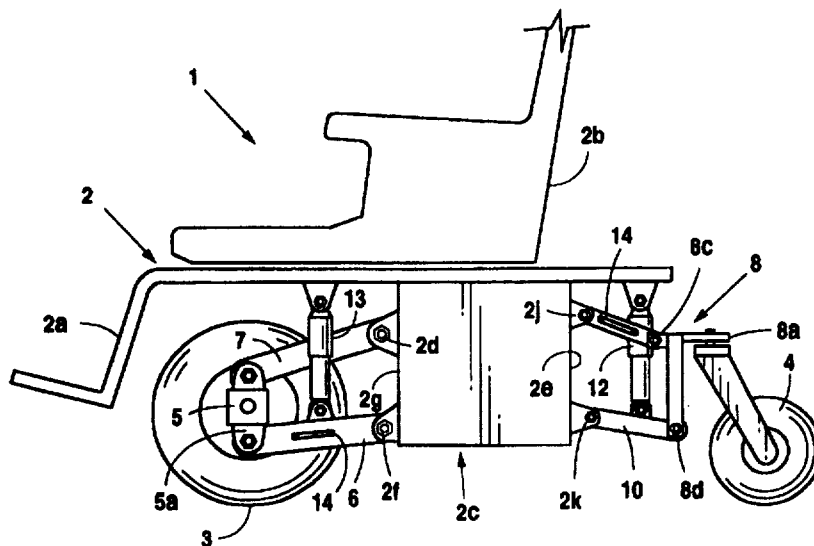




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : B60G 11/26	A1	(11) International Publication Number: WO 97/44206 (43) International Publication Date: 27 November 1997 (27.11.97)
<p>(21) International Application Number: PCT/US97/08556</p> <p>(22) International Filing Date: 20 May 1997 (20.05.97)</p> <p>(30) Priority Data: 60/017,679 21 May 1996 (21.05.96) US 08/744,204 5 November 1996 (05.11.96) US</p> <p>(71) Applicant: TEFTEC CORPORATION [US/US]; 6929 Spring Branch Road, Spring Branch, TX 78070 (US).</p> <p>(72) Inventors: FINCH, Thomas, E.; 6929 Spring Branch Road, Spring Branch, TX 78070 (US). FINCH, James, A.; 6929 Spring Branch Road, Spring Branch, TX 78070 (US).</p> <p>(74) Agents: PETERSON, Gale, R. et al.; Cox & Smith Incorporated, Suite 1800, 112 East Pecan Street, San Antonio, TX 78205 (US).</p>	<p>(81) Designated States: CA, CN, JP, KP, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p>Published <i>With international search report.</i> <i>With amended claims.</i></p>	

(54) Title: SUSPENSION SYSTEM FOR POWERED WHEELCHAIR



(57) Abstract

A suspension system for the ground engaging powered wheels (3) and/or caster wheels (4) of a power wheelchair (1) comprises three links, two of which (6) are universally pivotally connected between the frame (2) of the wheelchair (1) and a wheel mounting transaxle housing or subframe (5) so that the wheels (3) can tilt relative to the frame (2) of the wheelchair (1) in a vertical plane. A third link (7) is connected between the vehicle frame (2) and the wheel mounting structure which can only pivot in a vertical plane, thus restraining the wheels (3) from any lateral displacement relative to the vehicle frame (2). Fluid cylinders (13, 13) operable between the links (6, 7) and the vehicle frame (20) provide cushioning of the frame (2) and also, by subtraction of fluid from the fluid cylinders (13), can lower the entire frame of the wheelchair (2) relative to the ground engaging wheels (3) to permit the wheelchair (1) and occupant to drive into the side door opening of a conventional van.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

5 Another approach is to raise the roof of the van and install a powered lifting platform, which projects through the side door of the van. Such modifications of conventional passenger vans having side loading doors generally involve expenditures on the order of \$10,000 over and above the cost of the van.

10 Another problem encountered with conventional wheelchairs and similar self-propelled vehicles is that the wheel mountings do not permit any of the wheels, whether power driven or caster wheels, to move independently in a vertical plane to follow the ground or road contour on which the vehicle is operated.

15 Cushioning the frame of the vehicle and the occupant from road shocks is also greatly desired.

It is the object of this invention to overcome the above listed problems that are encountered with conventional suspension systems for power wheelchairs and similar self-propelled vehicles.

20 **SUMMARY OF INVENTION**

A powered wheelchair, or similar self-propelled vehicle, embodying this invention preferably employs two powered ground engaging wheels which are rotatably mounted on opposite ends of a transaxle housing which contains a dual planetary transmission. The transaxle housing and the enclosed dual planetary transmission is preferably of the constructions disclosed in issued U.S. Patent No. 5,275,248 and our pending application Serial No. 08/652,975, filed May 25, 1996, both of which are incorporated herein by reference.

30 An elongated frame for the wheelchair is provided which mounts an occupant seat, driving and steering motors, and a battery

5 compartment in conventional fashion. The battery compartment is preferably located beneath the vehicle seat. In accordance with this invention, the transaxle housing is mounted to a first vertically depending frame portion by three links. Two of the links are identical and one end of such links is respectively mounted in a pair of universal
10 pivot mountings respectively provided in horizontally spaced relation on the aforementioned depending frame portion. The other ends of such links are respectively mounted to two universal pivot mountings provided on the transaxle housing in horizontally spaced relation. Thus the powered wheels are free to move vertically relative to each
15 other by tilting of the transaxle housing to follow the ground or road contour.

To prevent lateral displacement of the powered wheels relative to the frame, a third link of generally triangular configuration is provided. Such link has horizontal pivots on each end of its triangular base and
20 two horizontally spaced, single axis pivot mountings for said horizontal pivots are provided on the aforementioned first depending frame portion in vertically spaced relation to the universal pivot mountings. The vertex portion of the triangular link, which is hereinafter referred to as the stabilizing link, is pivotally secured to a universal pivot
25 mounting on the transaxle housing at a position centrally intermediate the aforementioned two universal pivot mountings.

Thus the transaxle housing, and hence the powered wheels, is prevented from horizontal displacement relative to the vehicle frame.

Two caster wheels for the vehicle are conventionally mounted on
30 an inverted L-shaped subframe having a horizontal leg that supports

5 the caster wheels and a vertical leg which is mounted to a second
depending frame portion that is longitudinally spaced relative to the
first depending frame portion. For example, the one depending frame
portion may also provide a front wall for the battery compartment,
while the other depending frame portion provides a rear wall for the
10 battery compartment.

The mounting of the caster wheel subframe to the second
depending frame portion is accomplished by the same arrangement of
three links, two of the links having universal pivot connections to the
second depending frame portion and the vertical leg of the caster wheel
15 subframe, plus a triangular stabilizing link having two horizontal axis
pivot connections to the second depending frame portion and a single
universal pivot connection to the caster wheel subframe. Thus the
caster wheels have the same mountings as described for the powered
wheels and can move independently of each other and the vehicle frame
20 to conform to the ground or road contour.

To selectively position the height of the frame relative to the
powered wheels and the caster wheels, a pair of hydraulic or pneumatic
cylinders are respectively mounted between the two stabilizing links
and said vehicle frame. The axis of such cylinder is generally vertical.
25 A motor driven fluid pump is mounted at any convenient location on
the vehicle frame. An operator actuator fluid control circuit is provided
to selectively effect the elongation or contraction of both the fluid
cylinders.

Alternatively, and in the preferred embodiment of the invention,
30 two fluid cylinders can be utilized to respectively connect the two links

5 connecting the transaxle to separate locations provided on the frame. These two cylinders would be substituted for the single cylinder connecting the stabilizing link to the vehicle frame as discussed above. Such two cylinders would be connected in parallel in the fluid control circuit, hence would be concurrently controlled.

10 Thus the operator can raise, lower or tilt the vehicle frame in a vertical plane relative to the ground engaging powered wheels and caster wheels. The overall height of the vehicle plus the operator can be reduced to permit direct entry into the side loading door of a conventional van by merely providing a ramp from the ground or road
15 to the floor of the van.

The two fluid cylinders can also function to cushion the frame of the vehicle from road shocks, and still permit the wheels of the vehicle, both powered and caster wheels, to move vertically to follow the contour of the ground or road over which the vehicle travels.

20 The advantages of the aforescribed suspension system for wheel chairs and similar vehicles will be readily apparent to those skilled in the art.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a schematic side elevational view of this invention as
25 applied to a powered wheelchair, showing the frame and seat of the wheelchair in their normal elevated position relative to the ground engaging wheels.

Figure 2 is a view similar to Figure 1 but showing the frame and seat of the wheelchair in a lower position relative to the ground
30 engaging wheels.

5 Figure 3 is a schematic perspective view of a suspension system embodying this invention as applied to the powered wheels of a wheelchair.

 Figure 4 is an enlarged schematic perspective view of a suspension system embodying this invention as applied to the caster
10 wheels of a wheelchair.

 Figure 5 is a detailed pressured fluid control circuit for effecting changes in elevation of the frame and seat of the wheelchair relative to the ground engaging wheels.

 Figure 6 is a front elevational view of the wheelchair of Figure 1,
15 illustrating the conformity of the powered wheels to the ground contour.

 Figure 7 is a rear elevational view of the wheelchair of Figure 1, illustrating the conformity of the caster wheels to the ground contour.

 Figure 8 is a schematic side elevational view of a powered wheelchair incorporating a modification of this invention.

20 **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

 Referring to Figure 1, a powered wheelchair 1 of the type described in detail in U.S. Patent No. 5,275,248 and our pending application Serial No. 08/652,975, filed May 24, 1996 is schematically illustrated. Such wheelchair comprises an elongated articulated frame
25 2, which, at its forward end, defines a leg rest portion 2a while the medial portion of the elongated frame defines a conventional mounting for an occupant seat 2b above the frame 2 and a battery compartment 2c beneath the frame 2 having a forward vertical wall 2d and a rearward vertical wall 2e. The frame 2 is supported and powered by

5 two ground engaging wheels 3 shown at the forward end of the elongated frame 2, and a pair of caster wheels 4 at the rearward end of the frame 2. Those skilled in the art will understand the terms "forward" and "rearward" are relative terms and the positions of the powered wheels 3 and the caster wheels 4 relative to the frame 2 may
10 be reversed.

The two powered wheels are mounted on opposite ends of a transaxle housing 5 which is described in detail in the above referred to issued patent and pending application. For clarity of the drawings, the transaxle housing is deliberately shown in greatly reduced size, but
15 such housing will be understood to contain a dual planetary transmission for applying driving and steering power to the powered wheels 3 as controlled by the occupant, as is fully described in the aforementioned issued patent and pending application. Steering of the wheelchair 1 is accomplished by providing a differential in direction or
20 speed of rotation of the two powered wheels 3.

The mounting of the transaxle housing 5 to the frame 2 thus controls the vertical position of power wheels 3 relative to frame 2, while the mounting of the subframe 8 to the frame 2 controls the vertical position of caster wheels 4 relative to the frame 2.

25 In accordance with this invention, the mountings for the powered wheels 3 and the caster wheels 4 are functionally identical. A pair of mounting links 6 respectively have their one end connected in horizontally spaced relation to the depending front wall 2d of the battery compartment 2c by universal pivot bearings 2f. The other ends
30 of mounting links 6 are connected by universal pivot bearings 5a

5 provided on the bottom wall of the transaxle housing 5, or any other
convenient location which disposes the mounting links in generally
parallel relationship. Due to the universal pivot mountings of both
ends of the mounting links 6, the powered wheels 3 may assume a
plurality of vertical positions relative to the frame 2 as they follow the
10 contour of the ground or road traversed by such wheels.

To prevent lateral shifting of the transaxle housing 5, hence
lateral shifting of the powered wheels 3 relative to frame 2, a
stabilizing link 7 is provided which is of a generally triangular or T
shaped configuration, having a wide base portion 7a and a vertex
15 portion 7b, as best shown in Figure 3. A pair of horizontally spaced,
horizontal axis pivot mountings 2g are provided on the forward battery
compartment vertical wall 2d to respectively receive pivot pins
traversing pivot holes 7c provided at the lateral end of stabilizing link
7. Thus stabilizing link 7 can only move in a vertical plane about a
20 horizontal axis defined by the pivot bearings 2g, and can be either
above the universal pivot bearings 2f, as shown in Figure 3, or below.

The vertex end 7b of stabilizing link 7 is secured to the transaxle
housing 5 by a universal pivot 5c, thus permitting the transaxle
housing 5 to tilt in a vertical plane, due to the powered wheels 3
25 following ground contours, but there is no significant lateral
displacement of the transaxle housing 5 relative to the elongated frame
2.

To similarly mount the caster wheels 4 to the frame 2, a
subframe 8 (best shown in Figure 4) is provided having a generally
30 inverted L shaped configuration with a horizontal caster wheel

5 mounting leg 8a and a generally vertical link mounting leg 8b. One or preferably two caster wheels 4 are conventionally swivelly mounted on horizontal leg 8a of subframe 8.

To secure the subframe 8 to the elongated frame 2, a pair of mounting links 9 are respectively connected to a pair of universal pivot
10 mountings 8c provided in horizontally spaced relation on the horizontal leg 8a of subframe 8. The other ends of mounting links 9 are respectively connected to a pair of horizontally spaced, universal pivot mountings 2j provided on the rearward vertical wall 2e of the battery compartment 2c. Thus the subframe 8 may freely pivot in a vertical
15 plane as the caster wheels follow the road or ground contours. Links 9 may, if desired, be loosely interconnected by a transverse rod 14.

To prevent lateral movement of the subframe 8 relative to the elongated frame 2, a generally triangular or T shaped stabilizing link 10 is provided. Link 10 has a wide base portion 10a terminating in two
20 horizontally spaced single axis pivot bores 10b which are respectively secured to two horizontally spaced, horizontal axis pivot mountings 2k provided on the rearward wall 2e of the battery compartment. The vertex portion 10c of stabilizing link 10 is universally pivotally secured to a pivot bearing 8d on subframe 8. Thus no significant lateral
25 movement of the caster wheels 4 can occur as the wheelchair moves over an uneven surface. Stabilizing link 10 may be either below (as shown in Figure 4) or above the mounting links 9, as shown for the powered wheels 4 in Figure 3.

5 Preferably a torsion rod 14 is connected between mounting links 6 and also between mounting links 9 to maintain the parallelity of the mounting links 6 and 9 relative to each other.

 While the aforescribed mounting structures for the powered and caster wheels of a powered wheelchair will permit such wheels to
10 follow the road or ground contours, such mounting structures also provide for effecting occupant controlled vertical raising and lowering of the frame and seat relative to the wheels. This highly desirable feature is accomplished by providing a pair of fluid pressure cylinders 12 operating between the stabilizing link 10 and the vertical frame 2, as
15 shown in Figure 4, or by utilizing a pair of fluid pressure cylinders 13 respectively operating between the mounting links 7 and the frame 2, as shown in Figure 3.

 In either modification, the supply of pressured fluid, either air or hydraulic, to the fluid pressure cylinder will cause such cylinder(s) to
20 expand and elevate the entire frame 2 and the seat occupant relative to the wheels as shown in Figure 1. Removal of fluid from such cylinder(s) will cause the frame to lower relative to the ground engaging wheels to permit the wheelchair with an occupant to enter the side door of a conventional van, as shown in Figure 2.

25 The occupant controlled fluid circuit is fully illustrated in Figure 5. The applied legends on Figure 5 make such circuit self-explanatory. It should be particularly noted that separate control of the vertical positions of the powered wheels relative to the caster wheels may be effected by appropriate movement of the control stick.

5 The frame elevating and lowering fluid pressure cylinders perform another desirable feature, particularly when such cylinders contain air as the activating fluid. A conventional air bag can be employed. Since the fluid pressure cylinders are respectively connected between the wheel mounting links and the frame, the vertical
10 movements of such links caused by a powered wheel or a caster wheel encountering a ridge or depression are cushioned by the fluid pressure cylinders, thus reducing shock forces imparted to the frame, hence to the occupant of the wheelchair. Figure 6 illustrates the manner in which the powered wheels 3 conform to a ridge in the road or ground
15 surface by tilting of the transaxle housing in a vertical plane. Obviously, the caster wheels 4 will equally conform by tilting of the subframe 8 in a vertical plane. All of the wheels will also ride through depressions with minimum shock to the occupant, as illustrated in Figure 7.

20 Referring now to Figure 8 of the drawings, there is shown a modification of this invention which is particularly suited for powered wheelchairs having large transaxle housings 5. Such large transaxle housings would interfere with the location of the fluid cylinders 12 as shown in Figure 1. Instead, the links 6 are extended forwardly as
25 shown at 6', and an airbag-type fluid cylinder 15 is mounted between the forward end of each link extension 6' and a ledge 5m formed on the transaxle housing 5.

 The functioning of this embodiment is the same as previously described. Pressured air is supplied to, or withdrawn from airbags 15
30 which function to raise or lower frame 2 relative to the power wheels 3 by pivoting the mounting links 6 and stabilizing link 7. A similar

- 5 airbag 15 is applied between stabilizing link 10 and a projection 2m on frame 2 to control the vertical position of frame 2 relative to caster wheels 4, also function to reduce rough road shocks transmitted to frame 2, without interfering with the vertical movements of powered wheels 3 to follow the road or ground contours.
- 10 Obvious modifications of this invention can be made by those skilled in the art, and it is intended that all such modifications fall within the scope of the appended claims.

5

CLAIMS

We claim:

1. A suspension system for a powered wheelchair having an elongated frame supporting an occupant seat;

10 a transaxle housing having a pair of power driven wheels mounted on opposite ends of said transaxle housing;

linkage means for connecting said transaxle housing in transverse relation to said elongated frame with said transaxle housing being freely tiltable in a vertical plane transverse to said elongated frame, whereby said power driven wheels may follow the contour of the ground traversed by said power driven wheels;

15

fluid pressure cylinder means operatively connected between said linkage means and said frame for vertically positioning said frame relative to said ground engaging wheels; and

operator controlled means for supplying and withdrawing fluid from said fluid pressure cylinder means.

20

2. The suspension system of claim 1 further comprising:

a pair of caster wheels for said powered wheel chair;

a subframe supporting said caster wheels in laterally spaced relationship to said elongated frame;

25 a second linkage means for supporting said subframe in transverse relationship to said elongated frame to permit tilting movement of said subframe in a vertical transverse plane relative to said elongated frame, whereby said caster wheels may follow the contour of the ground traversed by said caster wheels;

5 a second fluid pressure cylinder means operatively connected between said second linkage means and said elongated frame for vertically positioning said elongated frame relative to said caster wheels; and

means connecting said second fluid pressure cylinder means to
10 said operator controlled means for supplying and withdrawing fluid from said second fluid pressure cylinder means.

3. A suspension system for a powered wheelchair having a rigid, elongated articulated frame with longitudinally spaced, depending first and second vertical portions, a laterally disposed
15 transaxle housing, a pair of power driven wheels rotatably mounted on opposite lateral ends of said transaxle housing and caster wheel means mounted on said second vertical frame portion for supporting one end of said frame, comprising, in combination:

a pair of horizontally aligned, laterally spaced, universal pivot
20 mountings on said first vertical frame portion;

a pair of identical mounting links respectively having one and
universally pivotally mounted in said pair of universal pivot mountings
and the other end universally pivotally secured to said transaxle
housing, whereby said power driven wheels can move in a vertical
25 plane;

a pair of laterally spaced, horizontally aligned, single axis pivot
mountings on said first vertical frame portion vertically spaced relative
to said pair of universal pivot mountings and defining a common
horizontal axis;

5 a stabilizing link having a generally triangular configuration defining a wide base portion and a vertex portion;

means on opposite ends of said base portion of said stabilizing link for respectively engaging said pair of single axis pivot mountings to permit pivotal movement of said stabilizing link only in a vertical
10 plane; and

means for universally pivotally connecting said vertex portion of said stabilizing link to the lateral center of said transaxle housing; thereby preventing lateral movement of said power wheels relative to said elongated frame without restricting independent vertical
15 movements of said power driven wheels to conform to the ground contour.

4. The suspension system of claim 3 further comprising shock absorbing means operable between said mounting links and said rigid frame.

20 5. The suspension system of claim 4 wherein said shock absorbing means comprises fluid pressure means for elongating and contracting said shock absorbing means; and

operator controlled means for increasing or decreasing the amount of fluid existing in said fluid pressure means to elevate or lower
25 said frame relative to said power driven wheels.

6. The suspension system of claim 3 wherein said caster wheel mounting comprises an L-shaped subframe having a horizontal leg supporting two laterally spaced caster wheels in depending relation and a vertical leg;

5 a second pair of horizontally aligned, laterally spaced universal pivot mountings on said second vertical frame portion;

a second pair of identical mounting links respectively having one end universally pivotally mounted in said second pair of universal pivot mountings and the other end universally pivotally secured to said
10 vertical leg of said caster wheel subframe, whereby said caster wheels can move in a vertical plane;

a second pair of laterally spaced, horizontally aligned, single axis pivot mountings on said second vertical frame portion, vertically spaced relative to said second pair of universal pivot mountings and defining a
15 common horizontal pivot axis;

a second stabilizing link having a generally triangular configuration defining a wide base portion and a vertex portion;

means for universally pivotally connecting said vertex portion of said stabilizing link to said vertical leg of said caster wheel subframe,
20 thereby preventing lateral movement of said caster wheels without restricting independent vertical movements of said caster wheels to conform to the ground contour.

7. The suspension system of claim 6 further comprising a first shock absorbing means operable between said first pair of
25 mounting links and said rigid frame; and

a second shock absorbing means operable between said second stabilizing link and said rigid frame.

5 8. The suspension system of claim 7 wherein each said shock
absorbing means comprises fluid pressure means for elongating and
contracting each said shock absorbing means; and

 operator controlled means for increasing or decreasing the
amount of fluid existing in said fluid pressure means to elevate or lower
10 said frame relative to said power driven wheels and said caster wheels.

AMENDED CLAIMS

[received by the International Bureau on 27 October 1997 (27.10.97);
original claims 1-3 and 6-8 amended; remaining claims
unchanged (5 pages)]

1. A suspension system for a powered wheelchair having an
elongated frame supporting an occupant seat;

a transaxle housing having a pair of power driven wheels
10 mounted on opposite ends of said transaxle housing;

a first linkage means for connecting said transaxle housing in
transverse relation to the length of said elongated frame with said
transaxle housing being freely tiltable in a vertical plane transverse to
said elongated frame;

15 said first linkage means including universal type pivot bearings
on said elongated frame and said transaxle housing, whereby said
power driven wheels may follow the contour of the ground traversed by
said power driven wheels;

a fluid pressure cylinder operatively connected between said
20 linkage means and said frame for vertically positioning said elongated
frame relative to said ground engaging wheels; and

operator controlled means for supplying and withdrawing fluid
from said fluid pressure cylinder.

2. The suspension system of claim 1 further comprising:

25 a pair of caster wheels for said powered wheel chair;

a subframe supporting said caster wheels in horizontally spaced
relationship;

a second linkage means for supporting said subframe in
transverse relationship to the length of said elongated frame for

5 permitting tilting movement of said subframe in a vertical transverse plane relative to said elongated frame, whereby said caster wheels may follow the contour of the ground traversed by said caster wheels;

a second fluid pressure cylinder means operatively connected between said second linkage means and said elongated frame for
10 vertically positioning said elongated frame relative to said caster wheels; and

means connecting said second fluid pressure cylinder means to said operator controlled means for supplying and withdrawing fluid from said second fluid pressure cylinder means.

15 3. A suspension system for a powered wheelchair having a rigid, elongated frame with longitudinally spaced, depending first and second vertical frame portions, a laterally disposed transaxle housing;

a pair of power driven wheels rotatably mounted on opposite lateral ends of said transaxle housing and caster wheel means mounted
20 on said second vertical frame portion for supporting one end of said frame, comprising, in combination:

a pair of horizontally aligned, laterally spaced, universal pivot mountings on said first vertical frame portion;

a pair of identical mounting links respectively having one end
25 universally pivotally mounted in said pair of universal pivot mountings and the other end universally pivotally secured to said transaxle housing, whereby said power driven wheels can move in a vertical plane;

a pair of laterally spaced, horizontally aligned, single axis pivot
30 mountings on said first vertical frame portion vertically spaced relative

5 to said pair of universal pivot mountings and defining a common horizontal axis;

a stabilizing link having a generally triangular configuration defining a wide base portion and a vertex portion;

means on opposite ends of said base portion of said stabilizing
10 link for respectively engaging said pair of single axis pivot mountings to permit pivotal movement of said stabilizing link only in a vertical plane; and

means for universally pivotally connecting said vertex portion of said stabilizing link to the lateral center of said transaxle housing;
15 thereby preventing lateral movement of said power wheels relative to said elongated frame without restricting independent vertical movements of said power driven wheels to conform to the ground contour.

4. The suspension system of claim 3 further comprising shock
20 absorbing means operable between said mounting links and said rigid frame.

5. The suspension system of claim 4 wherein said shock absorbing means comprises fluid pressure means for elongating and contracting said shock absorbing means; and

25 operator controlled means for increasing or decreasing the amount of fluid existing in said fluid pressure means to elevate or lower said frame relative to said power driven wheels.

6. The suspension system of claim 3 wherein said caster wheel means comprises a T-shaped subframe having a horizontal leg

5 supporting two laterally spaced caster wheels in horizontally spaced depending relation and a vertical leg;

a second pair of horizontally aligned, laterally spaced universal pivot mountings on said second vertical frame portion;

10 a second pair of identical mounting links respectively having one end universally pivotally mounted in said second pair of universal pivot mountings and the other end universally pivotally secured to said horizontal leg of said T-shaped subframe, whereby said caster wheels can move in a vertical plane relative to each other;

15 a second pair of laterally spaced, horizontally aligned, single axis pivot mountings on said second vertical frame portion, vertically spaced relative to said second pair of universal pivot mountings and defining a common horizontal pivot axis;

a second stabilizing link having a generally triangular configuration defining a wide base portion and a vertex portion;

20 pivot pins on each end of said wide base portion respectively mounted in said second pair of single axis pivot mountings; and

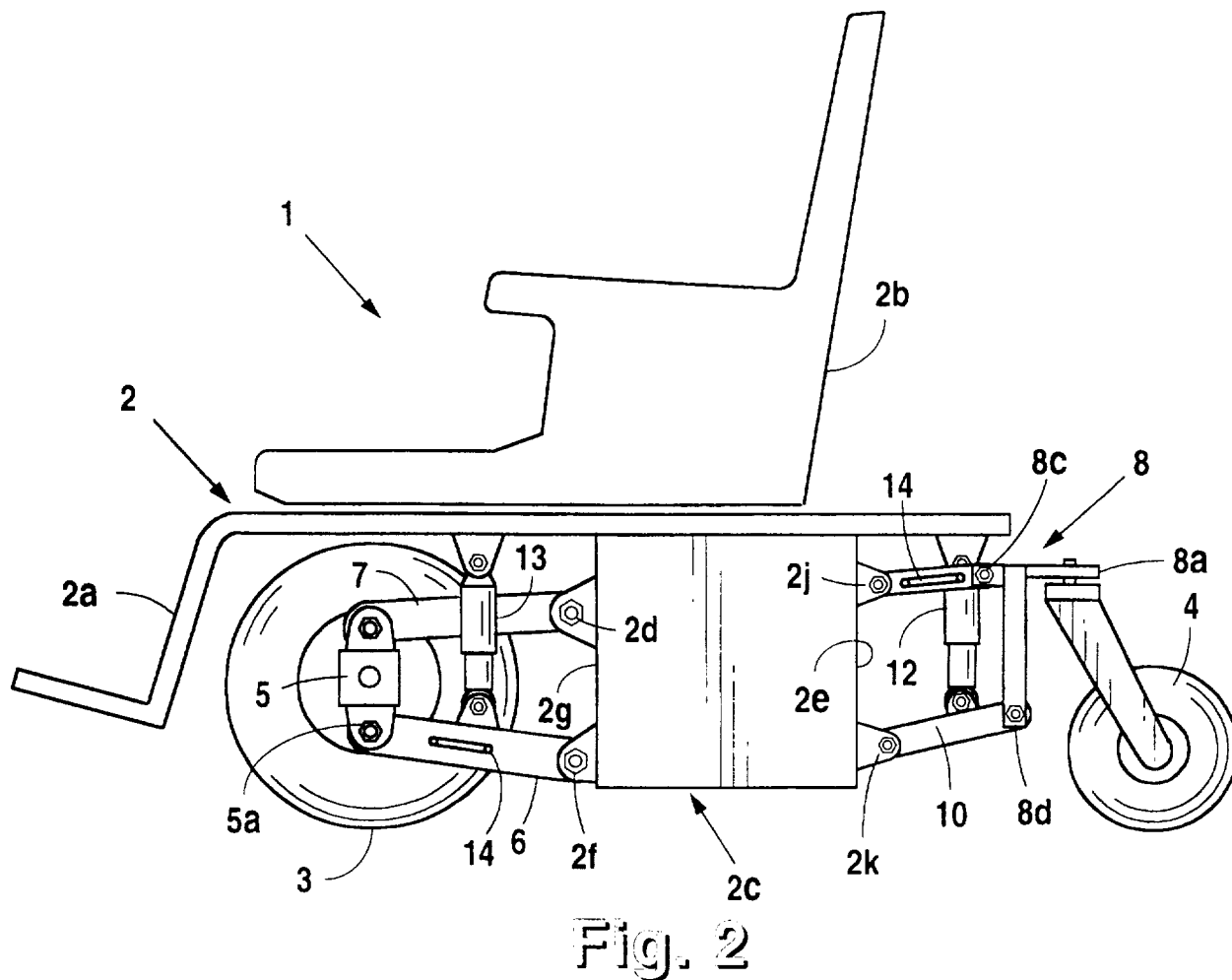
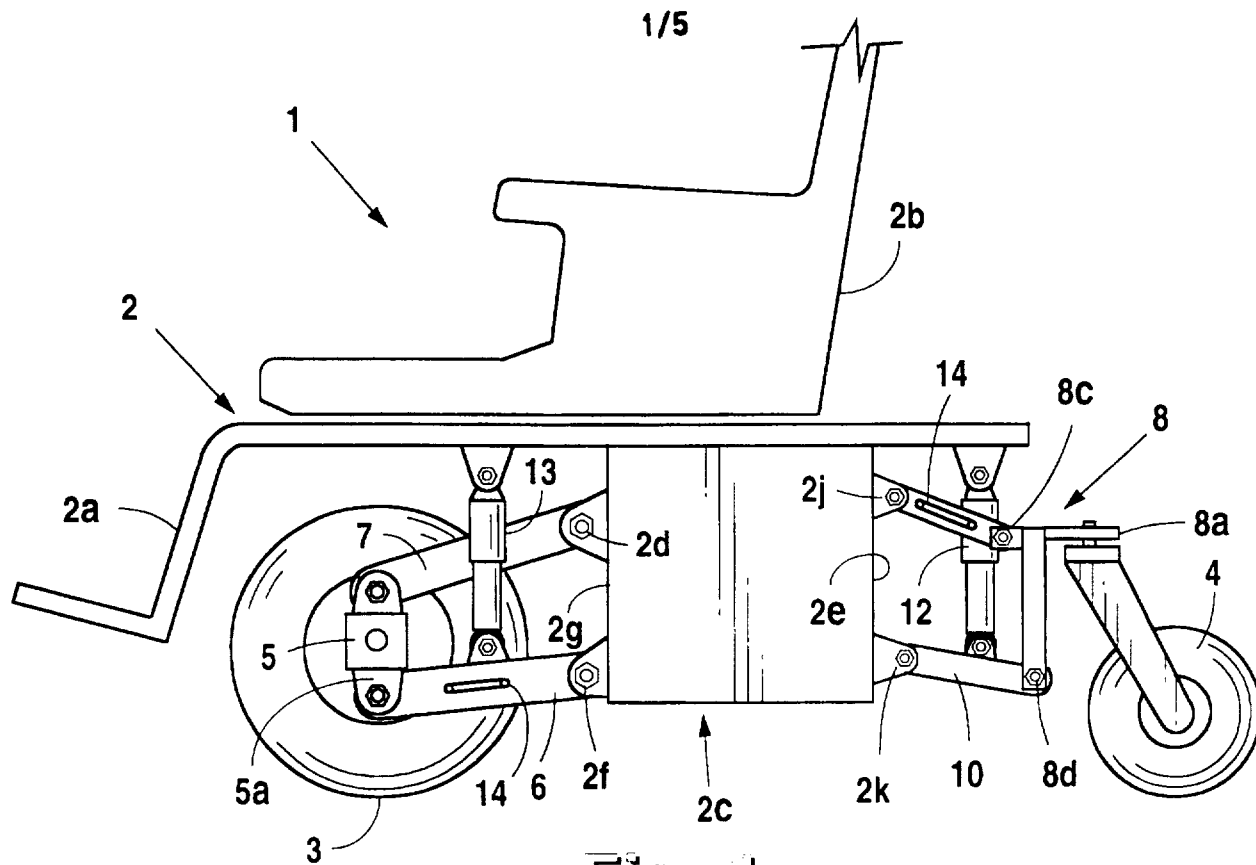
25 means for universally pivotally connecting said vertex portion of said stabilizing link to said vertical leg of said caster wheel subframe, thereby preventing horizontal movement of said caster wheels without restricting independent vertical movements of said caster wheels to conform to the ground contour.

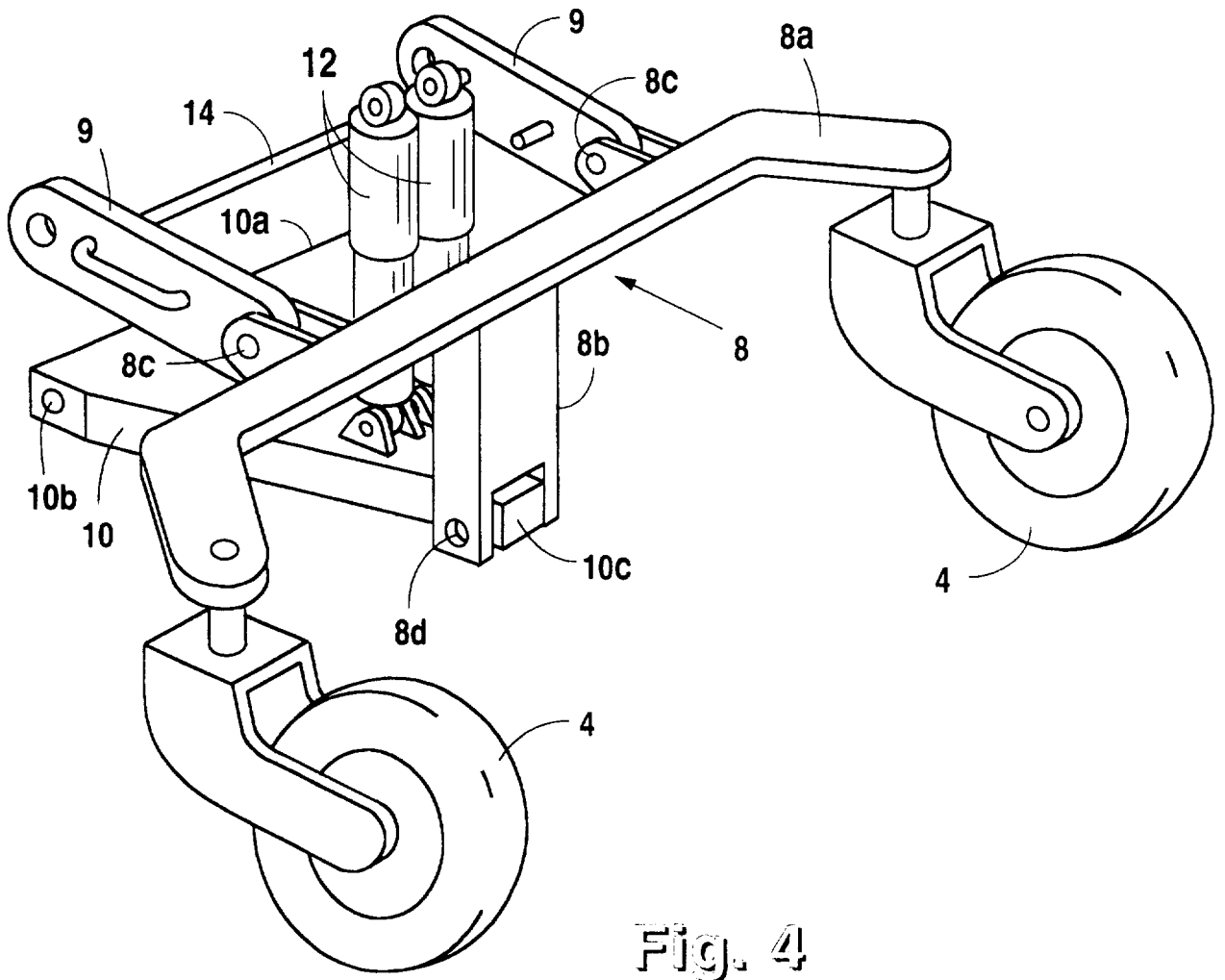
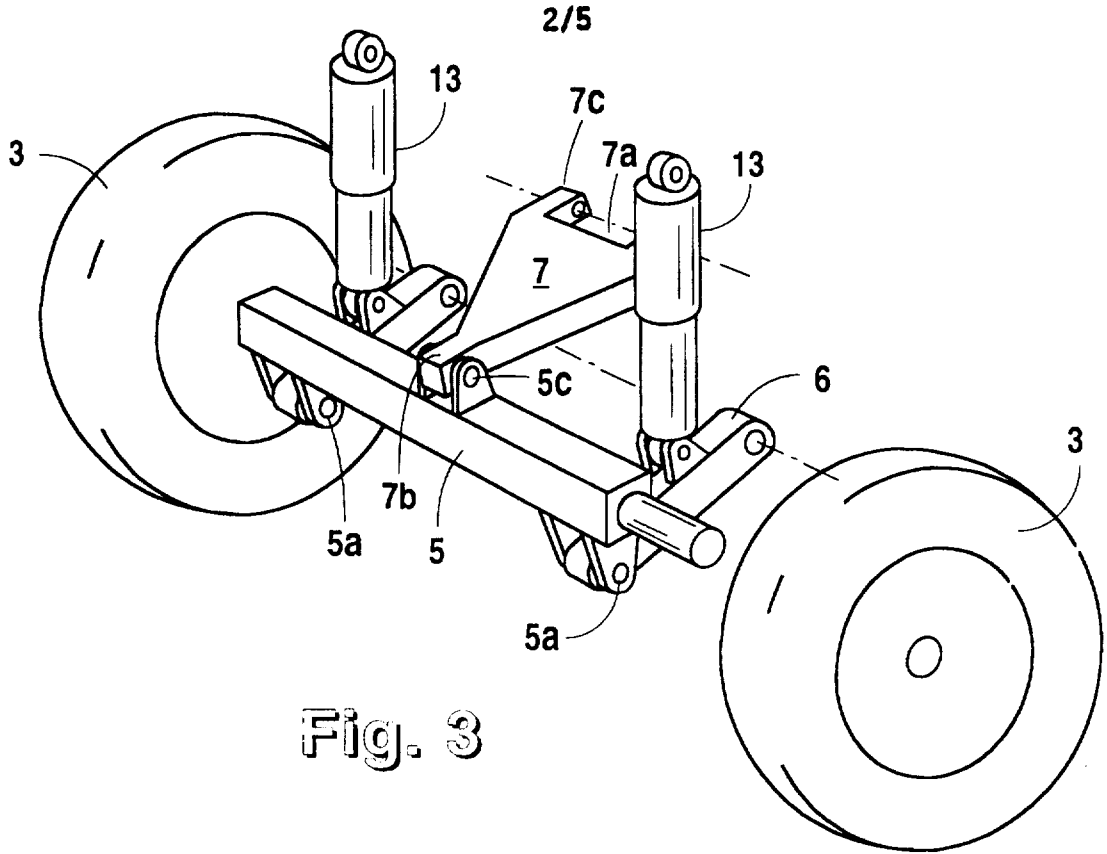
7. The suspension system of claim 6 further comprising a first shock absorbing means operable between said first pair of mounting links and said rigid elongated frame; and

5 a second shock absorbing means operable between said second stabilizing link and said rigid elongated frame.

8. The suspension system of claim 7 wherein each said shock absorbing means comprises fluid pressure means for elongating and contracting each said shock absorbing means; and

10 operator controlled means for increasing or decreasing the amount of fluid existing in said fluid pressure means to elevate or lower said rigid, elongated frame relative to said power driven wheels and said caster wheels.





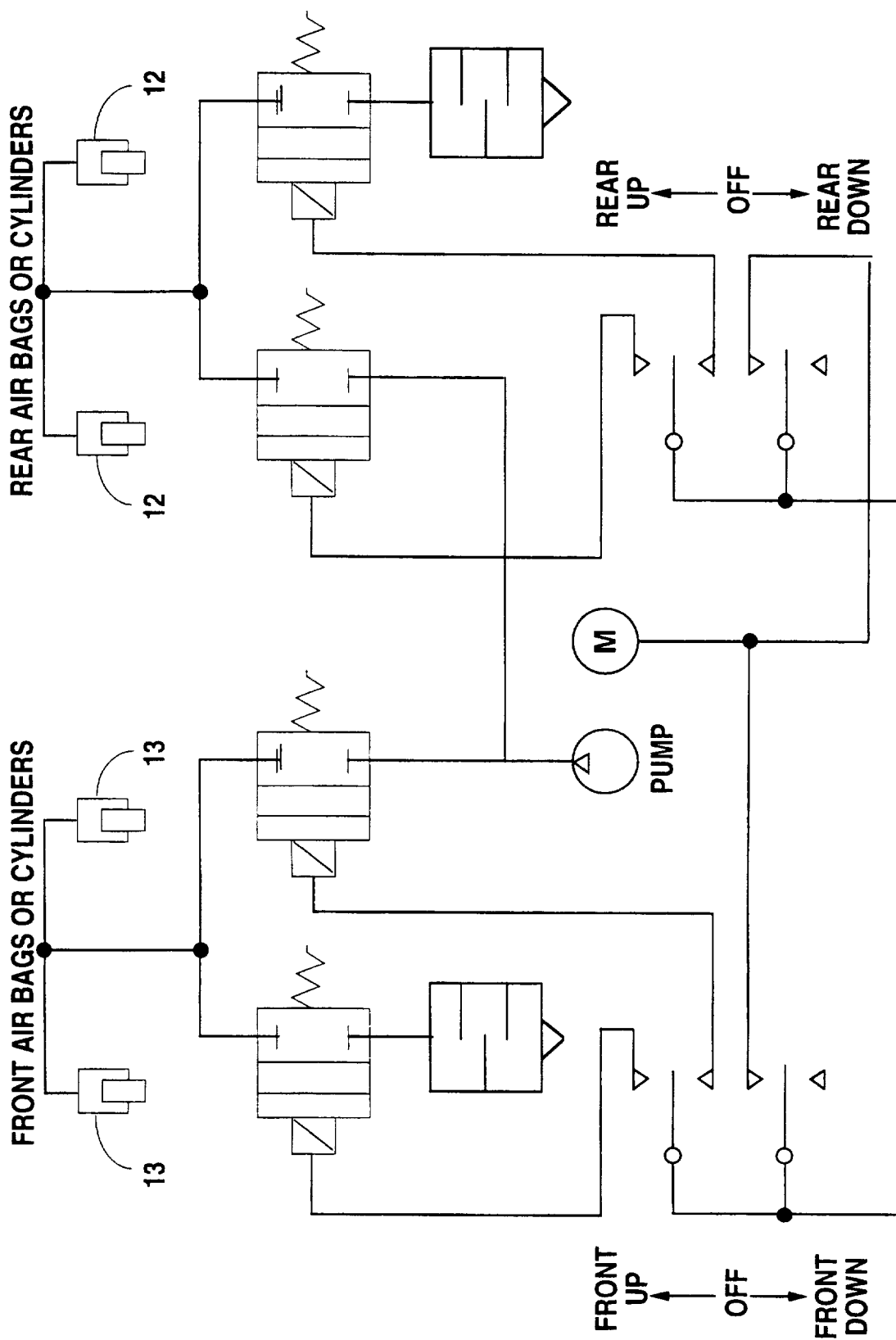


Fig. 5

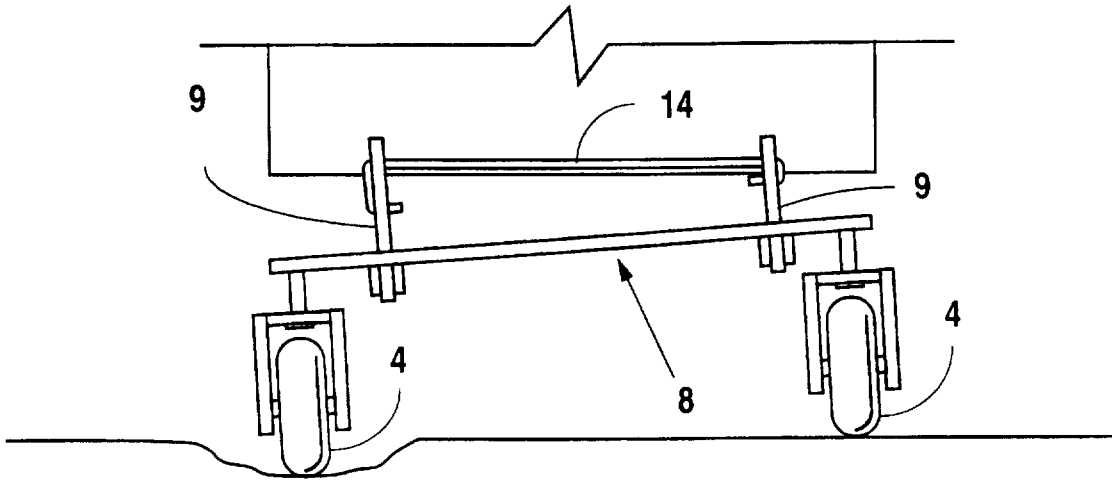


Fig. 6

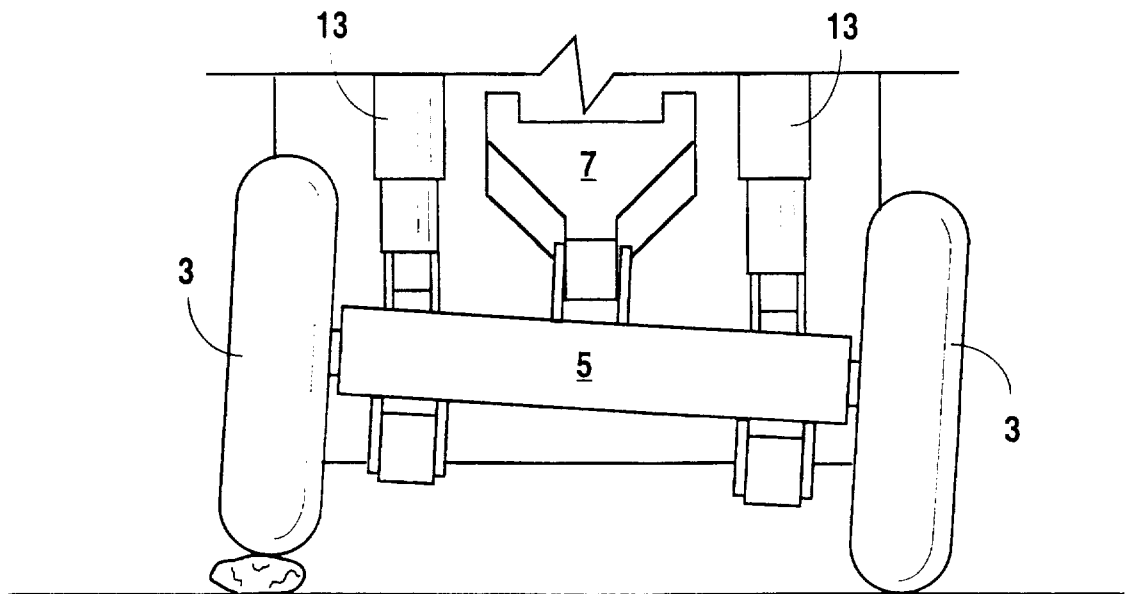


Fig. 7

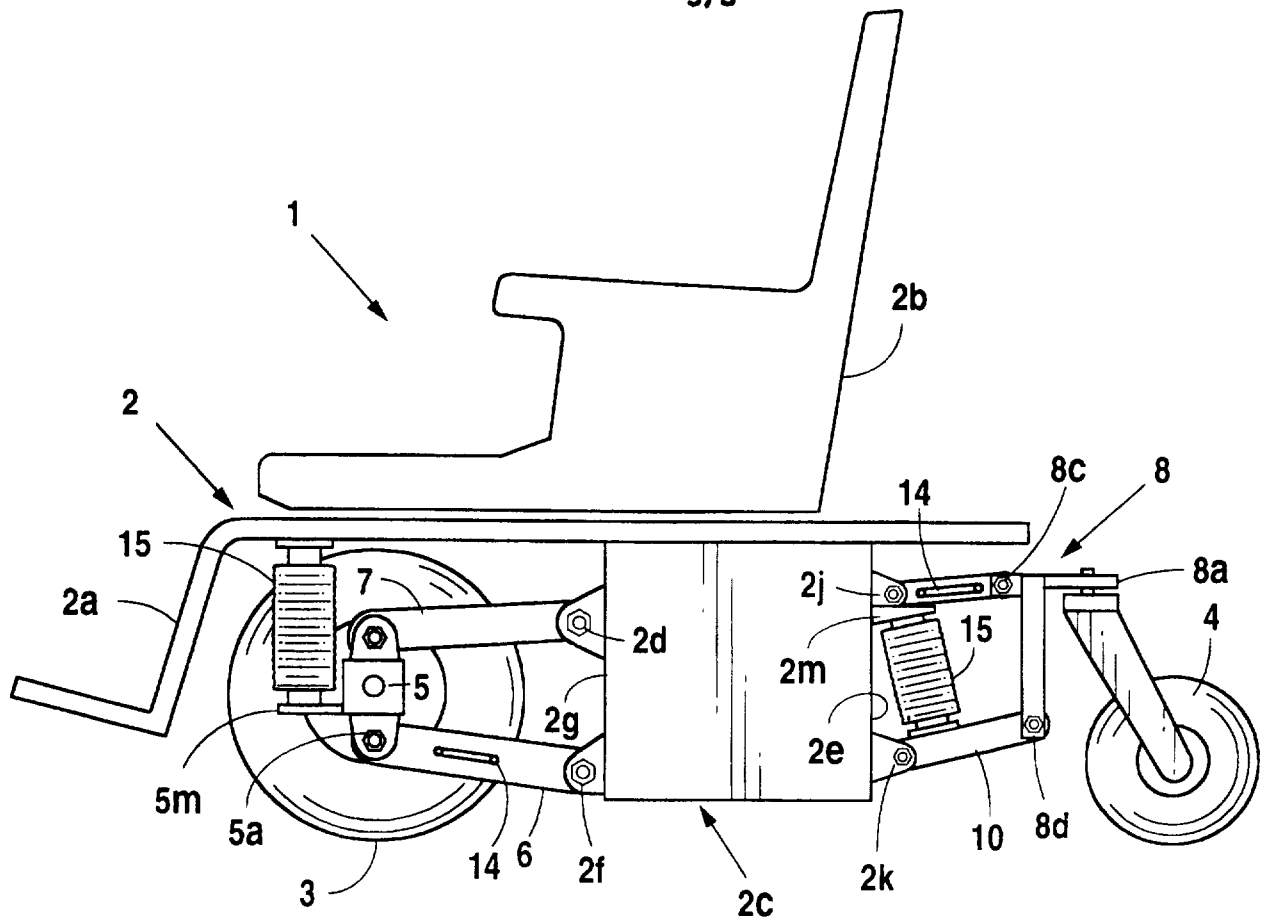
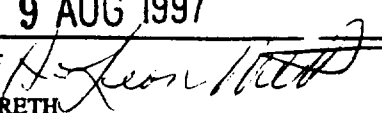


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US97/08556

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :B60G 11/26 US CL :280/704 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 280/704, 250.1, 43, 43.17, 43.18, 43.22, 43.23, 702, 711; 297/DIG 3, DIG 10, 344.12, 344.18, 344.19; 441/921; 180/65.1, 65.5, 907 Documentation searched other than minimum documentation to the extent that such documents are included in the field searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3,578,352 A (HEINE) 11 May 1971, col. 2, line 5 - col. 3, line 4.	1
Y	GB 857,039 A (DAIMLER-BENZ AKTIENGESELLSCHAFT) 29 December 1960, page 2, lines 19-63.	1
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	(date or priority date) understand the invention inventive step invention cannot be document is combination
Date of the actual completion of the international search 08 AUGUST 1997		Date of mailing of the international search report 29 AUG 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer ERIC CULBRETH  Telephone No. (703) 308-0360