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(71) Applicant: **EURONAL EXPORT S.R.O.** [CZ/CZ]; Bezručova 186/32, 301 00 Plzeň (CZ).

(72) Inventor: **VLK, Josef**; Štefánikova 190, 337 01 Rokycany (CZ).

(74) Agent: **LANGROVA, S.R.O.**; Skrétova 48, 301 00 Plzeň (CZ).

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(54) Title: MANUAL STAIR CLIMBER FOR A MECHANICAL WHEELCHAIR AND A METHOD OF USING A MECHANICAL WHEELCHAIR IN CONJUNCTION WITH SUCH MANUAL STAIR CLIMBER

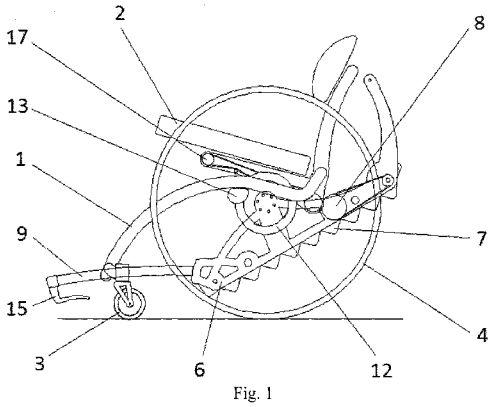

Fig. 1

(57) Abstract: The manual stair climber for a mechanical wheelchair includes a support structure (6) and a crawler track (7). The track (7) of the stair climber (5) and/or the entire stair climber (5) is shiftable and/or the rear wheel (4) of the wheelchair (10) is relocatable. The assembly of the stair climber (5) installed to the wheelchair (10) includes a transmission (8) which is connected to the track (7) of the stair climber (5), and to a torque transmitter (14). The stair climber (5), which is pivotably fixed to the wheelchair (10), includes a brake (11) which has a progressively increasing effect and is provided with a brake control element (5). The brake disc (12) of the brake (11) is attached to the stair climber (5) which is installed pivotably; and the brake caliper (13) of the brake (11) is attached to the wheelchair (10) and/or vice versa. In the configuration (II) for travelling across a grade-separated obstacle, the rear wheels (4) constitute a torque transmitter (14).

Manual stair climber for a mechanical wheelchair and a method of using a mechanical wheelchair in conjunction with such manual stair climber

Technical Field

The field of the present invention relates to chairs, more particularly to personal means of transport which are specially adapted for patients or disabled persons, and provided with devices for negotiating grade-separated obstacles, particularly for ascending stairs.

Background Art

Wheelchairs which can be used for negotiating grade-separated obstacles (and stairs in particular) can be divided into several categories. The fundamental classification comprises two categories: mechanical wheelchairs propelled by the power of the user, and the motorized ones where the power is provided by a motor. Motorized wheelchairs can be divided into special wheelchairs, and into motorized attachments for wheelchairs, to which a wheelchair is connected and is carried by it up the stairs. The drawbacks of such motorized wheelchairs include their large weight, their dependence on a power source, and price. In addition, solutions of this kind are unnecessarily bulky for physically strong users. This means that such users could do with simpler devices propelled by their own power – which is not possible with such bulky equipment. Finally, motorized equipment also causes rehabilitation passivity.

A known mechanical wheelchair for negotiating grade-separated obstacles is provided with two crosses at the front and two at the rear which are held above-ground when riding on a flat ground. Before climbing stairs, these crosses are lowered to and rested on the ground by means of a lever and the two large wheels of the wheelchair are raised above the ground by pulling the lever. The wheelchair is then supported on four four-arm crosses. By turning the large wheels, these crosses are propelled, and therefore it is possible to travel up and down the stairs. There is an advantage in the relatively low weight of this solution, whereas the size of

this wheelchair fails to deliver user comfort when riding on a flat surface and therefore becomes a disadvantage.

A description of another known mechanical wheelchair is given in file no. CZ 296180. The rear part of this wheelchair is provided with an arm whose free end has on each side one cruciform engaging element with adhesion tips. The large (rear) wheels of this wheelchair are attached so that they are shiftable. For the purpose of negotiating a grade-separated obstacle, the rear wheels are moved to the front of the wheelchair, thereby changing the position of the wheelchair's centre of gravity. Instead of four wheels, the wheelchair is then supported on the two rear wheels and on two cruciform engaging elements. Using these cruciform engaging elements powered by the user, the wheelchair can negotiate a grade-separated obstacle. Disadvantages of this solution include its high centre of gravity, large weight, large size and clearance width, and the use of the cruciform engaging elements. These elements pose a risk of slipping off the stair edge, causing the user to fall.

Disclosure of Invention

The summary of the invention is an engineering design creation of a manual stair climber for a mechanical wheelchair with a system of wheels. Two wheels of the wheelchair constitute rear wheels. The stair climber contains a support structure and a crawler track. The stair climber is adapted for installation to a mechanical wheelchair. The track of the stair climber and/or the entire stair climber is shiftable and/or the rear wheel of the wheelchair is relocatable. The stair climber is installed to a wheelchair in such a way that in a side view of the assembly of the wheelchair and the stair climber, when arranged for riding in the wheelchair, the contour of the rear wheel tread surface extends beyond the lower edge of the stair climber track. This means that the stair climber is not in contact with the walking surface (pavement, road surface) and the wheelchair is running on its wheels.

In the configuration for negotiating a grade-separated obstacle, the lower edge of the track extends beyond the contour of the rear wheel tread surface. This means that the rear wheels are not in contact with the walking surface. The wheelchair is therefore supported on the stair climber.

The assembly of the stair climber installed to the wheelchair contains a transmission. The transmission is connected to the stair climber track and to a torque transmitter. The torque

transmitter may comprise, for instance, a lever. While sitting in the wheelchair, the user can use the torque transmitter and the transmission to power the stair climber track, and thus travel effectively across a horizontal surface, as well as across grade-separated obstacles.

In a particular preferred embodiment, the stair climber also includes a control lever attached to the support structure. When the stair climber is installed to a wheelchair, this lever is accessible to the user who sits in the wheelchair. The stair climber is adapted for being installed pivotably to a mechanical wheelchair with relocatable rear wheels. This means that the stair climber can pivot partially at the bottom of the wheelchair. The pivot axis, i.e. the axis of rotation, is parallel to the axis of the rear wheels. The assembly of the stair climber installed to the wheelchair also contains a brake which has a progressively increasing effect and is provided with a brake control element. The brake disc is attached to the stair climber which is installed pivotably; and the brake caliper is attached to the wheelchair and/or vice versa. This means that the brake caliper may be attached to the stair climber which is installed pivotably and the brake disc may be attached to the wheelchair.

It is advantageous if the rear wheels are relocatable in such a way that in the configuration for travelling across a grade-separated obstacle they constitute the torque transmitter.

In another preferred embodiment, the stair climber is shiftable. This is achieved by providing at least one extendable element between the support structure of the stair climber and the frame of the wheelchair. The extendable element may, for instance, consist of a threaded rod, a powered hinged joint, or another device. In such case, the use of the stair climber is not limited to only mechanical wheelchairs with relocatable rear wheels. The condition that in a side view of the assembly of the wheelchair and the stair climber, when arranged for riding in the wheelchair, the contour of the rear wheel tread surface extends beyond the lower edge of the stair climber track is met by simply extending the stair climber to the required position.

A related invention is a method of using a mechanical wheelchair with a manual stair climber, preferably with the above-described stair climber. Using a control lever, the stair climber is rotated from the configuration for riding in the wheelchair in such a way that its part touches the ground and the rear wheels are raised. In the next step, the rear wheels are moved so that the clearance created by raising the wheels is increased. Then, the wheelchair is lowered by means of the brake in a controlled fashion to the configuration for travelling across a grade-separated obstacle.

It is advantageous if the wheels are moved so that they constitute a torque transmitter.

Brief Description of Drawings

An exemplary embodiment of the proposed solution is described with reference to drawings which show the following:

Fig. 1 – side view of the assembly of the stair climber and the wheelchair in configuration I for riding in the wheelchair;

Fig. 2 – the first step of the changeover to configuration II for travelling across a grade-separated obstacle with rear wheels raised;

Fig. 3 – the second step of the changeover to configuration II for travelling across a grade-separated obstacle with rear wheels moved to constitute the torque transmitter;

Fig. 4 – side view of the assembly of the stair climber and the wheelchair in configuration II for travelling across a grade-separated obstacle;

Fig. 5 – side view of the assembly of the stair climber and the wheelchair on a grade-separated obstacle;

Fig. 6 – side view of the stair climber separated from the wheelchair;

Fig. 7 – side view of the assembly of the stair climber and the wheelchair in configuration II for travelling across a grade-separated obstacle in the embodiment with a shiftable stair climber;

Best Mode for Carrying Out the Invention

An exemplary embodiment of a manual stair climber 5 for a mechanical wheelchair 10 includes a support structure 6 and a crawler track 7. The stair climber 5 is adapted for being installed to the mechanical wheelchair 10 with a system of wheels where two wheels constitute rear wheels 4. The assembly of the mechanical wheelchair 10 and the stair climber 5 is created so that in a side view of the assembly of the wheelchair 10 and the stair climber 5 in configuration I for riding in the wheelchair 10, the contour of the rear wheel 4 tread surface extends beyond the lower edge of the stair climber track 7. In configuration II for travelling across a grade-separated obstacle, the lower edge of the track 7 extends beyond the contour of the rear wheel 4 tread surface. In this example, it is accomplished by the rear wheels 4 of the wheelchair 10 being relocatable.

The assembly of the stair climber 5 installed to the wheelchair 10 includes a transmission 8 which is connected to the track 7 of the stair climber 5 and to a torque transmitter 14. In this case, the transmission 8 is part of the stair climber 5, as well as, partially, of the wheelchair 10. An advantage of this solution is that after detaching the stair climber 5, the separate wheelchair 10 can be used without further limitations, such as substantially larger weight.

The stair climber 5 also includes a control lever 9 attached to the support structure 6 of the stair climber 5. When the stair climber 5 is installed to the wheelchair 10, the control lever 9 is accessible to the user who sits in the wheelchair 10. The control lever is located in the front part of the stair climber 5; and in the configuration I for riding in the wheelchair 10, it is between the user's legs.

The stair climber 5 is adapted for being installed pivotably to the mechanical wheelchair 10 and is attached to the wheelchair. The pivot axis is parallel to the axis of the rear wheels 4.

The assembly of the stair climber 5 installed to the wheelchair 10 also contains a brake 11 which has a progressively increasing effect and is provided with a control element 15 of the brake 11. The control element 15 of the brake 11 is located at the end of the control lever 9. The brake disc 12 of the brake 11 is connected using a temporary joint to the pivotably-installed stair climber 5. The temporary joint is formed by a set of pins. The brake caliper 13 of the brake 11 is attached to the wheelchair 10. The temporary joint between the brake disc 12 and the stair climber 5 is suitable for simple detachment of the stair climber 5. After the stair climber 5 is detached, the brake disc 12 remains inserted in the brake caliper 13. This enables the stair climber 5 to be easily reinstalled to the wheelchair 10 because the problematic operation of replacing the brake disc 12 in the brake caliper 13 is eliminated.

The rear wheels 4 are relocatable in such a way that in configuration II for travelling across a grade-separated obstacle they constitute the torque transmitter 14. In practice, the rear wheels 4 are removed from their axle and placed onto pins 17 which are provided in the front part of the wheelchair 10. These pins 17 are connected to the transmission 8.

The above-described mechanical wheelchair 10 with the manual stair climber 5 is easily adapted from configuration I for riding in the wheelchair 10 to configuration II for travelling across a grade-separated obstacle. This is accomplished by first rotating the stair climber 5 by means of the control lever 9 from configuration I for riding in the wheelchair 10 to a position where the rear part of the stair climber 5 touches the ground. Thanks to the effective geometry of the entire system, the rear wheels 4 can be raised using a relatively small force. The system is secured in the raised position by pressing the control element 15 of the brake 11.

Subsequently, the rear wheels 4 are moved so that the clearance created by raising the wheels 4 increases. In particular, the rear wheels 4 are removed from their axle and placed onto pins 17 which are provided in the front part of the wheelchair 10. The wheels 4 are moved so that they constitute the torque transmitter 14. After that, the wheelchair 10 is lowered in a controlled fashion by means of the brake 11 to configuration II for travelling across a grade-separated obstacle. In the wheelchair configuration II, the user employs the torque transmitters 14 to move the wheelchair 10 with the stair climber 5 to the grade-separated obstacle and to negotiate this obstacle.

The exemplary embodiment is shown in Figs. 1 through 6.

List of reference symbols

1 – wheelchair frame
2 – seat
3 – front wheels
4 – rear wheels
5 – stair climber
6 – support structure
7 – crawler track
8 – transmission gear
9 – control lever
10 – wheelchair
11 – brake
12 – brake disc
13 – brake caliper
14 – torque transmitter
15 – control element of the brake
16 – extendable element
17 – pin of the torque transmitter
I – configuration for riding in the wheelchair
II – configuration for travelling across a grade-separated obstacle

Claims

1. A manual stair climber for a mechanical wheelchair with a system of wheels where two wheels constitute rear wheels (4),
said stair climber (5) containing a support structure (6), a crawler track (7) and is adapted for installation to a mechanical wheelchair (10),
characterized in that
the track (7) of the stair climber (5) and/or the entire stair climber (5) is shiftable
and/or the rear wheel (4) of the wheelchair (10) is relocatable so that
in a side view of the assembly of the wheelchair (10) and the stair climber (5) in configuration (I) for riding in the wheelchair (10), the contour of the rear wheel (4) tread surface extends beyond the lower edge of the stair climber track (7)
and in configuration (II) for travelling across a grade-separated obstacle, the lower edge of the track (7) extends beyond the contour of the rear wheel (4) tread surface,
where the assembly of the stair climber (5) installed to the wheelchair (10) includes a transmission (8) which is connected to the track (7) of the stair climber (5), and to a torque transmitter (14).

2. The manual stair climber for a mechanical wheelchair according to Claim 1 **characterized in that** the stair climber (5) also includes a control lever (9) which is attached to the support structure (6), where this control lever (9) of the stair climber (5) installed to the wheelchair (10) is accessible to the user sitting in the wheelchair (10),
the said stair climber (5) is adapted for pivotable installation to the mechanical wheelchair (10) with relocatable rear wheels (4), where the pivot axis is parallel to the axis of the rear wheels (4),
and the assembly of the stair climber (5) installed to the wheelchair (10) also contains a brake (11) which has a progressively increasing effect and is provided with a control element (15) of the brake (11),
where he brake disc (12) of the brake (11) is attached to the stair climber (5), which is installed pivotably, and the brake caliper (13) of the brake (11) is attached to the wheelchair (10) and/or vice versa.

3. The manual stair climber for a mechanical wheelchair according to Claim 2 **characterized in that** the rear wheels (4) are relocatable so that in configuration (II) for travelling across a grade-separated obstacle, they constitute the torque transmitter (14).

4. The manual stair climber for a mechanical wheelchair according to any of the preceding Claims **characterized in that** the stair climber (5) is shiftable in such manner that at least one extendable element (16) is provided between the support structure (6) of the stair climber (5) and the frame (1) of the wheelchair.

5. A method of using a mechanical wheelchair with a manual stair climber, preferably with the stair climber according to Claims 2 and 3, **characterized in that**
the stair climber (5) is rotated using a control lever (9) from the configuration (I) for riding in the wheelchair (10) in such a way that part of the stair climber (5) touches the ground and the rear wheels (4) are raised
in the next step, the rear wheels (4) are moved so that the clearance created by raising the wheels (4) is increased
after that, the wheelchair (10) is lowered in a controlled fashion by means of the brake (11) to the configuration (II) for travelling across a grade-separated obstacle.

6. The method of using a mechanical wheelchair with the manual stair climber according to Claim 5 **characterized in that**
the wheels (4) are moved so that they constitute the torque transmitter (14).

AMENDED CLAIMS
received by the International Bureau on 10 January 2017 (10.01.2017)

1. A manual stair climber for a mechanical wheelchair with a system of wheels where two wheels constitute rear wheels (4),
said stair climber (5), containing a support structure (6) and a crawler track (7), is adapted for pivotable installation to the mechanical wheelchair (10), where the pivot axis is parallel to the axis of the rear wheels (4),
said stair climber (5) also containing a control lever (9) which is attached to the support structure (6), where this control lever (9) of the stair climber (5) installed to the wheelchair (10) is accessible to the user sitting in the wheelchair (10),
said rear wheel (4) of the wheelchair (10) being relocatable so that in a side view of the assembly of the wheelchair (10) and the stair climber (5) in configuration (I) for riding in the wheelchair (10), the contour of the rear wheel (4) tread surface extends beyond the lower edge of the stair climber track (7)
and in configuration (II) for travelling across a grade-separated obstacle, the lower edge of the track (7) extends beyond the contour of the rear wheel (4) tread surface,
said assembly of the stair climber (5) installed to the wheelchair (10) containing a transmission (8) which is connected to the track (7) of the stair climber (5) and to a torque transmitter (14),
said assembly of the stair climber (5) installed to the wheelchair (10) also containing a brake (11) which has a progressively increasing effect and is provided with a control element (15) of the brake (11) **characterized in that**
a brake disc (12) of the brake (11) is attached to the stair climber (5) and a brake caliper (13) of the brake (11) is attached to the wheelchair (10) and/or vice versa.

2. The manual stair climber for a mechanical wheelchair according to Claim 1 **characterized in that** the rear wheels (4) are relocatable so that in configuration (II) for travelling across a grade-separated obstacle, they constitute the torque transmitter (14).

3. A method of using a mechanical wheelchair with a manual stair climber, preferably with the stair climber according to any of the preceding Claims, **characterized in that**

the stair climber (5) is rotated using a control lever (9) from the configuration (I) for riding in the wheelchair (10) in such a way that part of the stair climber (5) touches the ground and the rear wheels (4) are raised

in the next step, the rear wheels (4) are moved so that the clearance created by raising the wheels (4) is increased

after that, the wheelchair (10) is lowered in a controlled fashion by means of the brake (11) to the configuration (II) for travelling across a grade-separated obstacle.

4. The method of using a mechanical wheelchair with the manual stair climber according to Claim 3 **characterized in that**

the wheels (4) are moved so that they constitute the torque transmitter (14).

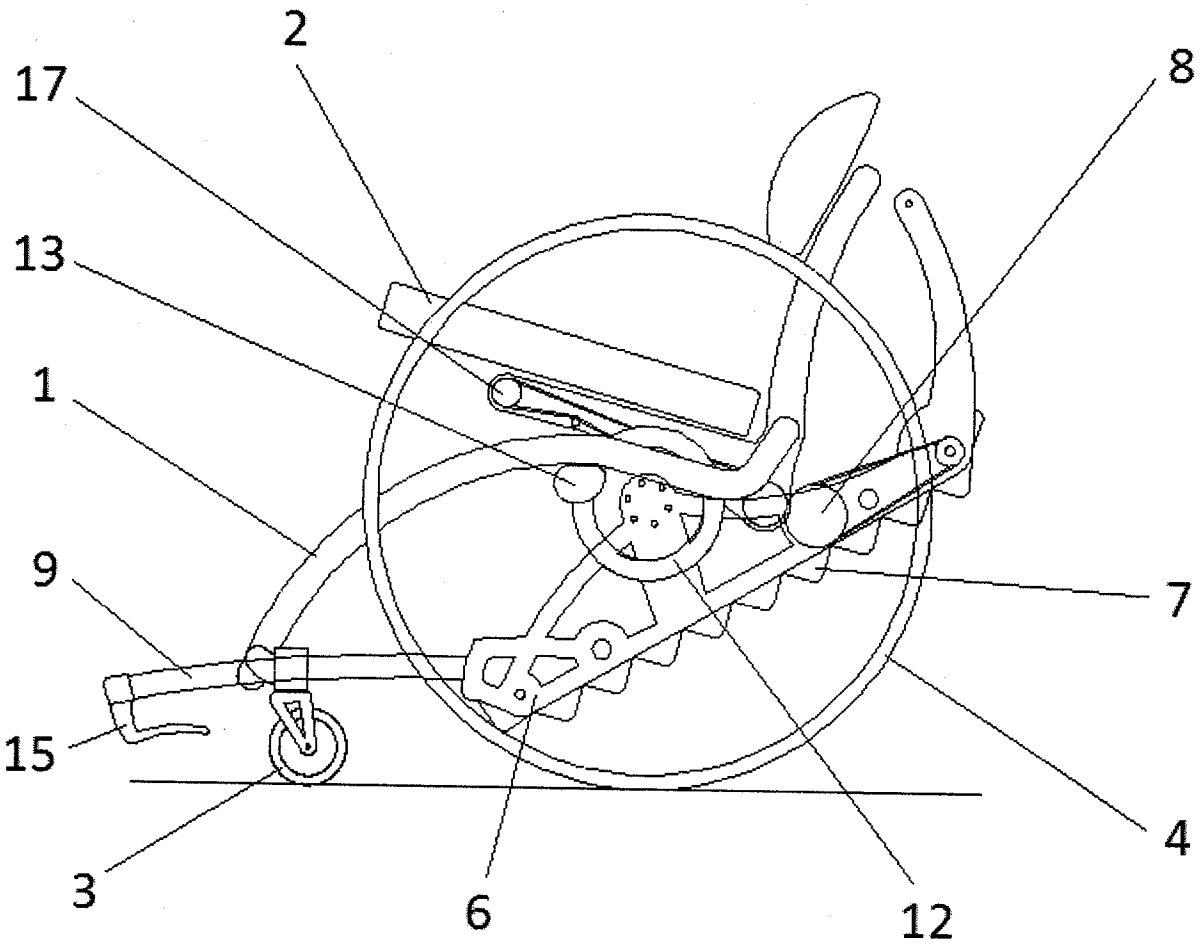

Fig. 1

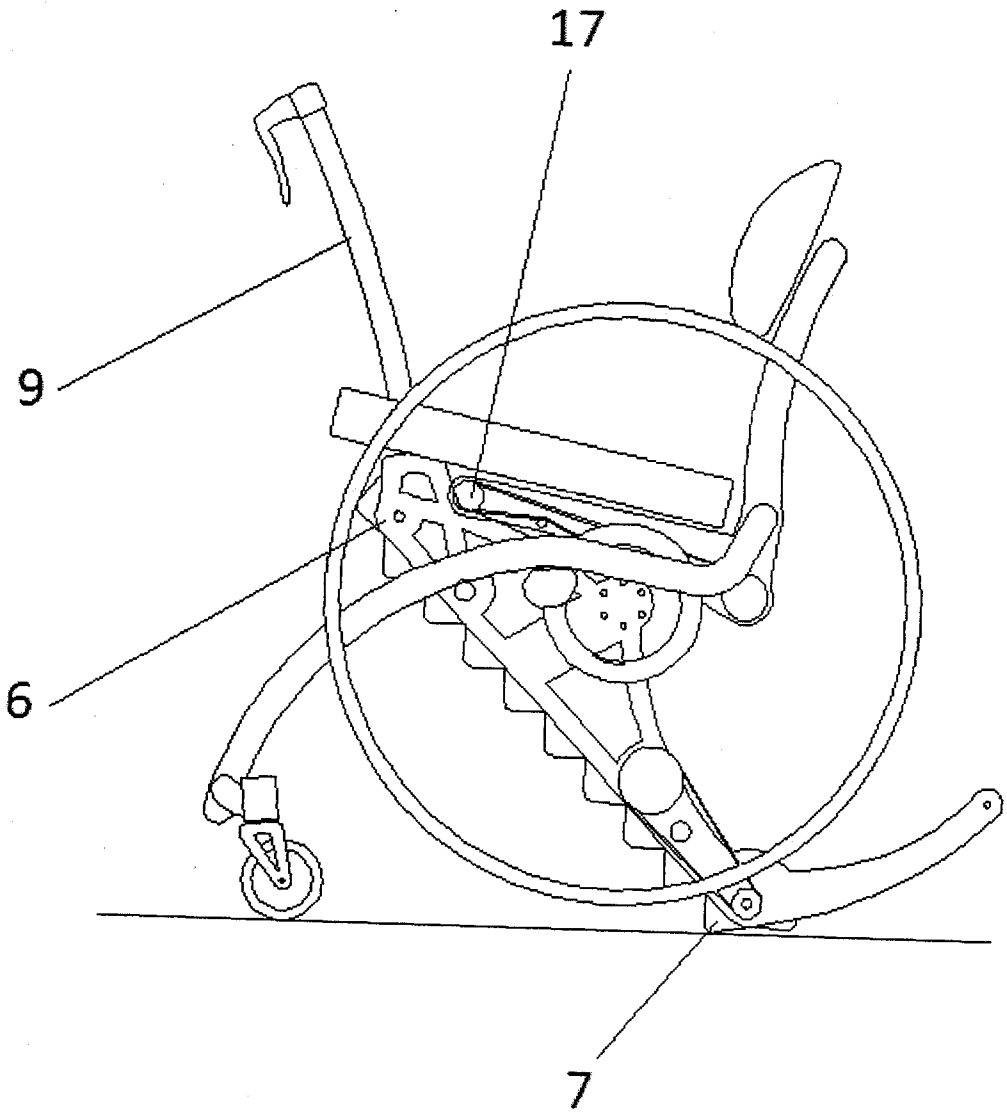

Fig. 2

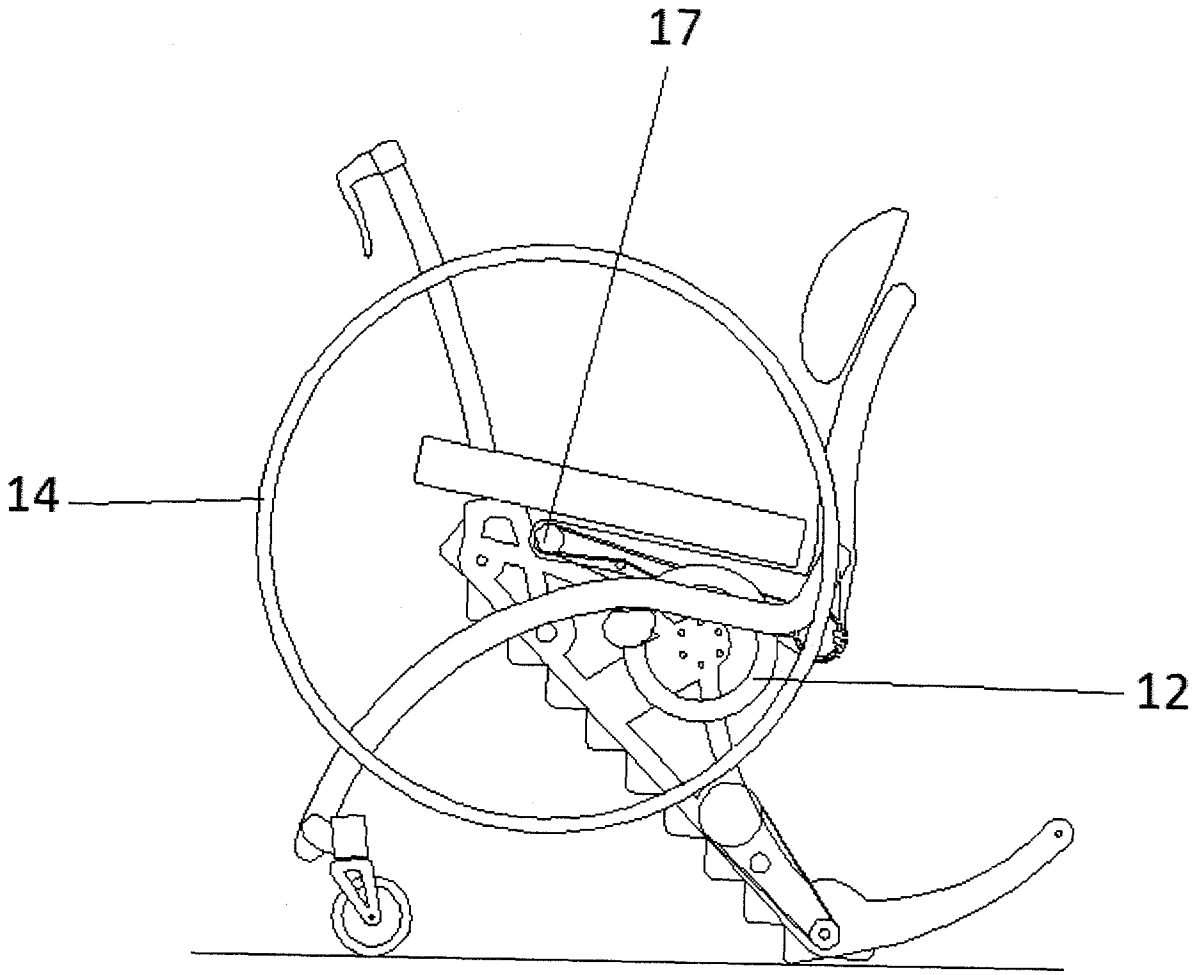

Fig. 3

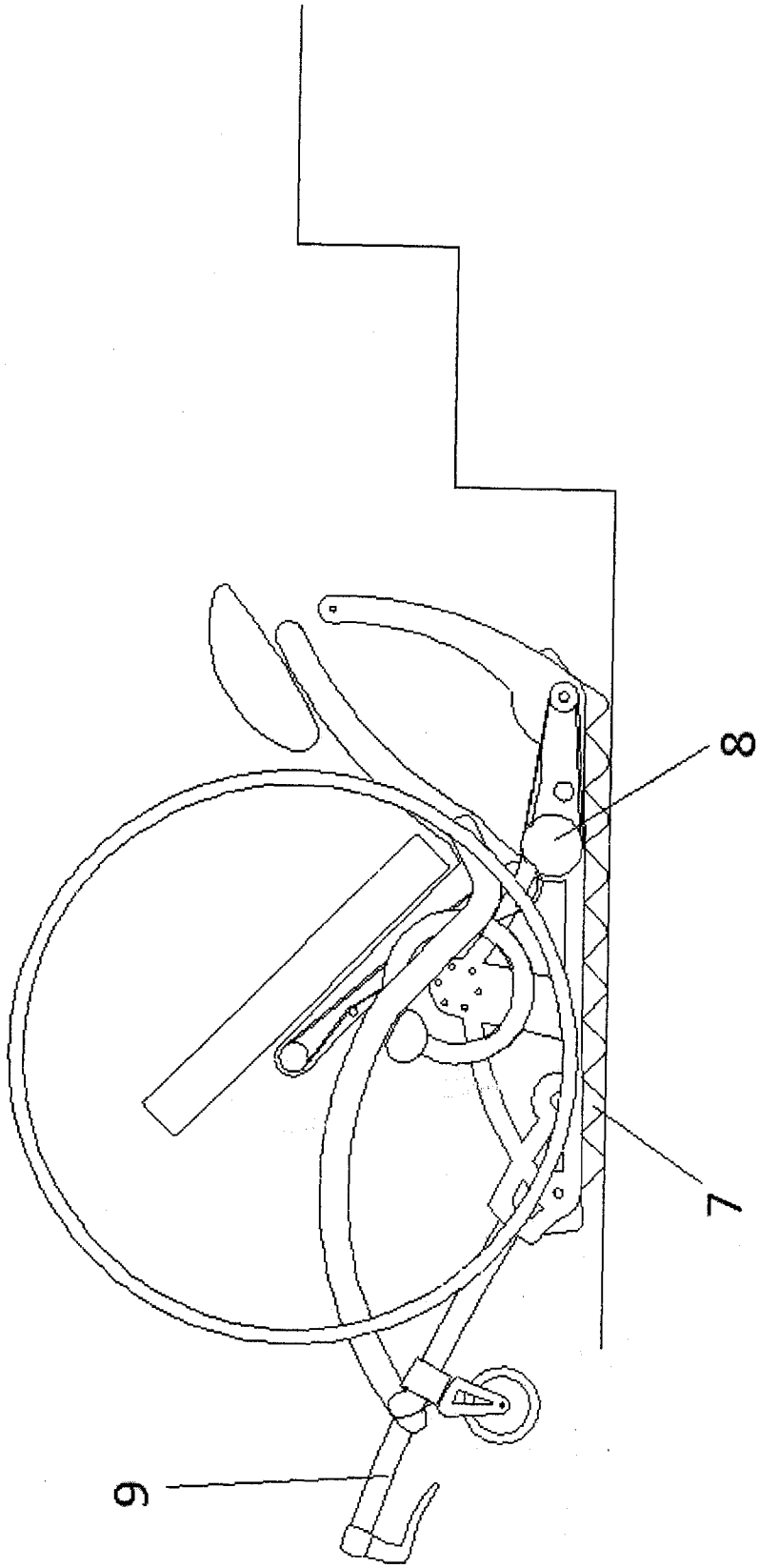

Fig. 4

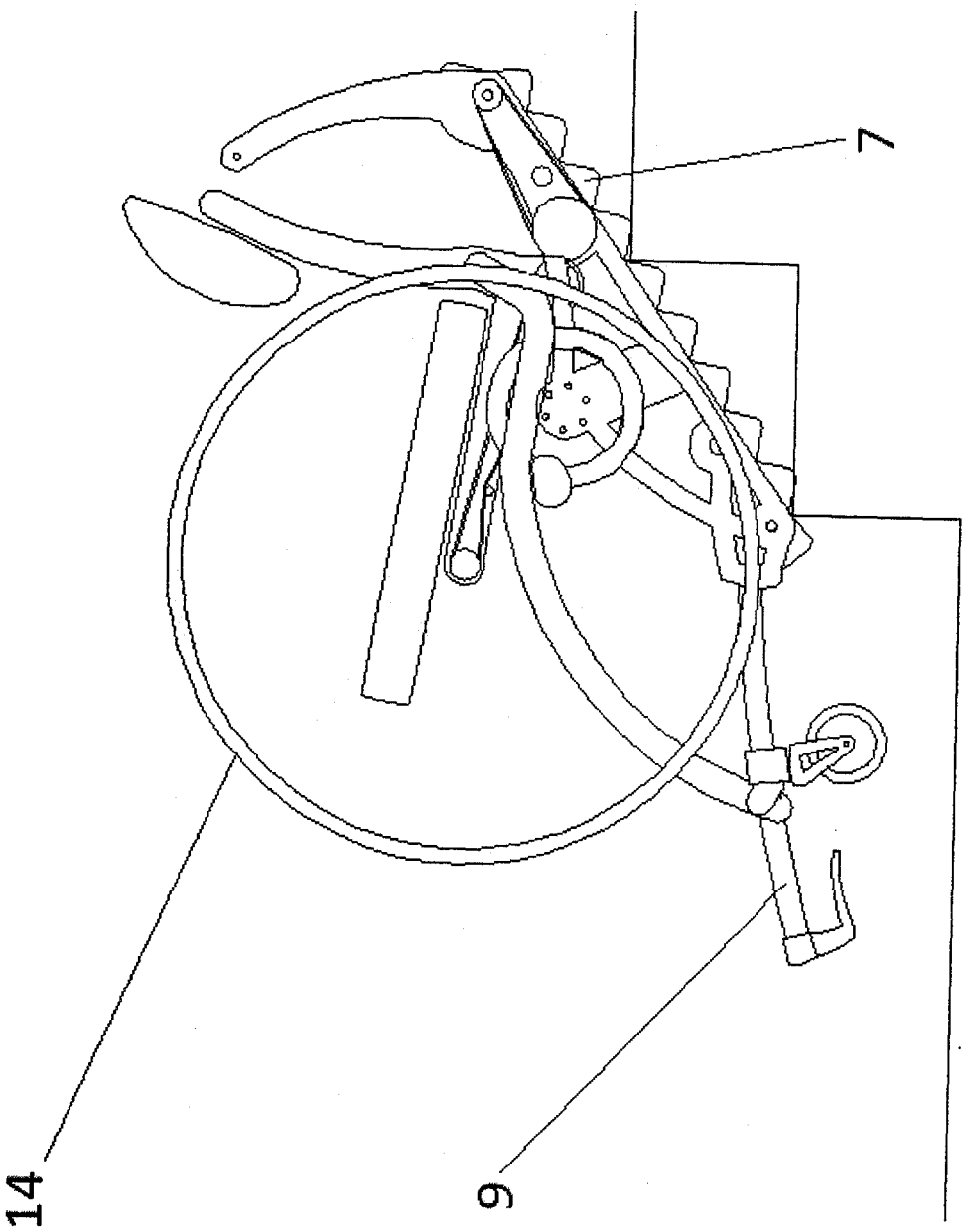

Fig. 5

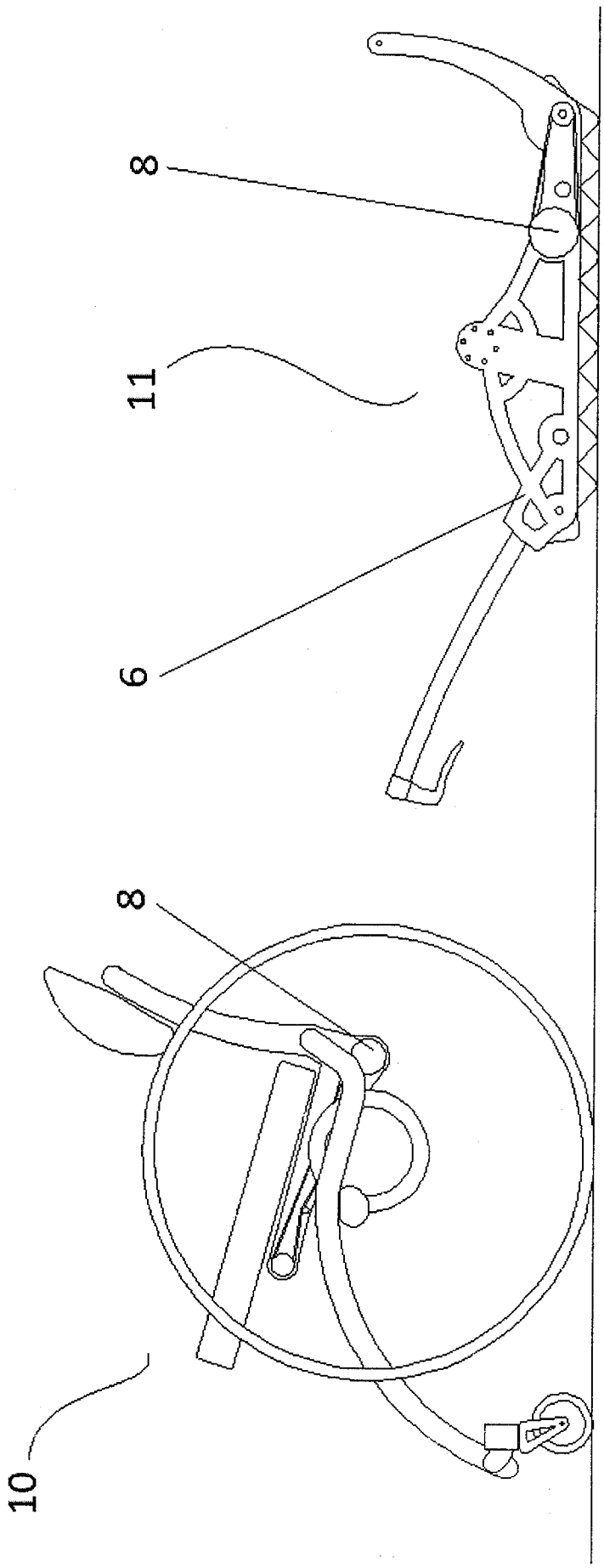

Fig. 6

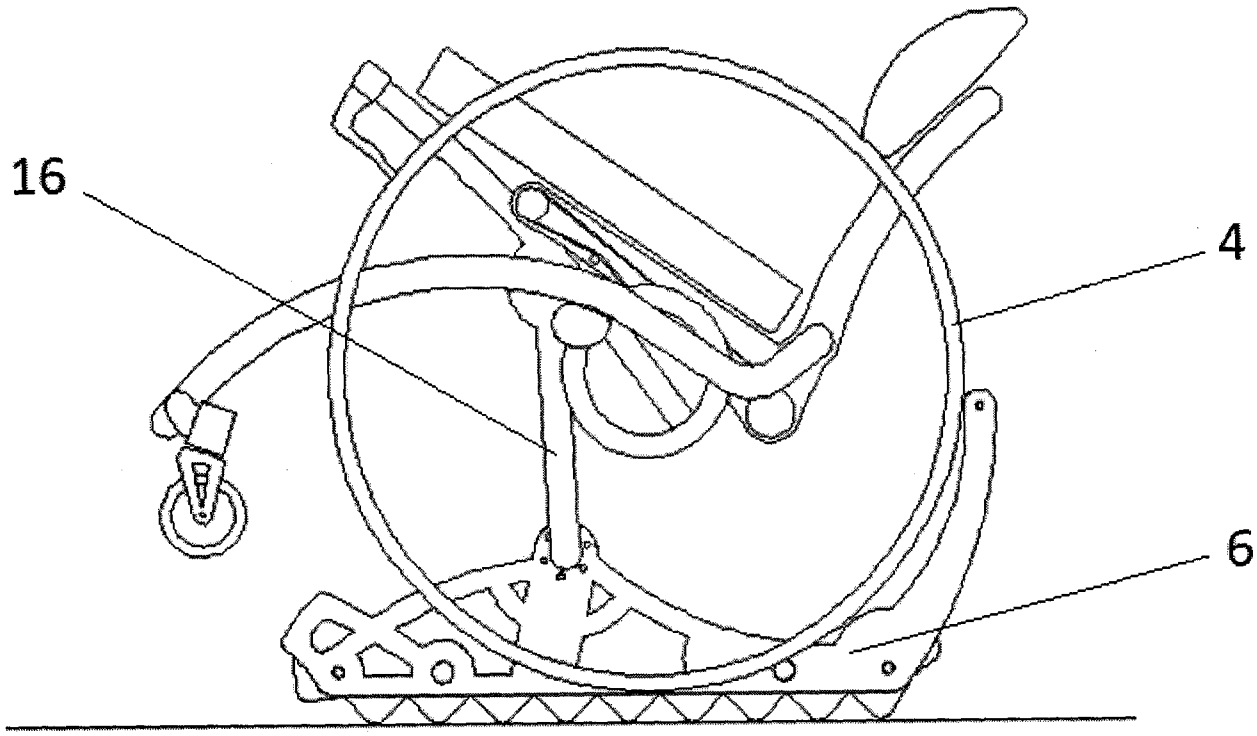

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2016/000081

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61G5/06
ADD.

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)
A61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 5 158 309 A (QUIGG ROBERT T [US]) 27 October 1992 (1992-10-27) figures 1-8 column 3, line 17 - column 5, line 48 -----	1,4-6 2,3
X	US 3 191 953 A (AYSTA EDWARD M) 29 June 1965 (1965-06-29) figures 1-6 column 3, line 5 - column 5, line 13 column 9, line 11 - column 10, line 33 -----	1,4-6
X	US 4 044 850 A (WINSOR MALCOLM C) 30 August 1977 (1977-08-30) figures 1-11 column 3, line 8 - column 8, line 8 ----- -/--	1,4-6

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
2 November 2016	10/11/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Koszewski, Adam

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INTERNATIONAL SEARCH REPORT

International application No
PCT/CZ2016/000081

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	CA 2 472 716 A1 (STRYKER CANADA LP [CA]) 21 August 2003 (2003-08-21) figures 1-4 page 8, line 9 - line 19 -----	2,3

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

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