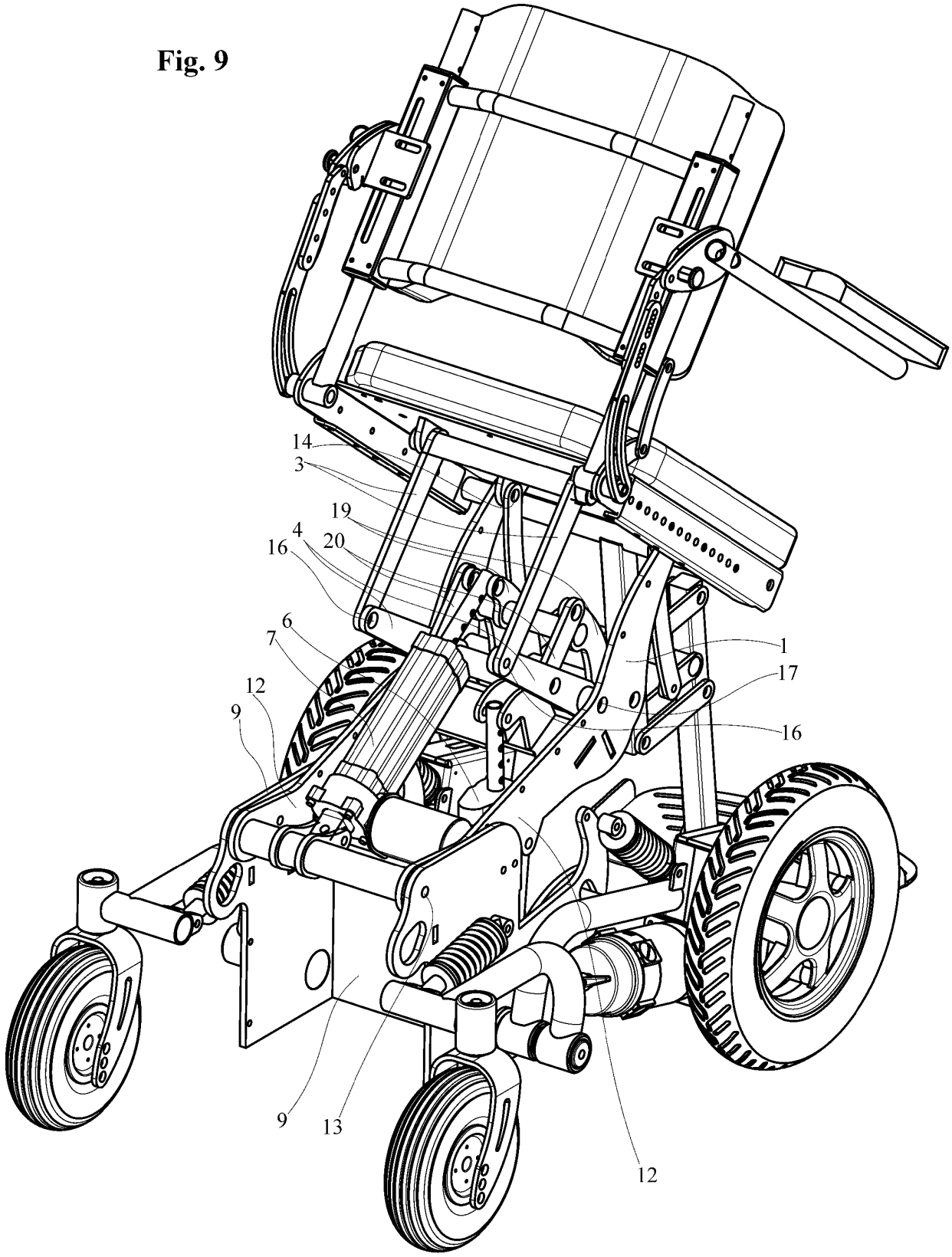
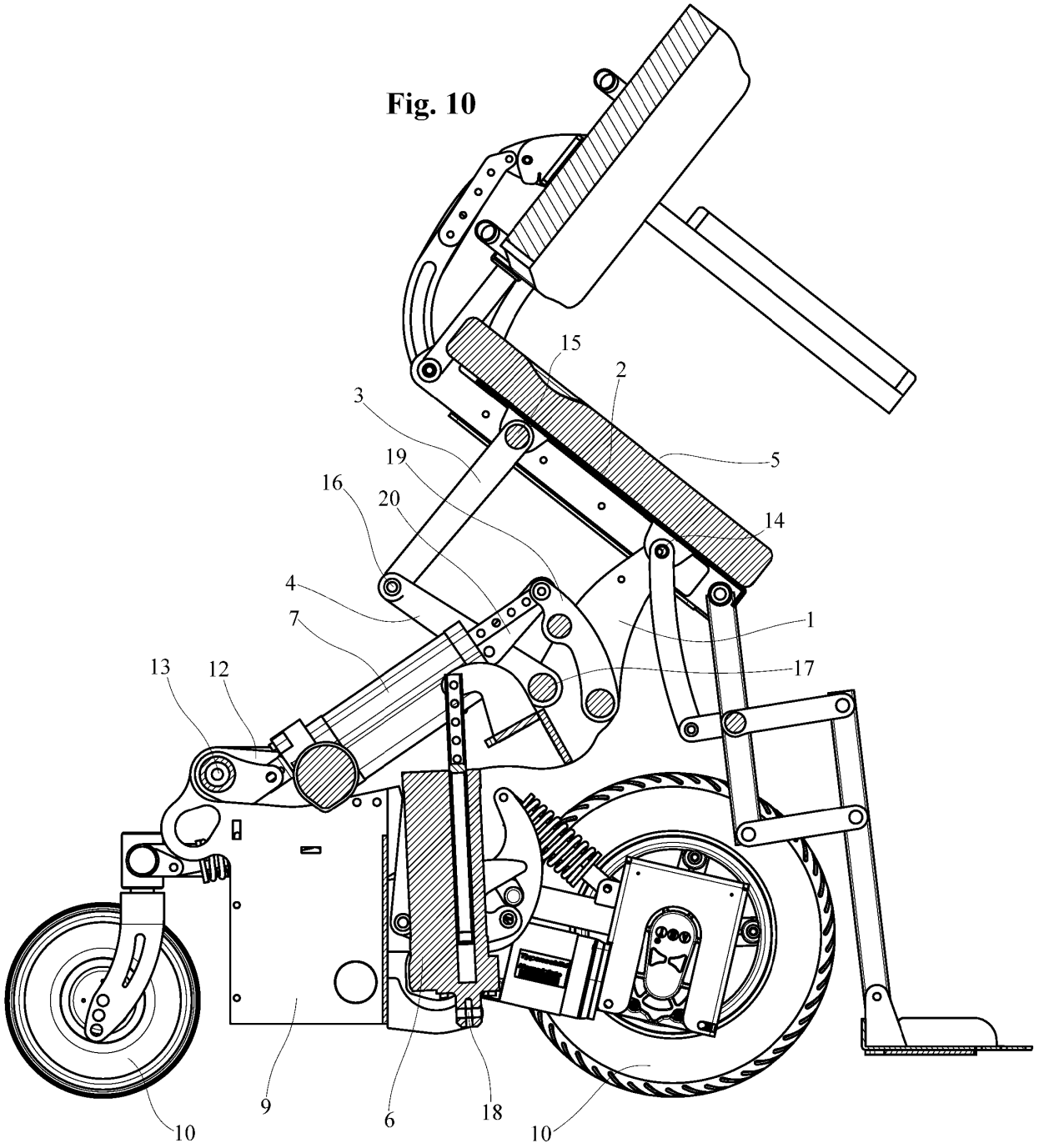


Fig. 10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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