WHEELCHAIR CURB-CLIMBING AND CURB-DESCENDING SYSTEM

FIELD OF THE INVENTION

[001] The present invention relates to equipment for aiding the handicapped, in particular, wheelchairs and accessories.

BACKGROUND OF THE INVENTION

[002] Wheelchairs are commonly used by people with ambulatory problems. A common issue with wheelchairs is that they do not easily roll or otherwise progress up and down step-like or elevated structures, such as sidewalk curbs; and if they do, it is typically via a complex mechanism and/or a mechanism that causes the user to be tilted, which can be uncomfortable or even dangerous to the user, as well as expensive.

[003] The following publications are believed to represent the current state of the art: WO 2001/053137 (Elsteel Danmark AS, 2001-07-26), which discloses a transport arrangement for running/movement on uneven surfaces, including a frame with successively arranged actuator legs; CN 101 869 522 (Daguang, 2012-02-19), which discloses a wheelchair with a set of outwardly and downwardly extendable mechanical arms to vertically lift the wheelchair to reach steps; EP 0 436 103 (Watkins, 1991-07-10), which discloses an electronic control system for a stair climbing vehicle/wheelchair with sensors for detecting a stairway or slope and a seat that can be tilted to keep the user approximately vertical; JP 2001212181 (Kiyohara Sadaji, et al., 2001-08-07); US 6554086 (Goertzen et al., April 29, 2003); US 8292010 (Puskar-Pasewicz, et al., October 23, 2012); US 7316282 (Mulhern et al., January 8, 2008); US 7360792 (Turturiello et al., April 22, 2008) US 2010/096194 (Starcevic, April 22, 2010); and WO 1998/046184 (Schaffner et al., October 22, 1998).

SUMMARY OF THE INVENTION

[003a] The invention is defined in the independent claim. Some optional features of the invention are defined in the dependent claims.

[004] The present disclosure relates to a wheelchair curb-climbing and curb-descending system adapted to raise a wheelchair to, and lower a wheelchair from, (hereinafter in the description and claims: “negotiate” or a derivative thereof) a step-like elevated structure or surface such as a sidewalk curb (hereinafter in the specification and claims: “curb” or any derivative thereof). As the present system is particularly suited for use with motorized wheelchairs, the present system will be described in this context. However the present wheelchair curb-climbing and curb-descending system, *mutatis mutandis*, is not limited to motorized wheelchairs.

[005] The term “curb” and its derivatives will be used herein the description and claims to indicate any relatively isolated obstacle of a curb-like nature, such as a sidewalk curb, a single stair, a step-up/down as may be found at a building or store entry-way, and so on. The term “curb” and its derivatives herein are not intended to include obstacles such as a flight of stairs.

[006] In accordance with one disclosed example, there is provided a wheelchair curb-climbing and curb-descending system for aiding a wheelchair to negotiate a curb. The system includes a wheelchair attachment mechanism for securing the system to the wheelchair; a pair of front arms, each front arm adapted and controllable to extend, or be positioned, forward and downward so as to lift a front portion of wheelchair and to retract back so as to lower the front portion of the wheelchair upon deployment of the system; a pair of rear arms, each rear arm adapted and controllable to extend, or be positioned, rearward and downward so as to lift a rear portion of wheelchair and to retract back so as to lower the rear portion of the wheelchair upon deployment of the system. The system further includes an arm extending mechanism having an arm extension and retraction motor associated with each of the front arms and with each of the rear arms for extending or positioning, and retracting the arms; a rotatable lifting-arm wheel disposed at the free ends of each front arm and each rear arm; a

wheel motor associated with, and adapted for rotating, at least one of the arm wheels; an operation control unit adapted to actuate and control operation of the system; and a leveling mechanism operably connected to the arms for ensuring the seat of the wheelchair remains substantially level to the ground during operation of the system. The system may further comprise a pair of arm housings for housing the front arms and the rear arms, the housings and the arms being arcuate.

[007] It is a particular feature of the present wheelchair curb-climbing and curb-descending system that it is adapted to negotiate a step-like elevated structure such as a sidewalk curb, essentially without tilting the user.

[008] Additional particular features of the present system include that it is relatively lightweight, for example on the order of 40 kg; allows overcoming a curb of about 20cm, within a reasonably quick period, for example approximately 10 seconds; and does not increase the existing footprint of the wheelchair so as not to interfere with maneuvering of the wheelchair or entry into doorways or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

[009] The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the appended drawings in which:

[010] **Figs. 1-2** are respective generally front and rear perspective side views of a wheelchair fitted with or incorporating a wheelchair curb-climbing and curb-descending system;

[011] **Figs. 3-5** are views of extendable lifting arms of the wheelchair curb-climbing and curb-descending system side, a perspective and two side views, respectively;

[012] **Fig. 6** is a perspective exploded view of the wheelchair with the curb-climbing and curb-descending system

[013] **Figs. 7A-7I** are side views of wheelchair curb-climbing and curb-descending system in various states of operation; and

[014] **Fig. 8A-8H** are side views of another example of the wheelchair curb-climbing and curb-descending system in various states of operation.

[015] The following detailed description of embodiments of the invention refers to the accompanying drawings referred to above. Dimensions of components and features shown in the figures are chosen for convenience or clarity of presentation and are not necessarily shown to scale. Wherever possible, the same reference numbers will be used throughout the drawings and the following description to refer to the same and like parts.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[016] Illustrative embodiments of the invention are described below. In the interest of clarity, not all features/components of an actual implementation are necessarily described.

[017] Figs. 1-6 also show a first embodiment and including optional modifications thereof, of the present wheelchair curb-climbing and curb-descending system for use with a wheelchair. Without limitation, the system is particularly suited for use with a motorized wheelchair and will be described in that context. The wheelchair typically comprises a chair 100, including a seat 102 and a chair support shaft 104; a base 106; a set of drive wheels 108; a set of front casters or wheels 110; a set of rear stabilizing wheels 112; footrest(s) 114; a propulsion power source (such as one or more batteries) and motor 116; arm rests 120 and a operation control unit 122 for the user to control the movement of the wheelchair.

[018] The curb-climbing and curb-descending system comprises a pair of lifting-arm housings 10, one housing on each side of the wheelchair. Arm housings 10 are made of a sturdy material, such as aluminum and are arcuate, as shown. The system includes a wheelchair attachment mechanism 11 (including in some embodiments a generally transversly oriented connector rod

52 and associated fasteners, Fig. 6) that typically connects the system to the wheelchair for example via an attachment between the system (e.g. arm housings 10) and chair support shaft 104, though the system could be attached in other ways and means, for example to base 106, etc.

[019] Each arm housing 10 has a pair of arm receiving tunnels 12, one tunnel configured to house a correspondingly shaped frontward/downward extendable wheelchair lifting and lowering arm 14 (herein-after in the specification and claims also/interchangably referred to as “front arms” 14, regardless of the method of their operation) and the other tunnel configured to house a correspondingly shaped rearward/downward extendable wheelchair lifting and lowering arm 16 (herein-after in the specification and claims also referred to as “rear arms” 16, regardless of the method of their operation). At the free ends of each lifting arm 16 are wheelchair lifting-arm wheels 18, rotatable via a wheel motor 20 as part of an arm extending mechanism. For such purpose, in some embodiments, each wheel motor 20 of the arm extending mechanism has an associated gear wheel 22 (Fig. 5); and each lifting/lowering arm (front arms 14 and rear arms 16) has a toothed portion or toothed rail 24 (Fig. 5) corresponding to its respective gear wheel. In some modifications, the arm extending mechanism includes friction rollers (not shown) or a pulley device (not shown) rather than gear wheels.

[020] For smooth operation during extension and retraction, each lifting/lowering arm 14 and 16 also typically has a roller or pair of rollers 26 for interfacing with the inner surface of tunnels 12 of housing 10. A lifting-arm extension and retraction motor 28 is associated with each of lifting/lowering arms 14 and 16, for extending and retracting the arms.

[021] In some preferred embodiments, a rear (or front) pair of lifting-arm wheels 18 are connected by an axle 30 so that both of the pair of wheels will be rotatable by wheel motor 20. In some embodiments, each wheel 18 has an associated motor such as wheel motor 20. In some embodiments, each pair of wheels, connected by an axle such as axle 30, has an associated motor such as wheel motor 20.

[022] In some embodiments, the curb climbing and curb-descending system further includes a leveling mechanism 32 (Fig. 6) including one or more level or inclinometer sensors 34 operably engaged with wheel motor(s) 20 to control the relative extension of arms 14 and 16 so as to ensure that seat 102 (i.e. the user) is maintained level to the ground during lifting and descent of the wheelchair.

CLAIMS

1. A wheelchair curb-climbing and curb-descending system for aiding a wheelchair having a seat to negotiate a curb, the system comprising:

a wheelchair attachment mechanism for securing the system to the wheelchair;

a pair of arcuate front arms, each of the arcuate front arms adapted and controllable to arcuately extend forward and downward so as to lift a front portion of the wheelchair and to arcuately retract back so as to lower the front portion of the wheelchair upon deployment of the system;

a pair of arcuate rear arms, each of the arcuate rear arms adapted and controllable to arcuately extend rearward and downward so as to lift a rear portion of the wheelchair and to arcuately retract back so as to lower the rear portion of the wheelchair upon deployment of the system;

an arm extending mechanism comprising an arm extension and retraction motor associated with each of the arcuate front arms and with each of the arcuate rear arms for extending or positioning, and retracting the arcuate front arms and arcuate rear arms;

a rotatable lifting-arm wheel disposed at free ends of each of the arcuate front arms and each of the arcuate rear arms;

a wheel motor associated with, and adapted for rotating, at least one of the lifting-arm wheels;

an operation control unit adapted to actuate and control operation of the system;

a leveling mechanism operably connected to the arcuate front arms and the arcuate rear arms and configured to ensure that the seat of the wheelchair remains substantially level to the ground during operation of the system; and

wherein the system further comprises a pair of arm housings for housing the front arms and the rear arms; each of the arm extension and retraction motors of the arm extending mechanism has an associated gear

wheel; and each of the front arms and each of the rear arms has a toothed portion or toothed rail corresponding to the respective gear wheels.

2. The system according to claim **1**, wherein the front arms are attached to the wheelchair via an attachment rod.

3. The system according to claim **1**, wherein the leveling mechanism includes at least one inclinometer sensor.