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## (54) Suspension system for a mid-wheel drive wheelchair

(57) The invention relates to a mid wheel drive wheelchair, comprising a frame and a suspension unit connected thereto for at least one drivable wheel element. The suspension unit comprises a first bearing arm connected to the frame for the drivable wheel element. A first end of the first bearing arm is pivotably connected to the frame, wherein the drivable wheel element is rotatably mountable near a part of the first bearing arm which is spaced apart from the first end. The suspension unit is provided with a spring and/or damper element connected to the frame for damping a pivoting motion of the first bearing arm. The suspension unit comprises a second bearing arm for a rear supporting wheel element, wherein a first end of the second bearing arm is pivotably connected to the first bearing arm. The spring and/or damper element is thereby also configured for damping a pivoting motion of the second bearing arm. According to an aspect of the invention the suspension unit comprises a front bearing arm for a front supporting wheel element. A first end of this front bearing arm is pivotably connected to the first bearing arm. Additionally, the front spring and/or damper element is configured for damping a pivoting motion of the front bearing arm.

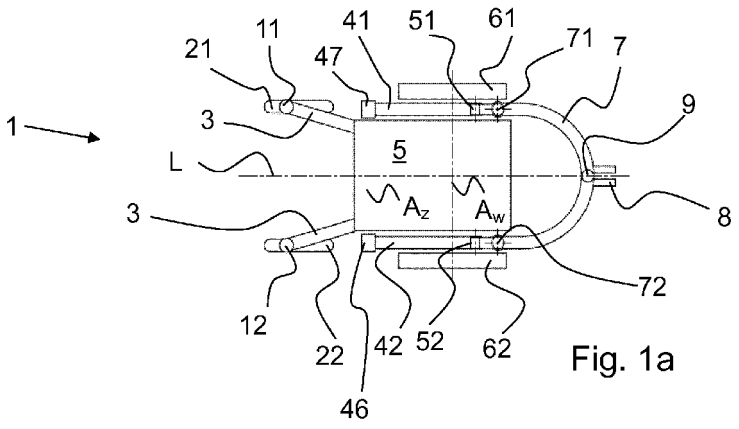


Fig. 1a

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## Description

**[0001]** The invention relates to a mid wheel drive wheelchair, comprising a frame and a suspension unit for at least one drivable wheel element connected thereto, wherein the suspension unit comprises a first bearing arm connected to the frame for the drivable wheel element, wherein a first end of the first bearing arm is pivotably connected to the frame, wherein the drivable wheel element is rotatably mountable near a part of the first bearing arm which part is spaced apart from the first end, and wherein the suspension unit is provided with a spring and/or damper element connected to the frame for damping a pivoting motion of the first bearing arm. The invention further relates to such a mid wheel drive wheelchair, wherein the suspension unit comprises a front bearing arm for a front supporting wheel element.

**[0002]** Such a mid wheel drive wheelchair is generally known. The generally known mid wheel drive wheelchair comprises a frame having a driving unit. A seat for a user is mounted on the frame. The user has access to control means shaped as a movable handle for thereby moving the wheelchair. The generally known wheelchair is provided with a total of six wheels: two front wheels, two middle wheels, and two rear wheels. The middle wheels are drivable by means of the driving unit, which is connected to the control means. The wheelchair is movable by driving the middle wheels. The front and rear wheels are not driven, but serve as a means of supporting the wheelchair, for acquiring the required stability during a rolling movement. A steering motion can be performed by driving the two middle wheels independently of one another. A great advantage of the generally known mid wheel drive wheelchair is that it is able, due to the relatively central positioning of the driven wheels, to perform a relatively compact rotation motion. To this end one middle wheel is driven in the forward direction, and the other middle wheel is driven in the backward direction.

**[0003]** A drawback of the known mid wheel drive wheelchair is, that the suspension unit is configured in a relatively complex manner. The complexity of the suspension unit makes the known wheelchair relatively expensive. Despite the complex suspension unit it has been shown that the stability and the comfort for the user can be improved.

**[0004]** Thus, the object of the current invention is to provide an improved mid wheel drive wheelchair, which preferably is provided with a simple suspension system, and wherein stability of the wheelchair on different surfaces and in varying circumstances is guaranteed, without at the same time losing track of the comfort of the user.

**[0005]** To this end, the invention provides a mid wheel drive wheelchair according to claim 1. According to the invention the suspension unit comprises a second bearing arm for a rear supporting wheel element. A first end of this second bearing arm is pivotably connected to the first bearing arm, wherein the first end of the second bearing arm is located between the spring and/or damper element and the first bearing arm. The spring and/or damper element is also configured for damping a pivoting motion of the second bearing arm. The first bearing arm with the drivable wheels is, by means of the second bearing arm which is hingedly connected thereto, dampingly suspended to the frame. Preferably the first bearing arm is thus connected to the frame only with the first end, and connected to the second bearing arm only with the second end Damping for both the first and the second bearing arm is thereby achieved in an embodiment by means of only a single spring and/or damper element. In this manner the number of required components, and the complexity of the suspension unit are reduced. By connecting the first bearing arm pivotably to the second bearing arm, both arms are dampingly connected to one another. It has been shown that this improves the stability of the wheelchair, and that the comfort of the user is therein secured. Thereby the object of the current invention is achieved.

**[0006]** Advantageous embodiments are subject of the dependent claims. Some of these will be discussed further in the text below.

**[0007]** Preferably, a first end of the spring and/or damper element is connected to the frame, wherein an end of the spring and/or damper element which is spaced apart from the frame is directly connected to the second bearing arm.

**[0008]** The spring and/or damper element may in an embodiment engage on a part of the second bearing arm which is located longitudinally spaced apart from the first end.

**[0009]** In an embodiment a point of rotation of the drivable wheel element is located between the hinging point of the first bearing arm and the hinging point of the second bearing arm.

**[0010]** Hereby it is possible that the hinging point of the second bearing arm is located between the point of rotation of the drivable wheel element and the spring and/or damper element.

**[0011]** In a fully assembled condition the wheelchair comprises a seat element for a user which is connected to the frame. By means of the suspension system according to the invention it is possible to place the driven wheels relatively far to the front. In an embodiment the point of rotation of the drivable wheel element is substantially located perpendicularly spaced apart from the seat element, preferably perpendicularly spaced apart from the centre of the seat element. This increases the manoeuvrability of the wheelchair, but achieves, especially during in place rotations (being a rotation motion of the wheelchair, without a translating motion) a higher level of comfort for the user, because the point of rotation then substantially coincides with the centre of mass of the user.

**[0012]** Aside from pivotably suspending the second bearing arm, in an embodiment the second bearing arm is also suspended pivotably about its longitudinal axis. Thus, the second bearing arm is pivotably suspended

about its longitudinal axis. The number of degrees of freedom of the second bearing arm is thereby increased, by means of which an accurate following motion of the wheels across the surface is possible.

**[0013]** According to an aspect the invention provides a mid wheel drive wheelchair according to claim 7. According to the invention the suspension unit comprises a front bearing arm for a front supporting wheel element. A first end of this front bearing arm is pivotably connected to the first bearing arm, which comprises the drivable middle wheel element. Additionally, a front spring and/or damper element is provided which is configured for damping of a pivoting motion of the front bearing arm. Such a construction is relatively compact. By pivotably connecting the first bearing arm to the front bearing arm, the front bearing arm is able to pivot in a damping manner with respect to the frame and to the first bearing arm. It has been shown that in this way the stability of the wheelchair is increased and that the comfort of the user is secured.

**[0014]** A first end of the front spring and/or damper element is preferably connected to the frame, and an opposite end of the front spring and/or damper element is directly connected to the front bearing arm. Preferably at least one front pivoting wheel element is mountable on the front bearing arm.

**[0015]** The front bearing arm is mounted to the first bearing arm near the first end of the first bearing arm, which first end is connected to the frame. A pivoting axis of the first bearing arm can therein substantially coincide with a pivoting axis of the front bearing arm.

**[0016]** The front bearing arm is preferably pivotably connected, about a substantially vertical axis, to the first bearing arm.

**[0017]** In an embodiment the front spring and/or damper element can engage on a part of the front bearing arm which is longitudinally spaced apart from the first end.

**[0018]** In an embodiment the front bearing arm can be pivotably connected to the first bearing arm on the site of the hinging point of the first bearing arm. By pivotably connecting the front bearing arm and the first bearing arm in a single hinge a simple and compact embodiment is achieved. Hereby the pivoting axes of the front bearing arm and the first bearing arm substantially coincide.

**[0019]** The front bearing arm is mounted to the first bearing arm near the first end of the first bearing arm which is connected to the frame. A pivoting axis of the bearing first arm may substantially coincide with a pivoting axis of the front bearing arm.

**[0020]** In an embodiment the front spring and/or damper element can engage on a part of the front bearing arm which is longitudinally spaced apart from the first end.

**[0021]** The front bearing arm is preferably pivotably connected, about a substantially vertical axis, to the first bearing arm.

**[0022]** In an embodiment the front bearing arm can be pivotably connected to the first bearing arm on the site of the hinging point of the first bearing arm. By pivotably connecting the front bearing arm and the first bearing arm in a single hinge a simple and compact embodiment is achieved. Thereby the pivoting axes of the front bearing arm and the first bearing arm substantially coincide.

**[0023]** In an embodiment the wheelchair is configured symmetrically. The suspension unit is configured for bearing a drivable wheel element located on one side of the wheelchair. The wheelchair comprises a further suspension unit configured for carrying a further wheel element located on the opposite side of the wheelchair. By means of the suspension unit and the further suspension unit, two drivable wheels are mountable on both sides of the wheelchair. The suspension unit and the further suspension unit can be configured identically (as mirror images of one another), but can also be configured differently. The further suspension unit is preferably configured according to an embodiment of the suspension unit of the wheelchair corresponding to the present invention, as described above. Preferably pivoting of the left front bearing arm is independent of pivoting of the right front bearing arm.

**[0024]** In that case, the further suspension unit for a further drivable wheel element comprises a further first bearing arm connected to the frame for the further drivable wheel element, wherein a first end of the further first bearing arm is pivotably connected to the frame, wherein the further drivable wheel element is rotatably mountable near a part of the further first bearing arm which is spaced apart form the first end. The further suspension unit is provided with a further spring and/or damper element connected to the frame for damping a pivoting motion of the further first bearing arm. The further suspension unit comprises a further second bearing arm, whereto a further rear supporting wheel element is mountable, or whereto, as will be discussed later, the rear supporting wheel element is mountable. A first end of the further second bearing arm is pivotably connected to the further first bearing arm. The further spring and/or damper element is also configured for damping a pivoting motion of the further second bearing arm.

**[0025]** In an embodiment the second bearing arm of the suspension unit and the further second arm of the further suspension unit are connected to one another to form one rear bearing arm. Hereby, It is advantageous when the second bearing arm and the further second bearing arm are integrally connected to one another.

**[0026]** As already described above, only one rear supporting wheel element can in an advantageous embodiment be applied, because the rear bearing arm is provided with one single rear supporting wheel unit, comprising at least one rear supporting wheel element. An embodiment with a plurality of supporting wheel elements is also imaginable.

**[0027]** In an embodiment the rear bearing arm has a curved, and preferably arctuate form. Hereby a compact construction becomes possible.

**[0028]** The wheelchair comprises in an advantageous embodiment a front bearing arm connected to the frame,

to which at least one front pivoting wheel element is rotatably mountable. Application of a further front bearing arm, with a further front pivoting wheel element increases the stability of the wheelchair.

**[0029]** Consequently, the suspension unit thus comprises the first bearing arm, the second bearing arm, and the front bearing arm, which are connected to one another to form a compact suspension unit. It is possible, without limitations, to configure a single suspension unit having a first bearing arm, a second bearing arm and a front bearing arm which are connected to one another. Each of the above described embodiments of a suspension unit having a front bearing arm can be configured in combination with each of the above described embodiments of a suspension unit having a second bearing arm.

**[0030]** In a simple to construct embodiment, the (front) spring and/or damper element is substantially made of rubber, preferably shaped as a massively configured elastic block element. The hardness of the block element can be chosen based on the desired comfort. Thereby the spring and/or damper element and the front spring and/or damper element can be configured identically, but also differently.

**[0031]** The invention shall be explained further by means of several examples of preferential embodiments shown in the attached figures. The figures show:

Fig. 1a - 1c: a top view, a side view and a rear view, respectively, of the wheelchair according to an embodiment of the present invention;

Fig. 2: a side view of the wheelchair according to an embodiment of the present invention while driving uphill;

Fig. 3: a rear view of the wheelchair according to an embodiment of the present invention on a downward inclining surface;

Fig. 4: a side view of the wheelchair according to an embodiment of the present invention on a convex surface;

Fig. 5: a side view of the wheelchair according to an embodiment of the present invention on a concave surface;

Fig. 6a - 6c: a top view, a side view and a rear view, respectively, of the wheelchair according to an embodiment of the present invention;

Fig. 7: a side view of the wheelchair according to an embodiment of the present invention while driving uphill;

Fig. 8: a rear view of the wheelchair according to an embodiment of the present invention on a downward inclining surface;

Fig. 9: a side view of the wheelchair according to an embodiment of the present invention on a convex surface;

Fig. 10: a side view of the wheelchair according to an embodiment according to the present invention on a concave surface;

**[0032]** Fig. 1a to Fig. 1c show a top view (Fig. 1a), a side view (Fig. 1 b) and a rear view (Fig. 1c) of a mid wheel drive wheelchair rolstoel 1 according to the present invention. The wheelchair 1 comprises a frame 4, on which a seat 5 having a seat surface 56 and back support 58 is mounted. A number of wheels 21, 22, 61, 62, 8 are provided on the frame 4. The wheelchair 1 comprises two front wheels 21, 22 connected with front arms 3 to the frame. As can be clearly seen in Fig. 1 b, a hinge 12 is provided at the end of the arm 3, wherein a wheel arm 27 is hingingly mounted. A front wheel 22 is mounted rotatably about an axis 26 on the wheel arm 27. The upper wheel 21 in Fig. 1 a is similarly suspended with a hinge fixture 11 to the upper arm 3. Hereby the two front wheels 21, 22 are configured as pivoting wheels.

**[0033]** The driven wheels 61, 62 located in the middle of the wheelchair 1 are connected to the frame 4 by means of a suspension unit 15 and a further suspension unit 16. The suspension unit 15 comprises a first bearing arm 42 connected pivotably around pivoting axis $A_z$ to the frame 4 by means of a pivoting hinge 46. On the end of the first bearing arm 42 which is opposite the pivoting hinge 46 the drivable wheel element 62 is provided, about axis 66. The wheel element 62 is rotatable about wheel axis $A_w$. This wheel axis $A_w$ is placed parallel to the pivoting axis $A_z$. By means of a, not depicted, driving unit connected to the frame 4, the wheel element 62 is drivable. Hereby, the drivable axis 66 is connected, by means of the first bearing arm 42 and the pivoting hinge 46, to the driving unit. Therefore the first bearing bearing 42 is also referred to as motorarm.

**[0034]** On the end of the first bearing arm 42 which is opposite to the pivoting hinge 46 the first bearing arm 42 is pivotably connected to the second bearing arm 7 by means of a pivoting hinge 52. The second bearing arm 7 is hereby pivotable about a pivoting axis (not depicted) which lies parallel to the pivoting axis $A_z$. The pivoting hinge 52 is, with respect to the axis 66, located spaced further apart from the pivoting hinge 46. At a rear side of the second bearing arm 7, spaced apart from the pivoting hinge 52, a rear wheel unit 8 is provided, having a number of wheel elements 8. The rear wheel unit 8 comprises a wheel arm 87 pivotably mounted to the second arm 7 by means of a pivoting hinge 9, to which the wheel element 8 is mountable. A spring and/or damper element 72 is provided between the wheel unit 8 and the pivoting hinge 52, one end of which is mounted to the second arm 7, and the other end of which is provided to the frame 4 . The spring and/or damper element 72 is in an embodiment substantially made of rubber, preferably in the shape of a block element that may be hollow, though differently configured springs and/or damper constructions are also imaginable. When moving the second arm 7 upwards, the spring and/or damper element 71, 72 becomes pressure loaded.

**[0035]** As is obvious from Fig. 1a and 1c, suspension

units 15, 16 are provided on both sides of the wheelchair 1, which are configured similarly, having a first arm 41, 42 pivotably connected to the frame 4 by means of a hinge 45, 46. The drivable wheel element 61, 62 is connected spaced apart from the hinge 45, 46. Spaced further apart from the hinge 45, 46 the second arm 7 is pivotably connected by means of the pivoting hinge 51, 52. A rear wheel unit 8 is provided spaced apart from the pivoting hinge 51, 52. A spring and/or damper element 71, 72 is located between each wheel unit 8 and pivoting hinge 51, 52 of the second arm 7. Shown, especially in Fig. 1a, is that the second arm 7 of the first suspension unit 15, continues into the second arm 7 of the further suspension unit 16. In the depicted embodiment the two arms 7 are configured as an integrally formed rear bearing arm 7. It will be obvious, however, to the skilled person, that an application of two second arms 7 that are independently movable, as shown in Fig. 6a, 6c and 8, is also imaginable.

**[0036]** Fig. 1b shows that starting from the pivoting point 46 of the first bearing arm 42, the suspension unit 15 subsequently comprises the following components: pivoting point 46, axis 66 of the drivable wheel element 62, pivoting hinge 52 which connects the first arm 42 with the second arm 7, the spring and/or damper element 72, and finally the rear wheel element 8. In other words, the first end 52 of the second bearing arm 7 is located between the spring and/or damper element 72 and the axis 66 of the first bearing arm 42. The point of rotation 66 of the drivable wheelelement 62 is located between the hinging point 46 of the first bearing arm 42 and the hinging point 52 of the second bearing arm 7. The hinging point 52 of he second bearing arm 7 is located between the point of rotation 66 of the drivable wheel element 62 and the spring and/or damper element 72.

**[0037]** Fig. 1b further shows that axis of rotation 66 of the drivable wheel element 62 is substantially located perpendicularly spaced apart from the seat element 56, between the center of the seat element 56 and the back support 58. This improves the user comfort, especially while rotating in place.

**[0038]** The workings of the here above described wheelchair will be further explained further with the aid of several example situations.

**[0039]** Fig. 2 shows the wheelchair 1 which drives leftwards uphill from a straight surface A towards an incline B. The second bearing arm 7 has undergone, with respect to the first bearing arm 42, a pivoting movement about pivoting hinge 52, such that all wheels 22, 62, 8 are in contact with the bottom surface. Hereby, the spring 71 provides a sufficient counterpressure, such that wheel 62 en wheel 8 are also actually pressed onto the bottom surface.

**[0040]** In an embodiment the second bearing arm 7 is not only pivotably connected to the first bearing arm 42, but is suspended such that de second bearing arm 7 is also pivotable around its longitudinal axis. Hereby a tilting of the second arm 7, about a longitudinal axis of the wheelchair 1, becomes possible. This also allows the wheelchair 1 to drive on unequal terrain, as shown in Fig. 3. Here it is shown that the wheelchair 1 drives partially on a straight surface D, and partially on an incline C. The wheelchair 1 drives parallel to the elevation contour lines of the incline C. By means of the suspension units 15, 16 according to the present invention, all wheels 62, 8, 61 remain in contact with the bottom surface C,D. The seat 5, remains substantially in the horizontal plane, which means the user hardly notices driving on an incline C. The seat 5 aligns itself as it were, and will remain horizontal, resulting in a reduced chance of the wheelchair 1 keeling over. The wheelchair 1 according to the invention is particularly stable due to the application of the suspension unit 15, 16.

**[0041]** The suspension unit 15, 16 is formed such that, when pivoting of the one arm 41 occurs, the other arm 42 initially pivots in an opposite direction (or does not pivot). This results from the second bearing arm 7 being only pivotably connected with a first end to the first bearing arm 41, 42, and not being directly connected to the frame 4. Additionally the spring and/or damper element 71, 72 is connected to the second bearing arm 7 such that it dampens a pivoting motion of the second bearing arm 7. Hereby a decent following behavior is obtained: the wheels 61, 62, 8 will follow the bottom surface in a decent manner, and will be in contact therewith.

**[0042]** Fig. 4 illustrates what occurs on a rounded, or convex, incline E. Here, the rear bearing arm 7 has moved downwards, because the first bearing arm 42 is slightly compressed, and the spring and/or damper element 72 provides sufficient force. The first bearing arm 42 has thus undergone a pivoting in the opposite direction.

**[0043]** Fig. 5 shows what occurs on a hollow, or concave surface F. The wheels 22, 62, 8 will follow the contour of the incline F. Here also the pivoting in opposite directions can be recognized.

**[0044]** Fig. 6a to Fig. 6c show a top view (Fig. 6a), a side view (Fig. 6b) and a rear view (Fig. 6c), respectively, of a mid wheel drive wheel chair 100 according to the present invention. The wheelchair 100 comprises two front wheels 21, 22 connected to the frame 4 by means of front arms 3. The upper wheel 21 in Fig. 6a (right wheel of the wheelchair 100) is suspended to the upper arm 3 by means of a hinge fixture 11. Hereby the two front wheels 21, 22 are configured as pivoting wheels. Between the hinge fixture 11 and the pivoting hinge 46 a front spring and/or damper element 32 is provided, which is mounted with an end to a front arm 3, and in which the other end is provided to frame 4. During upwards movement of the front arm 3, the spring and/or damper element 32 becomes pressure loaded.

**[0045]** A front arm 3 is pivotably connected on every hinge 45, 46. The front arms 3 are therefore each hingingly connected to the first arms 41, 42. Spaced apart from the pivoting hinge 45, 46, a front wheel unit 21, 22 is provided. A spring and/or damper element 32 is pro-

vided between the wheel unit 21, 22 and the pivoting hinge 45, 46 of the front arm 3. Shown especially in Fig. 6a, is that on one side of the wheelchair 100 a first front arm 3 of the first suspension unit 115, as well as on the other side of the wheelchair 100 a further front arm 3 of the second suspension unit 116, is provided.

**[0046]** From Fig. 6b it is clear that -as seen from the front side of the wheelchair 100- the suspension unit 115 comprises subsequently the following components: a front bearing arm 3 whereto a front wheel element 22 is mounted, a first bearing arm 42 having a drivable wheel, and the second bearing arm 7. Therein it can be seen that a first end of the front bearing arm 3 is placed on the hinging point 46 of the first bearing arm 42. The second end 11, 12 of the front bearing arm 3 is connected to the front wheel element 21, 22. The front spring and/or damper element 32 is connected to the front bearing arm 3 and the frame 4. The front spring and/or damper element 32 engages on a part of the front bearing arm 3, which is located between the hinging point 46 and the second end 11, 12 of the front bearing arm 3.

**[0047]** The operation of the wheelchair 100 described above will be further explained with the aid of several example situations.

**[0048]** Fig. 7 shows the wheelchair 100 driving uphill to the left from a flat bottom surface B onto an incline A. The front bearing arm 3 has with respect to the first bearing arm 42 undergone a pivoting around pivoting hinge 46, such that all wheels 22, 66, 8 are in contact with the bottom surface A, B. Therein the spring 32 provides sufficient counterpressure, such that the front wheel 22 is also actually pressed onto the bottom surface A, B. The pivoting of the front arm 3 with respect to the frame 4 also improves the user comfort.

**[0049]** In Fig. 8 it can be seen that the wheelchair 1 partially drives across a straight surface D, and partially on an incline C, as in Fig. 3. The wheelchair 1 drives parallel to the elevation contour lines of the incline C. Fig. 8 clearly illustrates the application of two second 7, 7' arms that are independently movable with respect to one another, and which are each connected to the frame 4 by means of a spring 71, 72. Each second arm 7, 7' is provided with a rear wheel element 8, 8'. As such the rear wheel elements 8, 8' are capable of maintaining contact with the bottom surface C, D without a tilting of the wheelchair 100.

**[0050]** Fig. 9 illustrates what occurs upon a rounded, or convex incline E. The front bearing arm 3 has moved downward here. The front spring and/or damper element 32 provides sufficient force to keep the front wheels 21, 22 on the road. The first bearing arm 42 has undergone a pivoting in the opposite direction. The wheels 8, 61, 62 maintain contact with the road surface E.

**[0051]** Fig. 10 show what occurs on a hollow, or concave bottom surface F. The wheels 22, 66, 8 will follow the contour of the incline F. Herein also the pivoting in opposite directions can be recognized.

CLAUSES

**[0052]** The invention will be further described with the aid of several clauses, wherein further embodiments of the invention, and combinations thereof, will be discussed.

Clause 1. Mid wheel drive wheelchair, comprising a frame and a suspension unit for at least one drivable wheel element connected thereto, wherein the suspension unit comprises a first bearing arm for the drivable wheel element connected to the frame, wherein a first end of the first bearing arm is pivotably connected to the frame, wherein the drivable wheel element is rotatably mountable near a part of the first bearing arm which is spaced apart from the first end, and wherein the suspension unit is provided with a spring and/or damper element connected to the frame for damping a pivoting motion of the first bearing arm, wherein the suspension unit comprises a second bearing arm for a second rear supporting wheel element, characterized in that a first end of the second bearing arm is pivotably connected to the first bearing arm, and in that the spring and/or damper element is also configured for damping a pivoting motion of the second bearing arm.

Clause 2. Mid wheel drive wheelchair according to clause 1, wherein the first end of the second bearing arm is located between the spring and/or damper element and the first bearing arm.

Clause 3. Mid wheel drive wheelchair according to clause 2, wherein a first end of the spring and/or damper element is connected to the frame, and wherein an end of the spring and/or damper element which is spaced apart from the frame is directly connected to the second bearing arm.

Clause 4. Mid wheel drive wheelchair according to any of the previous clauses, wherein the spring and/or damper element engages on a part of the second bearing arm which is longitudinally spaced apart from the first end.

Clause 5. Mid wheel drive wheelchair according to any of the previous clauses, wherein a point of rotation of the drivable wheel element is located between the hinging point of the first bearing arm and the hinging point of the second bearing arm.

Clause 6. Mid wheel drive wheelchair according to clause 5, wherein the hinging point of the second bearing is located between the point of rotation of the drivable wheel element and the spring and/or damper element.

Clause 7. Mid wheel drive wheelchair according to any of the previous clauses, wherein the wheelchair comprises a seat element for a user connected to the frame, wherein the point of rotation of the drivable wheel element is located substantially perpendicularly spaced apart from the seat element, preferably between the center of the seat element and a back

support thereof.

Clause 8. Mid wheel drive wheelchair according to any of the previous clauses, wherein the second bearing arm is suspended pivotably about its longitudinal axis.

Clause 9. Mid wheel drive wheelchair according to any of the previous clauses, wherein the wheelchair comprises a further suspension unit formed in accordance with the suspension unit as defined in one of the previous clauses.

Clause 10. Mid wheel drive wheelchair according to clause 9, wherein the second bearing arm of the suspension unit and the second bearing arm of the further suspension unit are connected to one another to form one rear bearing arm, and preferably are integrally connected to one another.

Clause 11. Mid wheel drive wheelchair according to clause 10, wherein the rear bearing arm is provided with a single rear supporting wheel element comprising at least one rear supporting wheel element.

Clause 12. Mid wheel drive wheelchair according to clause 10 or 11, wherein the rear bearing arm has a curved especially arcuate form.

Clause 13. Mid wheel drive wheelchair according to any of the previous clauses, wherein the wheelchair comprises a front bearing arm connected to the frame, wherein at least one front pivoting wheel element is rotatably mountable thereto.

Clause 14. Mid wheel drive wheelchair according to any of the previous clauses, wherein the spring and/or damper element is substantially made of rubber, preferably shaped as a block element that may be hollow.

Clause 15. Mid wheel drive wheelchair, comprising a frame and a suspension unit for at least one drivable wheel element connected thereto, wherein the suspension unit comprises a first bearing arm for the drivable wheel element connected to the frame, wherein a first end of the first bearing arm is pivotably connected to the frame, wherein the drivable wheel element is rotatably mounted near a part of the first bearing arm spaced apart from the first end, and wherein the suspension unit is provided with a spring and/or damper element connected to the frame for damping a pivoting motion of the first bearing arm, wherein the suspension unit further comprises a front bearing arm for a front supporting wheel element, characterized in that a first end of the front bearing arm is pivotably connected to the first bearing arm, and in that the suspension unit is provided with a front spring and/or damper element connected to the frame for damping a pivoting motion of the front bearing arm.

Clause 16. Mid wheel drive wheelchair according to clause 15, wherein the suspension unit comprises a second bearing arm for a rear wheel supporting wheel element, wherein a first end of the second bearing arm is pivotably connected to the first bearing arm, and wherein the spring and/or damper element is also configured for damping a pivoting motion of the second bearing arm.

Clause 17. Mid wheel drive wheelchair according to clause 15 or 16, wherein the front bearing arm is mounted to the first bearing arm near a first end of said first bearing arm which is connected to the frame.

Clause 18. Mid wheel drive wheelchair according to clause 17, wherein a pivoting axis of the first bearing arm substantially coincides with a pivoting axis of the front bearing arm.

Clause 19. Mid wheel drive wheelchair according to any of the clauses 15 to 18, wherein the front spring and/or damper element is spaced apart from a first end of the front bearing arm.

Clause 20. Mid wheel drive wheelchair according to any of the clauses 15 to 19, wherein a first end of the front spring and/or damper element is connected to the frame, and wherein an opposite end of the front spring and/or damper element is directly connected to the front bearing arm.

Clause 21. Mid wheel drive wheelchair according to any of the clauses 15 to 20, wherein the front bearing arm is pivotably connected, about a substantially vertical axis, to the first bearing arm.

Clause 22. Mid wheel drive wheelchair according to any of the clauses 15 to 21, wherein the wheelchair comprises a further suspension unit which is formed in accordance to the suspension unit as defined in any of the clauses 15 to 21.

Clause 23. Mid wheel drive wheelchair according to any of the clauses 15 to 22, wherein at least one front pivoting wheel element is rotatably mountable to the front bearing arm.

Clause 24. Mid wheel drive wheelchair according to any of the clauses 15 to 23, wherein at least one spring and/or damper element is substantially made of rubber, preferably shaped as a block element that may be hollow.

Clause 25. Mid wheel drive wheelchair according to clause 16 or a clause dependent thereon, wherein the first end of the second bearing arm is located between the spring and/or damper element and the first bearing arm.

Clause 26. Mid wheel drive wheelchair according to clause 25, wherein a first end of the spring and/or damper element is connected to the frame, and wherein an end of the spring and/or damper element which is spaced apart from the frame is directly connected to the second bearing arm.

Clause 27. Mid wheel drive wheelchair according to clause 16 or a clause dependent thereon, wherein the spring and/or damper element engages on a part of the second bearing arm which is longitudinally spaced apart from the first end.

Clause 28. Mid wheel drive wheelchair according to clause 16 or a clause dependent thereon, wherein

a point of rotation of the drivable wheel element is located between the hinging point of the first bearing arm and the hinging point of the second bearing arm.
Clause 29. Mid wheel drive wheelchair according to clause 28, wherein the hinging point of the second bearing arm is located between the point of rotation of the drivable wheel element and the spring and/or damper element.
Clause 30. Mid wheel drive wheelchair according to any of the clauses 15 to 29, wherein the wheelchair comprises a seat element for a user connected to the frame, wherein the point of rotation of the drivable wheel element is substantially located perpendicularly spaced apart from the seat element, preferably between the centre of the seat element and a back support thereof.
Clause 31. Mid wheel drive wheelchair according to clause 16 or clause dependent thereon, wherein the second bearing arm is also pivotably suspended about its longitudinal axis.

**[0053]** It will be obvious to the skilled person that the invention is described here above with the aid of several possible preferential embodiments. The invention though is not limited to these embodiments. Within the scope of the invention many modifications can be imagined. The requested protection is defined by the attached claims.

## Claims

1. Mid wheel drive wheelchair (1), comprising a frame (4) and a suspension unit (15, 16) for at least one drivable wheel element (61, 62) connected thereto, wherein the suspension unit (15, 16) comprises a first bearing arm (41, 42) for the drivable wheel element (61, 62) connected to the frame (4), wherein a first end of the first bearing arm (41, 42) is pivotably connected to the frame (4), wherein the drivable wheel element (61, 62) is rotatably mountable near a part of the first bearing arm (41, 42) which is spaced apart from the first end, and wherein the suspension unit (15, 16) is provided with a spring and/or damper element (71, 72) connected to the frame (4) for damping a pivoting motion of the first bearing arm (41, 42), wherein the suspension unit (15, 16) comprises a second bearing arm (7) for a rear supporting wheel element (8), **characterized in that** the first end of the second bearing arm (7) is pivotably connected to the first bearing arm (41, 42), **in that** the spring and/or damper element (71, 72) is also configured for damping a pivoting motion of the second bearing arm (7), and **in that** the first end of the second bearing arm (7) is located between the spring and/or damper element (71, 72) and the first bearing arm (41, 42).

2. Mid wheel drive wheelchair (1) according to claim 1, wherein a first end of the spring and/or damper element (71, 72) is connected to the frame (4), and wherein an end of the spring and/or damper element (71, 72) which is spaced apart from the frame (4) is directly connected to the second bearing arm (7).

3. Mid wheel drive wheelchair (1) according to any of the previous claims, wherein the spring and/or damper element (71, 72) engages on a part of the second bearing arm (7) which is longitudinally spaced apart from the first end thereof.

4. Mid wheel drive wheelchair (1) according to any of the previous claims, wherein a point of rotation (66) of the drivable wheel element (61, 62) is located between the hinging point (46) of the first bearing arm (41, 42) and the hinging point (51, 52) of the second bearing arm (7), preferably wherein the hinging point (51, 52) of the second bearing arm (7) is located between the point of rotation (66) of the drivable wheel element (61, 61) and the spring and/or damper element (71, 72).

5. Mid wheel drive wheelchair (1) according to any of the previous claims, wherein the wheelchair (1) comprises a seat element (5) for a user connected to the frame (4), wherein the point of rotation (66) of the drivable wheel element (61, 62) is substantially located perpendicularly spaced apart from the seat element (5), preferably between the centre of the seat element (5) and a back support (58) thereof.

6. Mid wheel drive wheelchair (1) according to any of the previous claims, wherein the second bearing arm (7) is suspended pivotably about its longitudinal axis.

7. Mid wheel drive wheelchair (100), comprising a frame (4) and a suspension unit (115, 116) for at least one drivable wheel element (61, 62) connected thereto, wherein the suspension unit (115, 116) comprises a first bearing arm (41, 42) for the drivable wheel element (61, 62) connected to the frame (4), wherein a first end of the first bearing arm (41, 42) is pivotably connected to the frame (4), wherein the drivable wheel element (61, 62) is rotatably mountable near a part of the first bearing arm (41, 42) which is spaced apart from the first end, and wherein the suspension unit (115, 116) is provided with a spring and/or damper element (71, 72) connected to the frame (4) for damping a pivoting motion of the first bearing arm (41, 42), wherein the suspension unit (115, 116) further comprises a front bearing arm (3) for a front supporting wheel element (21, 22), **characterized in that** a first end of the front bearing arm (3) is pivotably connected to the first bearing arm (41, 42), and that the suspension unit (115, 116) is provided with a front spring and/or damper element (32) connected to the frame (4) for damping a pivot-

ing motion of the front bearing arm (3).

**8.** Mid wheel drive wheelchair (100) according to claim 7, wherein the front bearing arm (3) is mounted to the first bearing arm (41, 42) near the first end of said first bearing arm (41, 42) which is connected to the frame (4), wherein preferably at least one front pivoting wheel element (21, 22) is rotatably mountable to the front bearing arm (3).

**9.** Mid wheel drive wheelchair (100) according to claim 7 or 8, wherein a pivoting axis $A_Z$ of the first bearing arm (41, 42) substantially coincides with a pivoting axis of the front bearing arm (3) and/or wherein the front bearing arm (3) is pivotably connected, about a substantially vertical axis, to the first bearing arm (41, 42).

**10.** Mid wheel drive wheelchair (100) according to any of the claims 7 to 9, wherein the front spring and/or damper element (32) is located spaced apart from a first end of the front bearing arm (3), and wherein especially a first end of the front spring and/or damper element (32) is connected to the frame (4), and wherein an opposite end of the front spring and/or damper element (32) is directly connected to the front bearing arm (3).

**11.** Mid wheel drive wheelchair (100) according to any of the claims 7, 8, 9 or 10, wherein the front spring and/or damper element (32) is located spaced apart from the first end of the front bearing arm (3).

**12.** Mid wheel drive wheelchair (1, 100) according to any of the previous claims, wherein the wheelchair (1, 100) comprises a further suspension unit (15, 115) formed in accordance with the suspension unit (16, 116) as defined in any of the previous claims.

**13.** Mid wheel drive wheelchair (1, 100) according to claim 12, wherein the second bearing arm (7) of the suspension unit (16, 116) and the second bearing arm (7, 7') of the further suspension unit (15, 115) are connected to one another to form one rear bearing arm (7) which preferably has a curved and especially arctuate form, and are preferably integrally connected to one another, wherein the rear bearing arm (7) is preferably provided with one single rear supporting wheel unit (8) comprising at least one rear supporting wheel element (8).

**14.** Mid wheel drive wheelchair (1, 100) according to claim 1 or a claim depending thereon, and according to claim 7 or a claim depending thereon.

**15.** Mid wheel drive wheelchair (1, 100) according to any of the previous claims, wherein the spring and/or damper element (71, 72) or the front spring and/or damper element (32) are substantially made of rubber, preferably in the form of a block element that may be hollow.

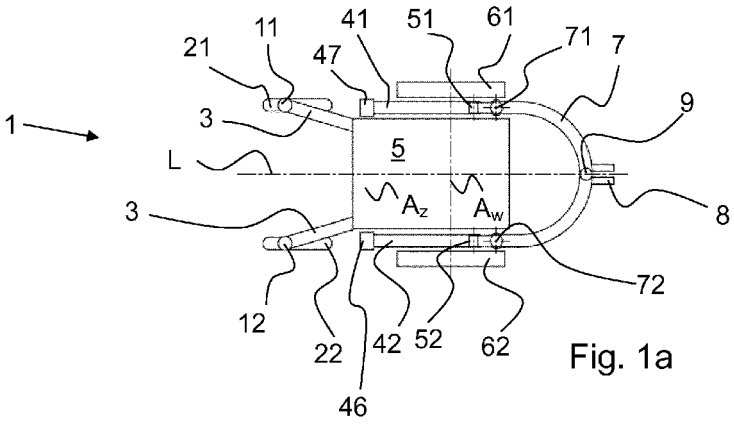


Fig. 1a

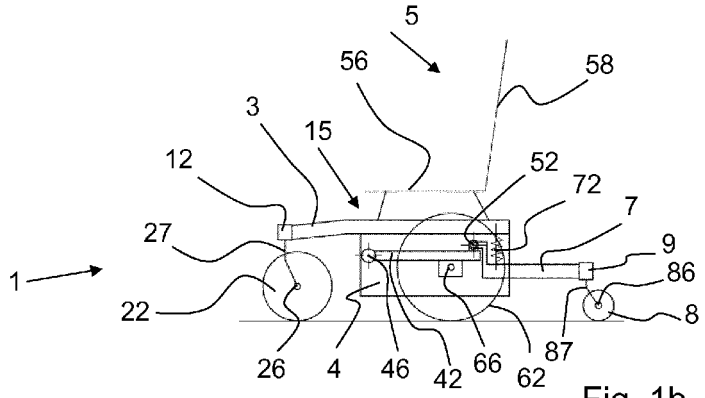


Fig. 1b

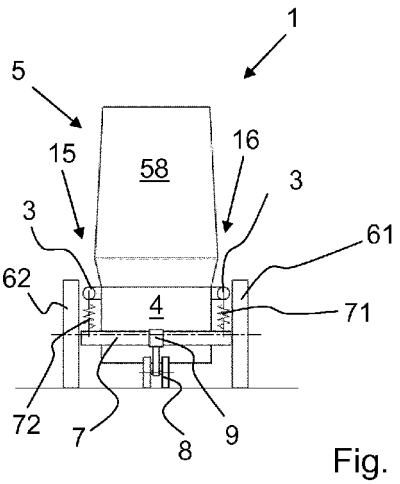


Fig. 1c

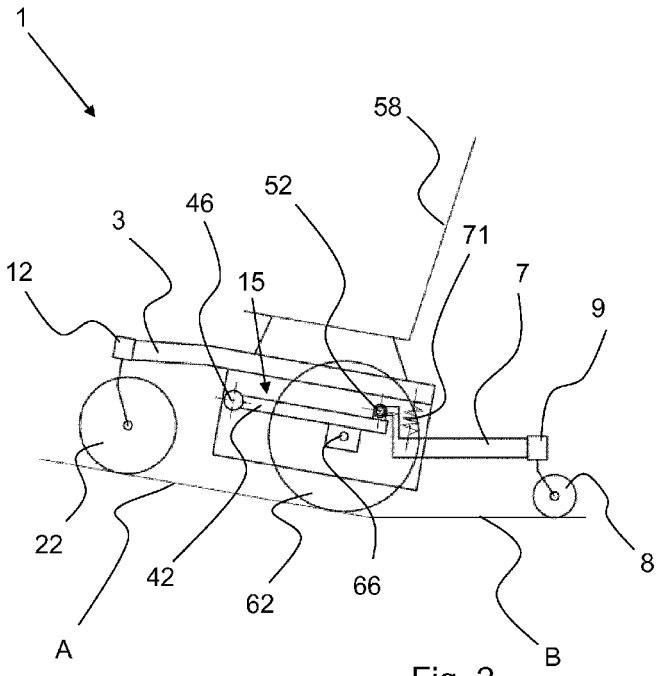
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Fig. 2

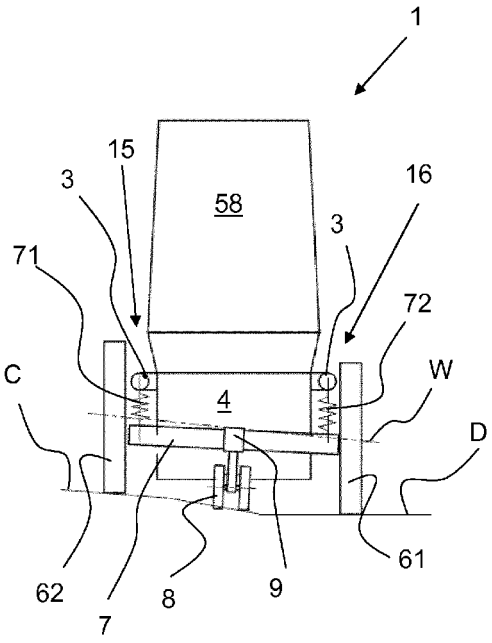
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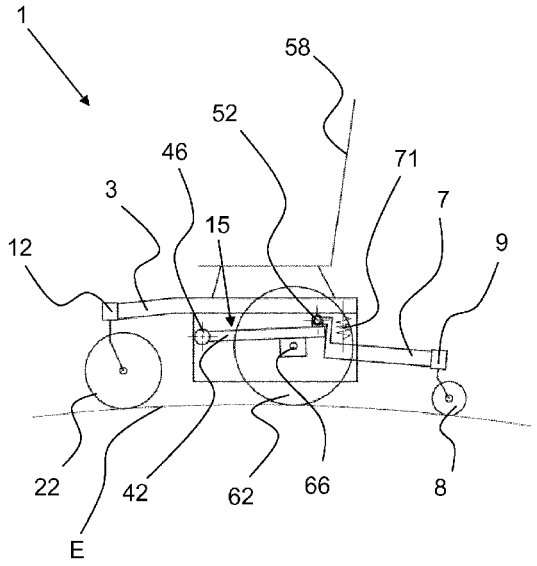
Fig. 3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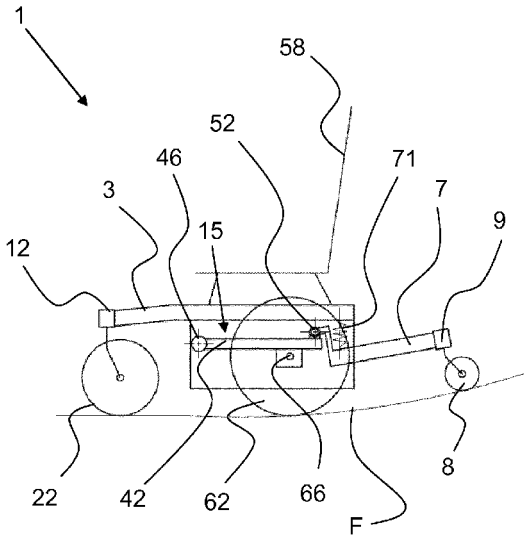
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Fig. 5

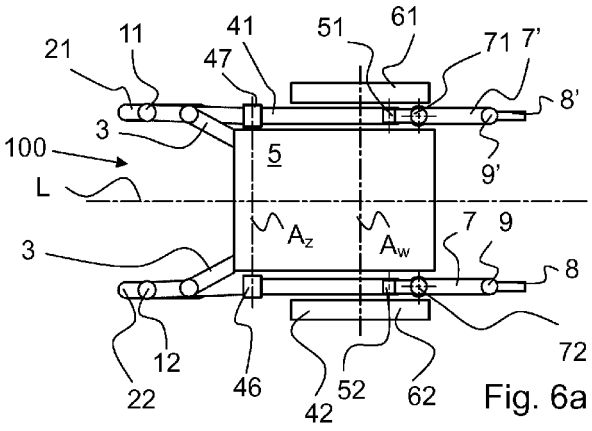


Fig. 6a

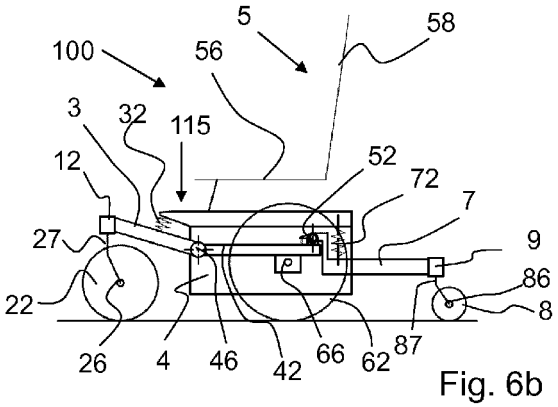


Fig. 6b

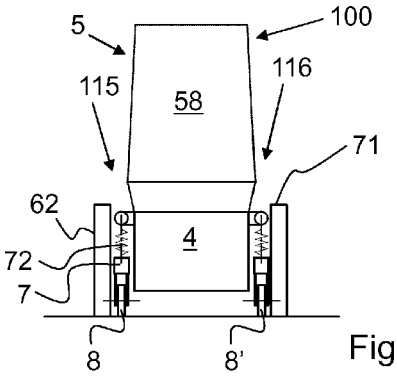


Fig. 6c

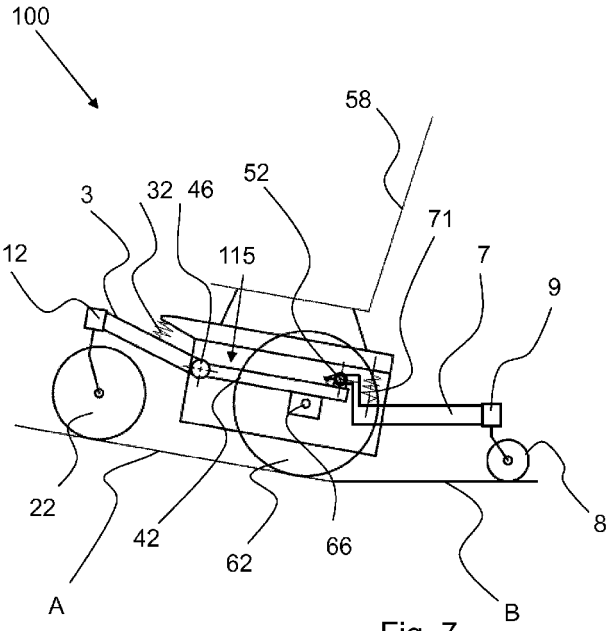
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Fig. 7

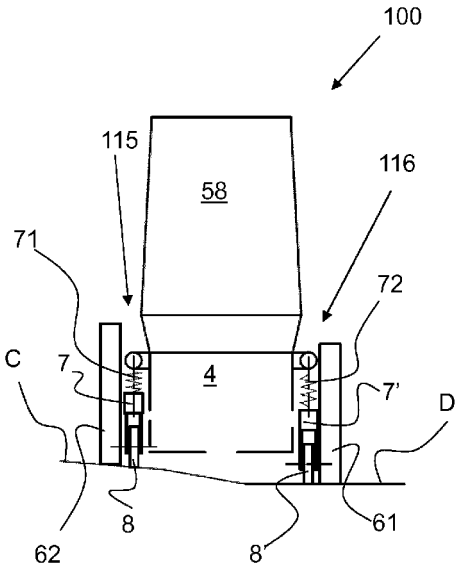
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Fig. 8

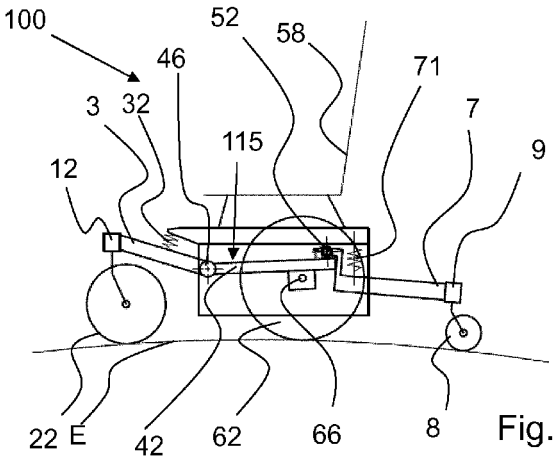
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Fig. 9

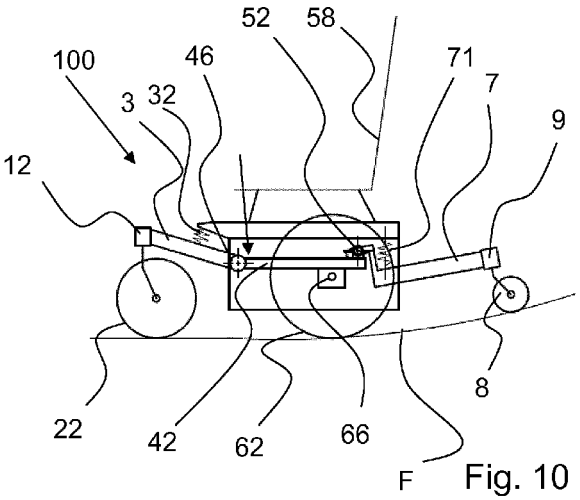
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Fig. 10