(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 308 761 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
**05.06.2019 Bulletin 2019/23**

(51) Int Cl.:
***A61H 3/04*** *(2006.01)*

(21) Application number: **17195658.4**

(22) Date of filing: **10.10.2017**

# (54) ELECTRIC VEHICLE AND METHOD OF BREAKING THE SAME

ELEKTROFAHRZEUG UND VERFAHREN ZUM ABBREMSEN DAVON

VÉHICULE ÉLECTRIQUE ET SON PROCÉDÉ DE FREINAGE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(30) Priority: **11.10.2016 JP 2016200320**

(43) Date of publication of application:
**18.04.2018 Bulletin 2018/16**

(73) Proprietor: **Nabtesco Corporation**
**Tokyo (JP)**

(72) Inventor: **HASHIMOTO, Hiroaki**
**Kobe-shi, Hyogo (JP)**

(74) Representative: **Grünecker Patent- und Rechtsanwälte**
**PartG mbB**
**Leopoldstraße 4**
**80802 München (DE)**

(56) References cited:
**EP-A1- 3 075 369**
**WO-A1-2015/085403**
**US-A1- 2009 045 021**
**US-A1- 2014 365 033**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 3 308 761 B1

Printed by Jouve, 75001 PARIS (FR)

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to an electric vehicle according to the preamble of claim 1, such as an electric vehicle for assisting elderly people, disabled people, patients and others with a gait impairment in walking. The invention also relates to a method of braking an electric vehicle according to the preamble of claim 9.

### BACKGROUND

**[0002]** There have conventionally been used a wheeled walker (a rollator, a rolling walker) that assists the elderly's outing, a walker that assists disabled people or patients in walking, and other walking aid devices. For example, US 2009/045021 A1 and JP 2009 183407 A each discloses a walking aid device that can be easily operated by a user to travel straight or turn.

**[0003]** From US 2009/045021 A1 a walking aid device (mobility assisting device) is known, having a support frame carried by at least one wheel and a brake assembly for the wheel. This known device may further include a speed sensor for detecting acceleration of said device. A microprocessor is responsive to said speed sensor to modify the operation of a brake controller connected to energize the brake assembly.

**[0004]** The walking aid device (an electric rolling walker) disclosed in JP 2009 183407 A includes a frame body having a handle portion to be gripped by a user, more than one wheel provided on left and right sides of the frame body, more than one driving motor that drives each of the wheels to rotate, and a controller that detects a counter electromotive force generated at the driving motor and controls the driving motor based on the counter electromotive force.

**[0005]** The walking aid devices of US 2009/045021 A1 and JP 2009 183407 A also each include a grip sensor (touch sensor) on the handle portion, for detecting whether a user is gripping the handle portion. When determining that a user is not gripping the handle portion based on a detection signal of the grip sensor, the walking aid device applies brakes to the wheels. In such a conventional walking aid device, however, the grip sensor needs to be used to determine whether a user is gripping the handle portion. The grip sensor, therefore, is provided on the handle portion, which might result in a cost increase of the walking aid device.

### SUMMARY

**[0006]** It is an object of the present invention to provide an electric vehicle capable of determining, without using a grip sensor or the like, whether a user is operating the electric vehicle, and a method of braking the same.

**[0007]** An electric vehicle according to the present invention defined in claim 1 is an electric vehicle provided with a wheel or an endless track and comprising a brake unit for braking the wheel or the endless track and a control unit for determining that a user is not operating the electric vehicle, when an amount of change in acceleration of the electric vehicle is smaller than a predetermined threshold value, and controlling the brake unit based on a result of the determination. Herein, when a user is gripping handles of the electric vehicle with his/her hands, the term "operating" refers to a case where a part of a body of the user or his/her belonging leans against, rests on, or contacts with the electric vehicle, in addition to a case where the user is pushing or pulling the electric vehicle with his/her hands. Furthermore, the term "gripping" refers to holding the handles so as to cover them, which also includes a case where the handles are held lightly in addition to a case where the handles are gripped tightly.

**[0008]** In the electric vehicle according to the present invention, it may also be possible that, when the acceleration exceeds a predetermined upper limit value, the control unit assumes that the acceleration is equal to the upper limit value.

**[0009]** In the electric vehicle according to the present invention, it may also be possible that, when the acceleration is at least either smaller than a predetermined positive threshold value and/or larger than a predetermined negative threshold value, the control unit determines that the user is not operating the electric vehicle.

**[0010]** In the electric vehicle according to the present invention, it may also be possible that upon determining that the user is not operating the electric vehicle, the control unit controls the brake unit to brake the wheel or the endless track.

**[0011]** In the electric vehicle according to the present invention, it may also be possible that, after a start of braking the wheel or the endless track, during a time in which the acceleration of the electric vehicle is zero or negative, the control unit continues to brake the wheel or the endless track.

**[0012]** In the electric vehicle according to the present invention, it may also be possible that the electric vehicle further comprises a speed sensor for sensing a rotation speed of the wheel or the endless track, and the control unit calculates acceleration of the electric vehicle based on a signal from the speed sensor.

**[0013]** In the electric vehicle according to the present invention, it may also be possible that the electric vehicle further comprises an inclination sensor for sensing an inclination of the electric vehicle, and when the inclination sensor has determined that the electric vehicle is positioned on an upward inclined surface and the wheel or the endless track is rotating backward, the control unit determines that the user is not operating the electric vehicle.

**[0014]** In the electric vehicle according to the present invention, the following configuration may also be adopted. That is, the electric vehicle further comprises an inclination sensor for sensing an inclination of the electric

vehicle. The wheel or the endless track comprises a left-right pair of wheels or endless tracks. When the inclination sensor has determined that the electric vehicle is positioned on a laterally inclined surface, and one of the left-right pair of wheels or endless tracks which is positioned at one of an upper side and a lower side on the inclined surface is stationary or rotating forward, while the other of the left-right pair of wheels or endless tracks which is positioned at the other of the upper side and the lower side on the inclined surface is stationary or rotating backward, the control unit determines that the user is not operating the electric vehicle.

**[0015]** A method of braking an electric vehicle according to the present invention defined in claim 9 is a method of braking an electric vehicle provided with a wheel or an endless track and characterized by comprising a step of: determining that a user is not operating the electric vehicle, when an amount of change in acceleration of the electric vehicle is smaller than a predetermined threshold value, and braking the wheel or the endless track based on a result of the determination.

## ADVANTAGES

**[0016]** According to the present invention, without using a grip sensor or the like, it is possible to determine whether a user is operating an electric vehicle.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]**

Fig. 1 is a perspective view showing a power-assisted rollator according to one embodiment of the present invention.

Fig. 2 is a flowchart explaining one example of a method of braking the power-assisted rollator according to one embodiment of the present invention.

Fig. 3 is a graph showing an actual measured value of rotational acceleration of rear wheels and a low frequency component of the rotational acceleration of the rear wheels.

Fig. 4 is a flowchart explaining Variation 1 of the method of braking the power-assisted rollator.

Fig. 5 is a schematic view showing the power-assisted rollator positioned on an upward inclined surface.

Fig. 6 is a flowchart explaining Variation 2 of the method of braking the power-assisted rollator.

Fig. 7 is a schematic view showing the power-assisted rollator positioned on a laterally inclined surface.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0018]** The following details one embodiment of the present invention with reference to Fig. 1 to Fig. 3. In the following description, like elements are numbered and labeled similarly. The like elements also have the same names and functions. The descriptions of such elements will appear once.

**[0019]** Fig. 1 is a view showing an electric rollator (hereinafter referred to as a power-assisted rollator) as one example of an electric vehicle. Fig. 1 is a schematic perspective view showing one example of an external appearance of a power-assisted rollator 10 according to the embodiment.

**[0020]** (Configuration of Power-Assisted Rollator) As shown in Fig. 1, the power-assisted rollator 10 includes a frame 11, a pair of front wheels 12 and a pair of rear wheels (wheels) 13 provided on the frame 11, and a pair of handles 14 connected to the frame 11.

**[0021]** Each of the pair of rear wheels 13 has a motor 20 coupled thereto for assisting movement of the each of the pair of rear wheels 13 corresponding thereto. A battery 21 and a control unit 16 are mounted to the frame 11. Furthermore, the control unit 16 has a speed sensor (sensing unit) 22 and an inclination sensor 23.

**[0022]** Next, constituent elements of the power-assisted rollator 10 will further be described.

**[0023]** The frame 11 has a left-right pair of pipe frames 31. On front ends of the left-right pair of pipe frames 31, there are provided the pair of front wheels 12, respectively. The pair of front wheels 12 are each provided so as to be rotatable in a front-rear direction and swivelable also about vertical axes. In this case, the pair of front wheels 12 are universal wheels that can be freely turned around. In this specification, the terms "front/forward", "rear/backward", "left", and "right" refer to "front/forward", "rear/backward", "left", and "right" with respect to a traveling direction of the power-assisted rollator 10, respectively.

**[0024]** Furthermore, on rear ends of the left-right pair of pipe frames 31, there are provided the pair of rear wheels 13, respectively. The rear wheels 13 are provided so as to be rotatable in the front-rear direction. Accordingly, the power-assisted rollator 10 is easily movable forward and backward and, moreover, can be easily moved in a left-right direction or turned around.

**[0025]** On upper ends of the left-right pair of pipe frames 31, there are provided the pair of handles 14 to be operated by a user. The embodiment will be described for a case where the pair of handles 14 are gripped with hands of a user, for example. The pair of handles 14 are coupled to each other via a bar handle 17 extending horizontally. Furthermore, the pair of handles 14 and the bar handle 17 constitute a substantial U-shape. The pair of handles 14 are provided further with a horseshoe-shaped portion 27 that can support elbows of a user. The horseshoe-shaped portion 27 has openings in which the handles 14 can be inserted respectively for mounting. A configuration of the handles 14 is not limited thereto, and, for example, it may also be possible that an individual handle 14 is provided on each of the left-right pair of pipe frames 31.

**[0026]** In the embodiment, the power-assisted rollator 10 has no grip sensor, strain sensor, proximity sensor,

pressure sensor or the like that directly detects whether a user grips the pair of handles 14.

**[0027]** Between the left-right pair of pipe frames 31, there is provided a seat 37 on which a user can sit as necessary.

**[0028]** The battery 21 supplies power to the elements of the power-assisted rollator 10 such as the motors 20 and the control unit 16. The battery 21 is provided below the seat 37 positioned between the pair of pipe frames 31.

**[0029]** In the embodiment, the motors 20 are provided inside the rear wheels 13, respectively. The motors 20 can be any motors such as servomotors, stepper motors, AC motors, and DC motors. Moreover, a speed reducer may be integrated with the motors.

**[0030]** In the embodiment, the motors 20 assist movement of the rear wheels 13 and also serve as power-generating brakes. That is, in the embodiment, the motors 20 serve as drive units for driving the rear wheels 13 and as brake units for braking the rear wheels 13. When the motors 20 brake the rear wheels 13, the motors 20 serve as power generators while braking the rear wheels 13 with resistance forces thereof. When the motors 20 serve as brake units, the motors 20 may be used as reverse brakes for reversely driving the motors 20 or as short-circuit brakes for causing interphase short circuit in the motors 20. Alternatively, it may also be possible that the motors 20 serve only as drive units for driving the rear wheels 13, and the brake units for braking the rear wheels 13 are provided separately from the motors 20. Such brake units are, for example, electromagnetic brakes or mechanical brakes. It may also be possible that when the power-assisted rollator 10 is positioned on an inclined surface (an upward, downward, or laterally inclined surface), the motors 20 are used as reverse brakes, while when the power-assisted rollator 10 is positioned on a flat surface (a surface perpendicular to a vertical direction), the motors 20 are used as power-generating brakes. That is, it is necessary that when a user has let go of the handles 14 or the like on an inclined surface, the power-assisted rollator 10 become stationary on the spot. For this reason, preferably, the motors 20 are used as reverse brakes. On the other hand, when a user has let go of the handles 14 or the like on a flat place, there is a possibility that a hand-free state such as when the user is seated continues for a long time. For this reason, preferably, the motors 20 are used as power-generating brakes so that power consumption is suppressed.

**[0031]** While in the embodiment, the rear wheels 13 have the motors 20 mounted thereto, respectively, there is no limitation thereto. It may also be possible that only the pair of front wheels 12 have the motors 20 mounted thereto, respectively, or that all of the pair of front wheels 12 and the pair of rear wheels 13 have the motors 20 mounted thereto, respectively.

**[0032]** The control unit 16 controls the entirety of the power-assisted rollator 10 including the motors 20 and so on. In this case, the control unit 16 is provided adjacently to the battery 21. A detail of how control is performed by the control unit 16 will be described later.

**[0033]** The speed sensor (sensing unit) 22 senses the number of rotations or a rotation speed of the rear wheels 13 and transmits a signal representing the number of rotations or the rotation speed to the control unit 16. In this case, based on the signal from the speed sensor 22, the control unit 16 differentiates the rotation speed of the rear wheels 13 to calculate rotational acceleration of the rear wheels 13. The speed sensor 22 may be installed inside each of the pair of rear wheels 13 of the power-assisted rollator 10. Alternatively, similarly to the motors 20, the speed sensor 22 may be installed only inside each of the pair of front wheels 12 or inside all of the pair of front wheels 12 and the pair of rear wheels 13.

**[0034]** In a case where the motors 20 are brushless motors, it may also be possible that the speed sensor 22 calculates the number of rotations or a speed of the wheels or a speed of the power-assisted rollator 10 by using a Hall element installed in each of the motors 20.

**[0035]** In a case where a speed can be detected from a counter electromotive force of the motors 20, the number of rotations or the speed of the wheels or the speed of the power-assisted rollator 10 can be calculated from the counter electromotive force. In a case where angular velocities of the rear wheels 13 or the front wheels 12 can be detected, the number of rotations or the speed of the wheels or the speed of the power-assisted rollator 10 can be calculated from the angular velocities.

**[0036]** Furthermore, with no limitation to a configuration in which the speed sensor 22 is installed in each of the pair of front wheels 12 and/or the pair of rear wheels 13, it may also be possible that the speed sensor 22 is mounted in any other component such as the frame 11 and the pair of handles 14. Alternatively, it may also be possible that the speed sensor 22 is disposed adjacently to the control unit 16.

**[0037]** Alternatively, it may also be possible that the sensing unit is constituted by an acceleration sensor. In this case, without using rotational acceleration of the rear wheels 13, the acceleration sensor directly senses acceleration of the power-assisted rollator 10 and transmits a signal representing the acceleration to the control unit 16. Furthermore, the control unit 16 is configured to calculate a speed by integrating the acceleration.

**[0038]** Furthermore, it may also be possible that the sensing unit is constituted by a global positioning system (GPS) device. In this case, the GPS device detects a position of the power-assisted rollator 10 without using rotational acceleration of the rear wheels 13. Furthermore, the control unit 16 can be configured to differentiate positional information from the GPS device to calculate a speed of the power-assisted rollator 10, and differentiate the positional information from the GPS device twice to calculate acceleration.

**[0039]** The inclination sensor 23 senses an inclination of the power-assisted rollator 10, i.e., for example, wheth-

er the power-assisted rollator 10 is on a flat surface or an inclined surface, and transmits to the control unit 16 a signal related to the inclination of the power-assisted rollator 10 in the front-rear direction and/or the left-right direction. In this case, the inclination sensor 23 is constituted by an acceleration sensor having two or more axes. The inclination sensor 23 is provided adjacently to the control unit 16. Alternatively, the inclination sensor 23 may be provided in an upper portion of the power-assisted rollator 10. It may also be possible that the inclination sensor 23 is constituted by a gyrosensor, instead of an acceleration sensor, for sensing an attitude of the power-assisted rollator 10.

**[0040]** In the embodiment, based on a change in acceleration of the power-assisted rollator 10, the control unit 16 determines whether a user is operating the handles 14 or the like of the power-assisted rollator 10. Further, when it is determined that a user is not operating the power-assisted rollator 10 and has let go of the handles 14 (a both hands-off state), the control unit 16 controls the motors 20 (brake units) to brake the rear wheels 13. The following describes, as an example, a case where based on a signal sent from the speed sensor 22, the control unit 16 calculates rotational acceleration of the rear wheels 13, and based on a change in the rotational acceleration, the control unit 16 determines whether a user is operating the power-assisted rollator 10.

**[0041]** (Control Method by the Control Unit) Next, a method of controlling the power-assisted rollator 10 by the control unit 16 will be described. Fig. 2 is a flowchart for explaining one example of an operation of the control unit 16.

**[0042]** First, it is assumed that the control unit 16 is implementing an assist control mode (Step S11 in Fig. 2). In this case, rotation of the rear wheels 13 of the power-assisted rollator 10 is assisted by the motors 20, and the motors 20 are driven to generate a force to offset a deficiency of an operating force of a user.

**[0043]** Subsequently, the control unit 16 determines whether the user is operating the handles 14 or the like of the power-assisted rollator 10 (Step S12 in Fig. 2).

**[0044]** Specifically, based on a signal representing a rotation speed from the speed sensor 22, the control unit 16 differentiates said rotation speed to calculate a value of rotational acceleration of the rear wheels 13. The thus calculated value of the rotational acceleration is an actual measured value of the rotational acceleration of the rear wheels 13 and corresponds to momentary acceleration before the rotational acceleration is subjected to signal processing. In Fig. 3, a solid line indicates a change in the thus calculated value of rotational acceleration of the rear wheels 13.

**[0045]** Subsequently, the control unit 16 processes a signal representing the thus calculated value of the rotational acceleration of the rear wheels 13 by passing the signal through a low-pass filter and extracts only a low-frequency component of the signal of the rotational acceleration. The low-frequency component thus extracted corresponds to an average or chronological change in the rotational acceleration of the rear wheels 13. In Fig. 3, a broken line indicates the thus determined low-frequency component of the rotational acceleration of the rear wheels 13. It may also be possible that the control unit 16 performs signal processing by determining a moving average of a signal representing rotational acceleration of the rear wheels 13. In this case, it may also be possible that a low-frequency component of the rotational acceleration of the rear wheels 13 is calculated from a moving average of an actual measured value of the rotational acceleration.

**[0046]** Next, the control unit 16 calculates, as a high-frequency component (vibration component) of the rotational acceleration, a mean square of a difference between the actual measured value of the rotational acceleration (the momentary acceleration, the solid line in Fig. 3) and the low-frequency component thereof (the average or chronological acceleration, the broken line in Fig. 3). In Fig. 3, an area of each diagonally shaded region represents the difference (a value of the high-frequency component before being squared) between the actual measured value of the rotational acceleration and the low-frequency component thereof. It may also be possible that a value of the high-frequency component of the rotational acceleration is determined as an absolute value of the difference between the actual measured value of the rotational acceleration and the low-frequency component thereof.

**[0047]** Herein, typically, when a user is operating the handles 14 or the like of the power-assisted rollator 10, rotational acceleration of the rear wheels 13 is likely to momentarily change (increase/decrease) as the user walks. For this reason, when a user is operating the power-assisted rollator 10, the actual measured value of the rotational acceleration (the solid line in Fig. 3) is likely to deviate from the low-frequency component of the rotational acceleration (the broken line in Fig. 3).

**[0048]** On the other hand, when a user has let go of the handles 14 or the like of the power-assisted rollator 10 and thus the power-assisted rollator 10 is freely running down an inclined surface or the like, the rotational acceleration of the rear wheels 13 has a substantially constant value. For this reason, when a user has let go of the power-assisted rollator 10, the actual measured value of the rotational acceleration (the solid line in Fig. 3) tends to approximate to the low-frequency component of the rotational acceleration (the broken line in Fig. 3). Accordingly, by determining how much the actual measured value of the rotational acceleration deviates from the low-frequency component of the rotational acceleration, it can be determined whether a user has let go of the power-assisted rollator 10.

**[0049]** Specifically, as described above, the control unit 16 determines, as the high-frequency component, a mean square of a difference between the actual measured value of the rotational acceleration and the low-frequency component thereof, and determines whether a

value of the high-frequency component per unit time is larger than a predetermined threshold value. Then, when the value of the high-frequency component is smaller than the predetermined threshold value, the control unit 16 determines that a user is not operating the power-assisted rollator 10 and has let go of the handles 14. In this case, the control unit 16 controls the motors (brake units) 20 to serve as, for example, power-generating brakes and thus brakes the rear wheels 13 (Step S13 in Fig. 2). With this configuration, the power-assisted rollator 10 can be prevented from accidentally moving when a user is not operating the power-assisted rollator 10. In a possible case, a value of the high-frequency component temporarily becomes smaller than the predetermined threshold value due to, for example, a vibration applied to the power-assisted rollator 10 while being operated. At this time, in order to prevent the rear wheels 13 from being braked based on erroneous sensing that "a user is not operating the power-assisted rollator 10", it may also be possible that when a value of the high-frequency component has been smaller than the predetermined threshold value for a given time or longer, it is determined that "a user is not operating the power-assisted rollator 10".

**[0050]** On the other hand, when a value of the high-frequency component per unit time is larger than the predetermined threshold value, the control unit 16 determines that a user is operating the power-assisted rollator 10 and walking while gripping the handles 14. In this case, the control unit 16 continues to assist movement of the rear wheels 13 via the motors 20 without braking the rear wheels 13.

**[0051]** The control unit 16 repeats the above-described process until a main power supply of the power-assisted rollator 10 is turned off. In this manner, the control unit 16 can determine whether a user is operating the power-assisted rollator 10.

**[0052]** In addition to the above or as an alternative to the above, the control unit 16 may optionally perform the following control. It may also be possible that the following control steps (1) to (4) are performed individually, or a plurality of steps among the following control steps (1) to (4) are performed in combination.

(1) When the inclination sensor 23 has sensed that the power-assisted rollator 10 is on a downward inclined surface and a value of a high-frequency component of rotational acceleration of the rear wheels 13 is smaller than a predetermined threshold value, it is determined that a user has let go of the handles 14 or the like of the power-assisted rollator 10 on the downward inclined surface. In this case, the control unit 16 brakes the rear wheels 13 as described above, and in a possible case, at a moment when the rear wheels 13 are braked, the rotational acceleration of the rear wheels 13 abruptly changes, causing a momentary increase in the high-frequency component. In this case, the control unit 16 might erroneously determine that the user has operated the power-assisted rollator 10. Accordingly, it may also be possible that, after a start of braking the rear wheels 13, during a time in which an actual measured value of the rotational acceleration of the rear wheels 13 is zero or a negative value, regardless of a value of the high-frequency component, the control unit 16 continues to brake the rear wheels 13.

(2) In a case where a signal representing rotational acceleration of the rear wheels 13 is processed by being passed through a low-pass filter, when an actual measured value of the rotational acceleration immediately therebefore is large, even if a user actually lets go of the handles 14, it might take time for a value of a high-frequency component of the rotational acceleration to decrease to the threshold value or lower. In this case, it takes a longer time to brake the rear wheels 13 to stop the power-assisted rollator 10. To avoid this, it may also be possible that when an actual measured value of rotational acceleration exceeds a predetermined upper limit value, the control unit 16 processes a signal representing the rotational acceleration by using a low-pass filter on an assumption that the rotational acceleration is equal to the upper limit value. With this configuration, even when an actual measured value of rotational acceleration momentarily increases, it is possible to reduce a time taken to brake the rear wheels 13 after a user has let go of the handles 14.

(3) Typically, when walking, a human moves his left and right legs alternately, so that rotational acceleration of the rear wheels 13 changes as the user moves his/her legs. Based on this, it is conceivable that when there is no change in acceleration for a time longer than a walking cycle, the human is not operating the power-assisted rollator 10. There are various methods of observing a cyclic variation in acceleration. A simple way of determining a cycle of this variation is to determine whether the acceleration has exceeded a threshold value. It may also be possible that when rotational acceleration of the rear wheels 13 is smaller than a predetermined positive threshold value, it is determined that a user has let go of the handles 14 or the like of the power-assisted rollator 10. In this case, the control unit 16 can be effectively prevented from erroneously sensing acceleration based on an output of the motors 20 as acceleration based on an operation by a user, thus erroneously determining that the user has let go of the handles 14. Furthermore, it may also be possible that when rotational acceleration of the rear wheels 13 is larger than a predetermined negative threshold value, it is determined that a user has let go of the handles 14 or the like of the power-assisted rollator 10. In this case, the control unit 16 can be effectively prevented from erroneously sensing downward

movement of the power-assisted rollator 10 due to gravity as downward movement thereof based on an operation by a user, thus erroneously determining that the user has let go of the handles 14. Moreover, this determination may be made based on both of the positive threshold value and the negative threshold value. Furthermore, it may also be possible that when an absolute value of rotational acceleration of the rear wheels 13 is not more than a threshold value, a time is counted up (a duration in which the absolute value of the rotational acceleration continues to be not more than the threshold value is measured), and in a case where the time thus counted up exceeds a given amount, it is determined that a user has let go of the handles 14 or the like of the power-assisted rollator 10.

(4) As rotational acceleration of the rear wheels 13, a sum of the respective values of the rotational acceleration of the left and right rear wheels 13 may be used. Alternatively, the following configuration may also be adopted. That is, in a case where a determination is made for each of the left and right rear wheels 13, and both of the respective values of a high-frequency component of the left and right rear wheels 13 are smaller than the predetermined threshold value (an AND condition) or either one of the respective values of the high-frequency component of the left and right rear wheels 13 is smaller than the predetermined threshold value (an OR condition), it is determined that a user has let go of the handles 14 or the like of the power-assisted rollator 10.

**[0053]** As discussed above, according to the embodiment, based on a change in rotational acceleration of the rear wheels 13, the control unit 16 determines whether a user is operating the power-assisted rollator 10. With this configuration, without the need to provide a grip sensor or the like on the handles 14, it can be determined whether a user is operating the power-assisted rollator 10. Thus, it is possible to prevent a trouble that the power-assisted rollator 10 accidentally moves when a user has let go of the handles 14. Furthermore, it is also possible to prevent a cost increase of the power-assisted rollator 10 caused by mounting a grip sensor on the handles 14. Moreover, since a grip sensor or the like is not provided on the handles 14, there is also no need to dispose wiring of the grip sensor or the like around the handles 14. Particularly in a case where the handles 14 are formed to be height-adjustable, it is no longer needed to lay out wiring in a movable portion used for height adjustment, and thus the movable portion can be structurally simplified.

**[0054]** Furthermore, according to the embodiment, the control unit 16 processes a signal representing rotational acceleration of the rear wheels 13. When a high-frequency component of the rotational acceleration is smaller than a predetermined threshold value, the control unit 16 determines that a user is not operating the power-assisted rollator 10. With this configuration, without the need to provide a grip sensor or the like on the handles 14, it can be determined with high accuracy whether a user is operating the power-assisted rollator 10.

**[0055]** Furthermore, according to the embodiment, when rotational acceleration of the rear wheels 13 exceeds a predetermined upper limit value, a signal representing the rotational acceleration is processed on an assumption that the rotational acceleration is equal to the upper limit value. With this configuration, even when an actual measured value of rotational acceleration momentarily increases, it is possible to reduce a time taken to brake the rear wheels 13 after a user has let go of the handles 14.

**[0056]** Furthermore, according to the embodiment, upon determining that a user is not operating the power-assisted rollator 10, the control unit 16 controls the motors 20 to brake the rear wheels 13. With this configuration, even when, for example, a user has let go of the handles 14 on an inclined surface such as a slope, there is no fear that the power-assisted rollator 10 moves unintentionally.

**[0057]** Furthermore, according to the embodiment, after a start of braking the rear wheels 13, during a time in which rotational acceleration of the rear wheels 13 is zero or negative, the rear wheels 13 continue to be braked. With this configuration, the control unit 16 is prevented from erroneously determining that the power-assisted rollator 10 is operated by a user.

**[0058]** Furthermore, according to the embodiment, based on a signal from the speed sensor 22, the control unit 16 calculates rotational acceleration of the rear wheels 13. In this case, by using the speed sensor 22 provided beforehand in each of the rear wheels 13, the control unit 16 can determine whether a user is operating the power-assisted rollator 10. With this configuration, without the need to provide a grip sensor or the like on the handles 14, it can be determined whether a user is operating the power-assisted rollator 10.

**[0059]** While the foregoing embodiment has described, as an example, a case where the control unit 16 controls the motors (brake units) 20 to brake the pair of rear wheels 13, there is no limitation thereto, and it may also be possible to brake the rear wheels 13 and/or the front wheels 12. Furthermore, while the embodiment has been described as including the pair of rear wheels (wheels) 13 as an example, there is no limitation thereto, and it may also be possible to use any endless track such as a loop of track shoes or a caterpillar that forms a belt surrounding a drive wheel, a track roller, and an idling wheel (idle wheel).

**[0060]** (Variations of Control Method in the Embodiment) Next, variations of the method of controlling the motors 20 by the control unit 16 in the embodiment will be described. Control methods according to the variations described below may be performed in parallel with the control method according to the embodiment de-

scribed above or independently of the above-described control method. Furthermore, only one of the following variations may be performed or a plurality of variations among the following variations may be performed in combination.

**[0061]** (Variation 1 of Control Method) It may also be possible that when the inclination sensor 23 has sensed that the power-assisted rollator 10 is on an upward inclined surface and the rear wheels 13 are rotating backward, the control unit 16 determines that a user is not operating the power-assisted rollator 10. In this specification, the term "upward" refers to ascending from a lower position to a higher position with respect to a traveling direction of the power-assisted rollator 10, and the term "downward" refers to descending from a higher position to a lower position with respect to the traveling direction of the power-assisted rollator 10.

**[0062]** In this case, first, the control unit 16 is implementing an assist control mode (Step S21 in Fig. 4). During this time, rotation of the rear wheels 13 of the power-assisted rollator 10 is assisted by the motors 20.

**[0063]** Subsequently, based on a signal from the inclination sensor 23, the control unit 16 determines whether the power-assisted rollator 10 is positioned on an upward inclined surface (Step S22 in Fig. 4). Specifically, based on a measured value obtained by the inclination sensor 23, the control unit 16 determines whether the power-assisted rollator 10 is positioned on an upward inclined surface inclined at a predetermined angle or more.

**[0064]** In a case where the power-assisted rollator 10 is positioned on an upward inclined surface, as a next step, the control unit 16 determines whether a user is operating the handles 14 or the like of the power-assisted rollator 10 (Step S23 in Fig. 4).

**[0065]** Specifically, based on a signal representing a rotation speed from the speed sensor 22, the control unit 16 senses whether the rear wheels 13 have been rotating backward for a predetermined determination time or longer. In the case where the power-assisted rollator 10 is positioned on an upward inclined surface, if braking of the rear wheels 13 is delayed, the power-assisted rollator 10 might run down toward a user who is behind it and scare the user. For this reason, preferably, the above-described determination time is set to be shorter compared with a case where it is determined whether a user is operating the handles 14 on a flat surface.

**[0066]** Herein, typically, it is conceivable that when a user is operating the handles 14 or the like of the power-assisted rollator 10 on an upward inclined surface, the rear wheels 13 are rotating forward or stationary. On the other hand, it is conceivable that when a user is not operating the handles 14 or the like of the power-assisted rollator 10, on an upward inclined surface, the rear wheels 13 rotate backward (see Fig. 5).

**[0067]** Accordingly, when the power-assisted rollator 10 is on an upward inclined surface and the rear wheels 13 are rotating backward, it can be determined that a user is not operating (has let go of) the power-assisted rollator 10. In this case, the control unit 16 controls the motors (brake units) 20 to serve as, for example, power-generating brakes and thus brakes the rear wheels 13 (Step S24 in Fig. 4). With this configuration, the power-assisted rollator 10 can be prevented from accidentally moving when a user is not operating the power-assisted rollator 10 on an upward inclined surface.

**[0068]** (Variation 2 of Control Method) The following configuration may also be adopted. That is, when the inclination sensor 23 has determined that the power-assisted rollator 10 is positioned on a laterally inclined surface, and one of the pair of rear wheels 13 which is positioned at an upper side on the inclined surface is stationary or rotating forward, while the other of the pair of rear wheels 13 which is positioned at a lower side on the inclined surface is stationary or rotating backward, the control unit 16 determines that a user is not operating the power-assisted rollator 10.

**[0069]** That is, first, the control unit 16 is implementing an assist control mode (Step S31 in Fig. 6). In this case, rotation of the rear wheels 13 of the power-assisted rollator 10 is assisted by the motors 20.

**[0070]** Subsequently, based on a signal from the inclination sensor 23, the control unit 16 determines whether the power-assisted rollator 10 is positioned on a laterally inclined surface (Step S32 in Fig. 6). Specifically, based on a measured value obtained by the inclination sensor 23, the control unit 16 determines whether the power-assisted rollator 10 is positioned on a laterally inclined surface inclined at a predetermined angle or more.

**[0071]** In a case where the power-assisted rollator 10 is positioned on a laterally inclined surface, the control unit 16 determines whether a user is operating the handles 14 or the like of the power-assisted rollator 10 (Step S33 in Fig. 6).

**[0072]** Specifically, based on a signal representing a rotation speed from the speed sensor 22, the control unit 16 senses whether each of the left and right rear wheels 13 is rotating forward or backward or is stationary. In this case, the speed sensor 22 measures the respective values of a rotation speed of the left and right rear wheels 13 independently of each other and transmits each of the respective values of the rotation speed in the form of a signal to the control unit 16.

**[0073]** Herein, typically, it is conceivable that when a user is operating the handles 14 or the like of the power-assisted rollator 10 on a laterally inclined surface, both of the rear wheels 13 are stationary or rotate forward. On the other hand, it is conceivable that when a user is not operating the handles 14 or the like of the power-assisted rollator 10 on a laterally inclined surface, one of the rear wheels 13 which is positioned at an upper side is stationary or rotates forward, while the other of the rear wheels 13 which is positioned at a lower side is stationary or rotates backward (see Fig. 7). This is because the power-assisted rollator 10 moves downward, starting from the front wheels 12, which are universal wheels.

**[0074]** Accordingly, when the power-assisted rollator

10 is on a laterally inclined surface, and one of the rear wheels 13 which is positioned at an upper side has been stationary or rotating forward for a predetermined determination time or longer, while the other of the rear wheels 13 which is positioned at a lower side has been stationary or rotating backward for the predetermined determination time or longer, it can be determined that a user is not operating the power-assisted rollator 10. In this case, the control unit 16 controls the motors (brake units) 20 to serve as, for example, power-generating brakes and thus brakes the rear wheels 13 (Step S34 in Fig. 6). With this configuration, the power-assisted rollator 10 can be prevented from accidentally moving when a user is not operating the power-assisted rollator 10 on a laterally inclined surface. In a case where the power-assisted rollator 10 is positioned on a laterally inclined surface, if braking of the rear wheels 13 is delayed, the power-assisted rollator 10 starts to rotate, causing the rotatable wheels (front wheels 12) to tilt. As a result, even when the rear wheels 13 are braked later on, a holding force generated thereby might not be sufficient to hold the power-assisted rollator 10, which, therefore, continues to tilt. For this reason, preferably, the above-described determination time is set to be shorter compared with a case where it is determined whether a user is operating the handles 14 on a flat surface. With this configuration, the rear wheels 13 can be braked at early timing before the power-assisted rollator 10 starts to rotate on a laterally inclined surface.

**[0075]** In a case where, while the rear wheels 13 have been braked in this manner, a speed at which one of the rear wheels 13 which is positioned at an upper side on an inclined surface rotates forward has reached a predetermined value or higher, it can be conceived that a user is trying to turn the power-assisted rollator 10. Accordingly, in the case where a speed at which one of the rear wheels 13 which is positioned at an upper side on an inclined surface rotates forward has reached a predetermined value or higher, the control unit 16 may release braking of the rear wheels 13.

**[0076]** As another variation, in a case where the rear wheels 13 are formed to be universal wheels and rotation of the front wheels 12 is sensed, the rear wheels 13, which are the universal wheels, move downward. Thus, it is conceivable that when a user is not operating the handles 14 or the like of the power-assisted rollator 10, one of the front wheels 12 which is positioned at an upper side is stationary or rotates backward, while the other of the front wheels 12 which is positioned at a lower side is stationary or rotates forward. In this case, when one of the rear wheels 13 which is positioned at an upper side is stationary or rotating backward, while the other of the rear wheels 13 which is positioned at a lower side is stationary or rotating forward, the control unit 16 determines that a user is not operating the power-assisted rollator 10, and thus brakes the rear wheels 13.

**[0077]** Furthermore, while in the above description, rotation of the front wheels 12 and/or the rear wheels 13 is sensed, it is also possible to perform similar control by using an inclination sensor such as the inclination sensor 23 or a gyrosensor to sense a rotational movement of a vehicle body of the power-assisted rollator 10.

**[0078]** (Variation of Constituent Elements of Power-Assisted Rollator) Next, a variation of the constituent elements of the power-assisted rollator 10 will be described. While the embodiment has been described as including the pair of rear wheels (wheels) 13 as an example, there is no limitation thereto, and it may also be possible to use any endless track such as a loop of track shoes or a caterpillar that forms a belt surrounding a drive wheel, a track roller, and an idling wheel (idle wheel).

## LIST OF REFERENCE NUMBERS

**[0079]**

| | |
|---|---|
| 10 | power-assisted rollator |
| 11 | frame |
| 12 | front wheel |
| 13 | rear wheel |
| 14 | handle |
| 16 | control unit |
| 20 | motor (brake unit) |
| 21 | battery |
| 22 | speed sensor |
| 23 | inclination sensor |

## Claims

1. An electric vehicle (10) provided with a wheel (13) or an endless track, comprising:

   a brake unit (20) for braking the wheel (13) or the endless track,
   **characterized by** further comprising:
   a control unit (16) for determining that a user is not operating the electric vehicle (10), when an amount of change in acceleration of the electric vehicle (10) is smaller than a predetermined threshold value, and controlling the brake unit (20) based on a result of the determination.

2. The electric vehicle (10) according to claim 1, wherein when the acceleration exceeds a predetermined upper limit value, the control unit (16) assumes that the acceleration is equal to the upper limit value.

3. The electric vehicle (10) according to claim 1, wherein when the acceleration is smaller than a predetermined positive threshold value and/or larger than a predetermined negative threshold value, the control unit (16) determines that the user is not operating the electric vehicle (10).

4. The electric vehicle (10) according to any one of

claims 1 to 3, wherein upon determining that the user is not operating the electric vehicle (10), the control unit (16) controls the brake unit (20) to brake the wheel (13) or the endless track.

**5.** The electric vehicle (10) according to claim 4, wherein after a start of braking the wheel (13) or the endless track, during a time in which the acceleration of the electric vehicle (10) is zero or negative, the control unit (16) continues to brake the wheel (13) or the endless track.

**6.** The electric vehicle (10) according to any one of claims 1 to 5, further comprising:

a speed sensor (22) for sensing a rotation speed of the wheel (13) or the endless track,
wherein the control unit (16) calculates acceleration of the electric vehicle (10) based on a signal from the speed sensor (22).

**7.** The electric vehicle (10) according to any one of claims 1 to 5, further comprising:

an inclination sensor (23) for sensing an inclination of the electric vehicle (10),
wherein when the inclination sensor (23) has determined that the electric vehicle (10) is positioned on an upward inclined surface and the wheel (13) or the endless track is rotating backward, the control unit (16) determines that the user is not operating the electric vehicle (10).

**8.** The electric vehicle (10) according to any one of claims 1 to 6, further comprising:

an inclination sensor (23) for sensing an inclination of the electric vehicle (10),
wherein the wheel (13) or the endless track comprises a left-right pair of wheels (13) or endless tracks, and
when the inclination sensor (23) has determined that the electric vehicle (10) is positioned on a laterally inclined surface, and one of the left-right pair of wheels (13) or endless tracks which is positioned at one of an upper side and a lower side on the inclined surface is stationary or rotating forward, while the other of the left-right pair of wheels (13) or endless tracks which is positioned at the other of the upper side and the lower side on the inclined surface is stationary or rotating backward, the control unit (16) determines that the user is not operating the electric vehicle (10).

**9.** A method of braking an electric vehicle (10) provided with a wheel (13) or an endless track, **characterized by** comprising a step of:

determining that a user is not operating the electric vehicle (10), when an amount of change in acceleration of the electric vehicle (10) is smaller than a predetermined threshold value, and braking the wheel (13) or the endless track based on a result of the determination.

**Patentansprüche**

**1.** Elektrofahrzeug (10), das mit einem Rad (13) oder einer Endlos-Laufkette versehen ist, wobei es umfasst:

eine Brems-Einheit (20) zum Bremsen des Rades (13) oder der Endlos-Laufkette,
**dadurch gekennzeichnet, dass** es des Weiteren umfasst:
eine Steuerungs-Einheit (16), mit der festgestellt wird, dass ein Benutzer das Elektrofahrzeug (10) nicht betätigt, wenn ein Maß der Änderung der Beschleunigung des Elektrofahrzeugs (10) unter einem vorgegebenen Schwellenwert liegt, und die Brems-Einheit (20) auf Basis eines Ergebnisses der Feststellung gesteuert wird.

**2.** Elektrofahrzeug (10) nach Anspruch 1, wobei, wenn die Beschleunigung einen vorgegebenen oberen Grenzwert überschreitet, die Steuerungs-Einheit (16) annimmt, dass die Beschleunigung dem oberen Grenzwert gleich ist.

**3.** Elektrofahrzeug (10) nach Anspruch 1, wobei, wenn die Beschleunigung unter einem vorgegebenen positiven Schwellenwert und/oder über einem vorgegebenen negativen Schwellenwert liegt, die Steuerungs-Einheit (16) feststellt, dass der Benutzer das Elektrofahrzeug (10) nicht betätigt.

**4.** Elektrofahrzeug (10) nach einem der Ansprüche 1 bis 3, wobei, wenn festgestellt wird, dass der Benutzer das Elektrofahrzeug (10) nicht betätigt, die Steuerungs-Einheit (16) die Brems-Einheit (20) steuert, um das Rad (13) oder die Endlos-Laufkette zu bremsen.

**5.** Elektrofahrzeug (10) nach Anspruch 4, wobei nach einem Beginn des Bremsens des Rades (13) oder der Endlos-Laufkette während eines Zeitraums, in dem die Beschleunigung des Elektrofahrzeugs (10) Null beträgt oder negativ ist, die Steuerungs-Einheit (16) das Rad (13) oder die Endlos-Laufkette weiter bremst.

**6.** Elektrofahrzeug (10) nach einem der Ansprüche 1 bis 5, das des Weiteren umfasst:

einen Geschwindigkeits-Sensor (22) zum Erfassen einer Drehgeschwindigkeit des Rades (13) oder der Endlos-Laufkette,
wobei die Steuerungs-Einheit (16) Beschleunigung des Elektrofahrzeugs (10) auf Basis eines Signals von dem Geschwindigkeits-Sensor (22) berechnet.

**7.** Elektrofahrzeug (10) nach einem der Ansprüche 1 bis 5, das des Weiteren umfasst:

einen Neigungs-Sensor (23) zum Erfassen einer Neigung des Elektrofahrzeugs (10), wobei, wenn der Neigungs-Sensor (23) festgestellt hat, dass sich das Elektrofahrzeug (10) an einer nach oben geneigten Fläche befindet und sich das Rad (13) oder die Endlos-Laufkette rückwärts dreht, die Steuerungs-Einheit (16) feststellt, dass der Benutzer das Elektrofahrzeug (10) nicht betätigt.

**8.** Elektrofahrzeug (10) nach einem der Ansprüche 1 bis 6, das des Weiteren umfasst:

einen Neigungs-Sensor (23) zum Erfassen einer Neigung des Elektrofahrzeugs (10),
wobei das Rad (13) oder die Endlos-Laufkette ein Links-Rechts-Paar von Rädern (13) oder Endlos-Laufketten umfasst, und
wenn der Neigungs-Sensor (23) festgestellt hat, dass sich das Elektrofahrzeug (10) an einer seitlich geneigten Fläche befindet und eines/eine von dem Links-Rechts-Paar von Rädern (13) oder Endlos-Laufketten, das/die sich an einer oberen Seite oder einer unteren Seite an der geneigten Fläche befindet, stationär ist oder sich vorwärts dreht, während das/die andere von dem Links-Rechts-Paar von Rädern (13) oder Endlos-Laufketten, das/die sich an der anderen von der oberen und der unteren Seite an der geneigten Fläche befindet, stationär ist oder sich rückwärts dreht, die Steuerungs-Einheit (16) feststellt, dass der Benutzer das Elektrofahrzeug (10) nicht betätigt.

**9.** Verfahren zum Bremsen eines Elektrofahrzeugs (10), das mit einem Rad (13) oder einer Endlos-Laufkette versehen ist, **dadurch gekennzeichnet, dass** es umfasst:
Feststellen, dass ein Benutzer das Elektrofahrzeug (10) nicht betätigt, wenn ein Maß der Änderung der Beschleunigung des Elektrofahrzeugs (10) unter einem vorgegebenen Schwellenwert liegt, und Bremsen des Rades (13) oder der Endlos-Laufkette auf Basis eines Ergebnisses der Feststellung.

**Revendications**

**1.** Véhicule électrique (10) prévu avec une roue (13) ou une chenille sans fin, comprenant :

une unité de frein (20) pour freiner la roue (13) ou la chenille sans fin,
**caractérisé en ce qu'**il comprend en outre :
une unité de commande (16) pour déterminer qu'un utilisateur n'actionne pas le véhicule électrique (10), lorsqu'une quantité de changement d'accélération du véhicule électrique (10) est inférieure à une valeur de seuil prédéterminée, et pour commander l'unité de frein (20) sur la base d'un résultat de la détermination.

**2.** Véhicule électrique (10) selon la revendication 1, dans lequel lorsque l'accélération dépasse une valeur de limite supérieure prédéterminée, l'unité de commande (16) suppose que l'accélération est égale à la valeur de limite supérieure.

**3.** Véhicule électrique (10) selon la revendication 1, dans lequel lorsque l'accélération est inférieure à une valeur de seuil positive prédéterminée et/ou supérieure à une valeur de seuil négative prédéterminée, l'unité de commande (16) détermine que l'utilisateur n'actionne pas le véhicule électrique (10) .

**4.** Véhicule électrique (10) selon l'une quelconque des revendications 1 à 3, dans lequel, suite à la détermination que l'utilisateur n'actionne pas le véhicule électrique (10), l'unité de commande (16) commande l'unité de frein (20) pour freiner la roue (13) ou la chenille sans fin.

**5.** Véhicule électrique (10) selon la revendication 4, dans lequel, après un début de freinage de la roue (13) ou de la chenille sans fin, pendant un moment pendant lequel l'accélération du véhicule électrique (10) est nulle ou négative, l'unité de commande (16) continue à freiner la roue (13) ou la chenille sans fin.

**6.** Véhicule électrique (10) selon l'une quelconque des revendications 1 à 5, comprenant en outre :

un capteur de vitesse (22) pour détecter une vitesse de rotation de la roue (13) ou de la chenille sans fin,
dans lequel l'unité de commande (16) calcule une accélération du véhicule électrique (10) sur la base d'un signal provenant du capteur de vitesse (22).

**7.** Véhicule électrique (10) selon l'une quelconque des revendications 1 à 5, comprenant en outre :

un capteur d'inclinaison (23) pour détecter une

inclinaison du véhicule électrique (10),
dans lequel lorsque le capteur d'inclinaison (23) a déterminé que le véhicule électrique (10) est positionné sur une surface inclinée vers le haut et que la roue (13) ou la chenille sans fin tourne vers l'arrière, l'unité de commande (16) détermine que l'utilisateur n'actionne pas le véhicule électrique (10).

**8.** Véhicule électrique (10) selon l'une quelconque des revendications 1 à 6, comprenant en outre :

un capteur d'inclinaison (23) pour détecter une inclinaison du véhicule électrique (10),
dans lequel la roue (13) ou la chenille sans fin comprend une paire gauche - droite de roues (13) ou de chenilles sans fin, et
lorsque le capteur d'inclinaison (23) a déterminé que le véhicule électrique (10) est positionné sur une surface latéralement inclinée, et que l'une des paires droite - gauche de roues (13) ou de chenilles sans fin qui est positionnée au niveau de l'un parmi un côté supérieur et un côté inférieur sur la surface inclinée est fixe ou tourne vers l'avant, alors que l'autre de la paire gauche - droite de roues (13) ou de chenilles sans fin qui est positionnée au niveau de l'autre parmi le côté supérieur et le côté inférieur de la surface inclinée est fixe ou tourne vers l'arrière, l'unité de commande (16) détermine que l'utilisateur n'actionne pas le véhicule électrique (10).

**9.** Procédé pour freiner un véhicule électrique (10) prévu avec une roue (13) ou une chenille sans fin, **caractérisé en ce qu'**il comprend les étapes suivantes :
déterminer qu'un utilisateur n'actionne pas le véhicule électrique (10) lorsqu'une quantité de changement d'accélération du véhicule électrique (10) est inférieure à une valeur de seuil prédéterminée, et freine la roue (13) ou la chenille sans fin sur la base d'un résultat de la détermination.

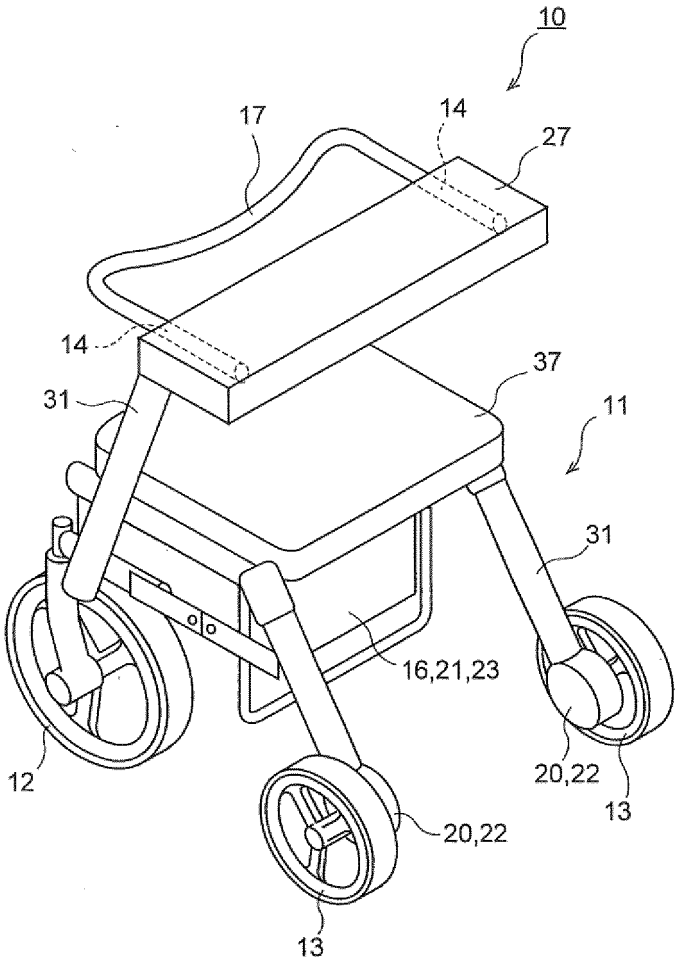



Fig. 1

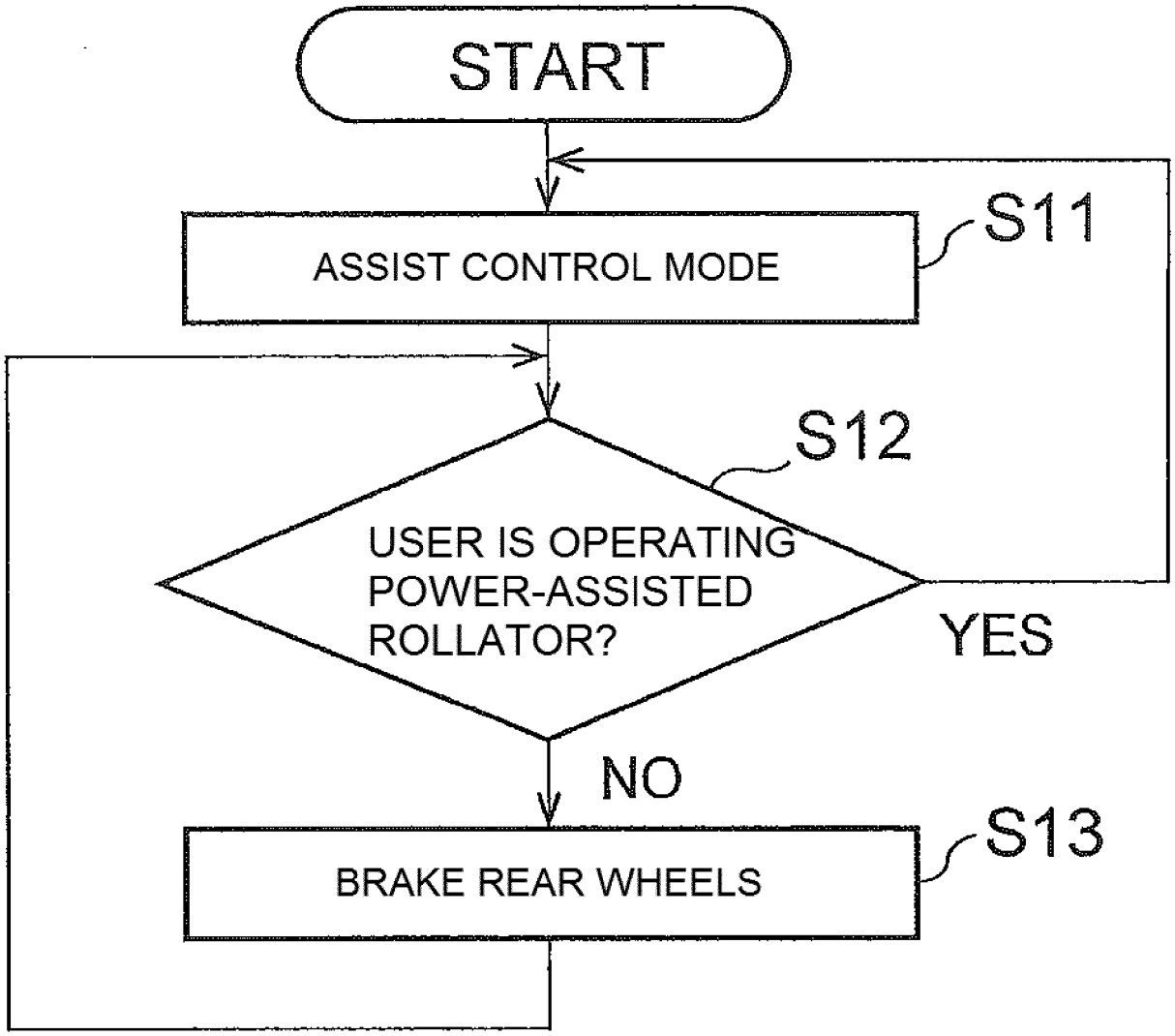

START
ASSIST CONTROL MODE
S11
S12
USER IS OPERATING POWER-ASSISTED ROLLATOR?
YES
NO
BRAKE REAR WHEELS
S13

Fig. 2

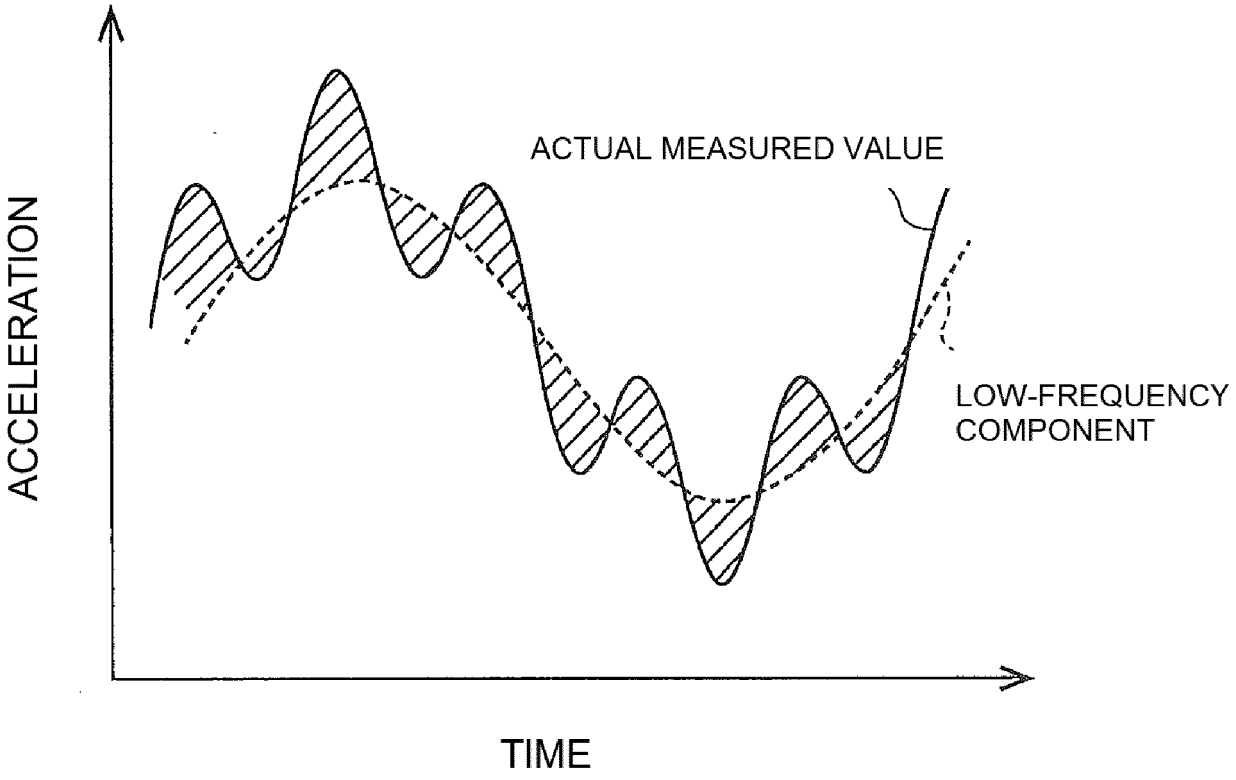

ACCELERATION
ACTUAL MEASURED VALUE
LOW-FREQUENCY
COMPONENT
TIME

Fig. 3

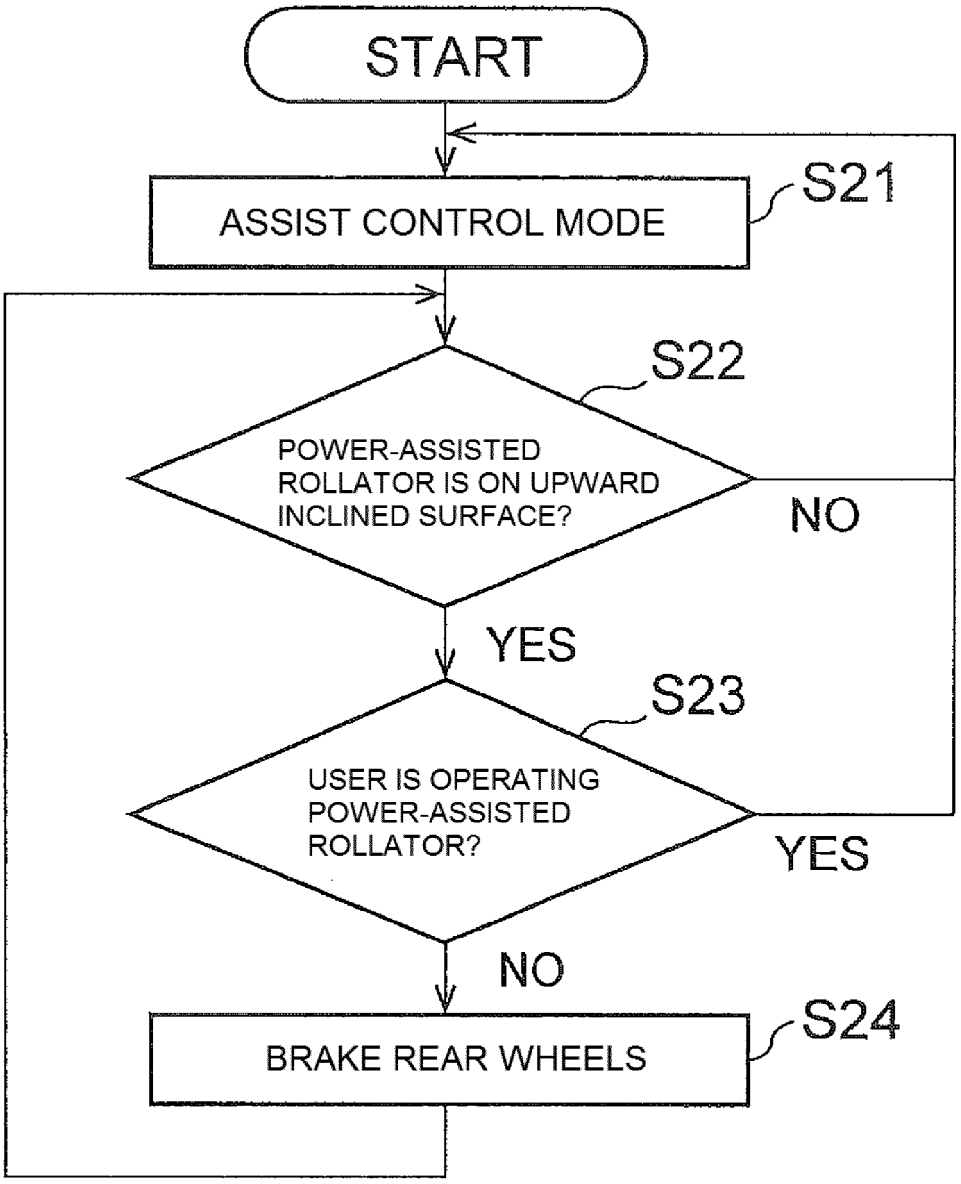

START
ASSIST CONTROL MODE
S21
S22
POWER-ASSISTED ROLLATOR IS ON UPWARD INCLINED SURFACE?
NO
YES
S23
USER IS OPERATING POWER-ASSISTED ROLLATOR?
YES
NO
BRAKE REAR WHEELS
S24

Fig. 4

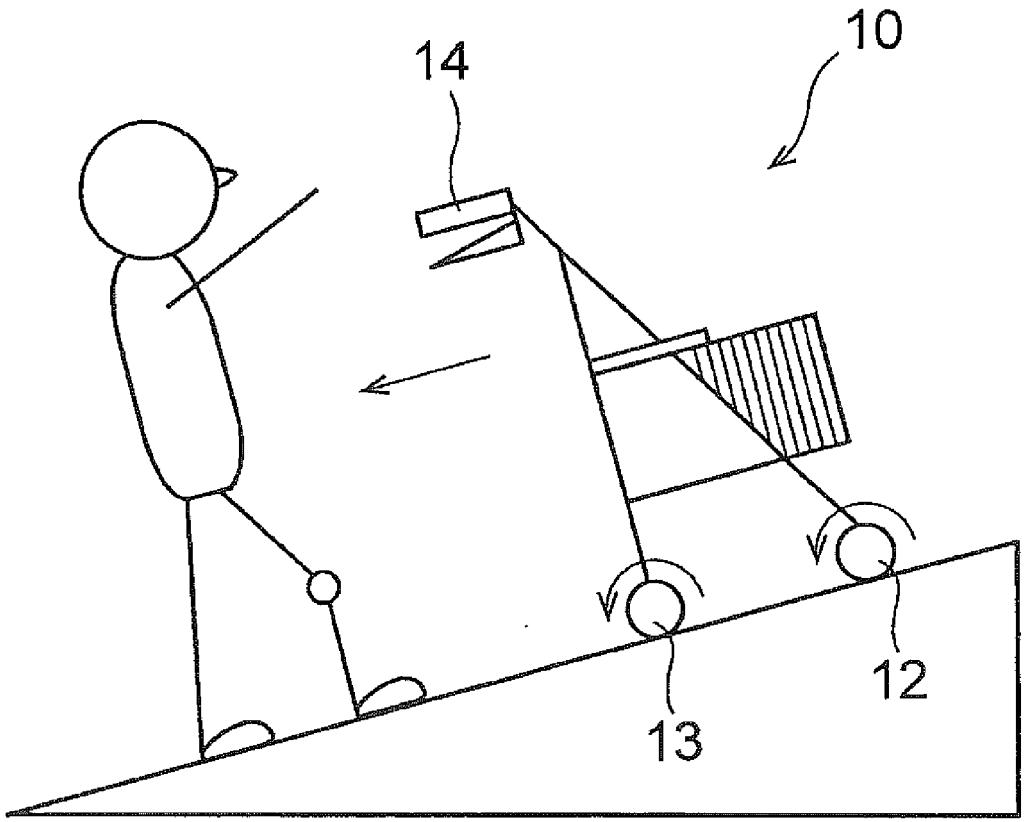



Fig. 5

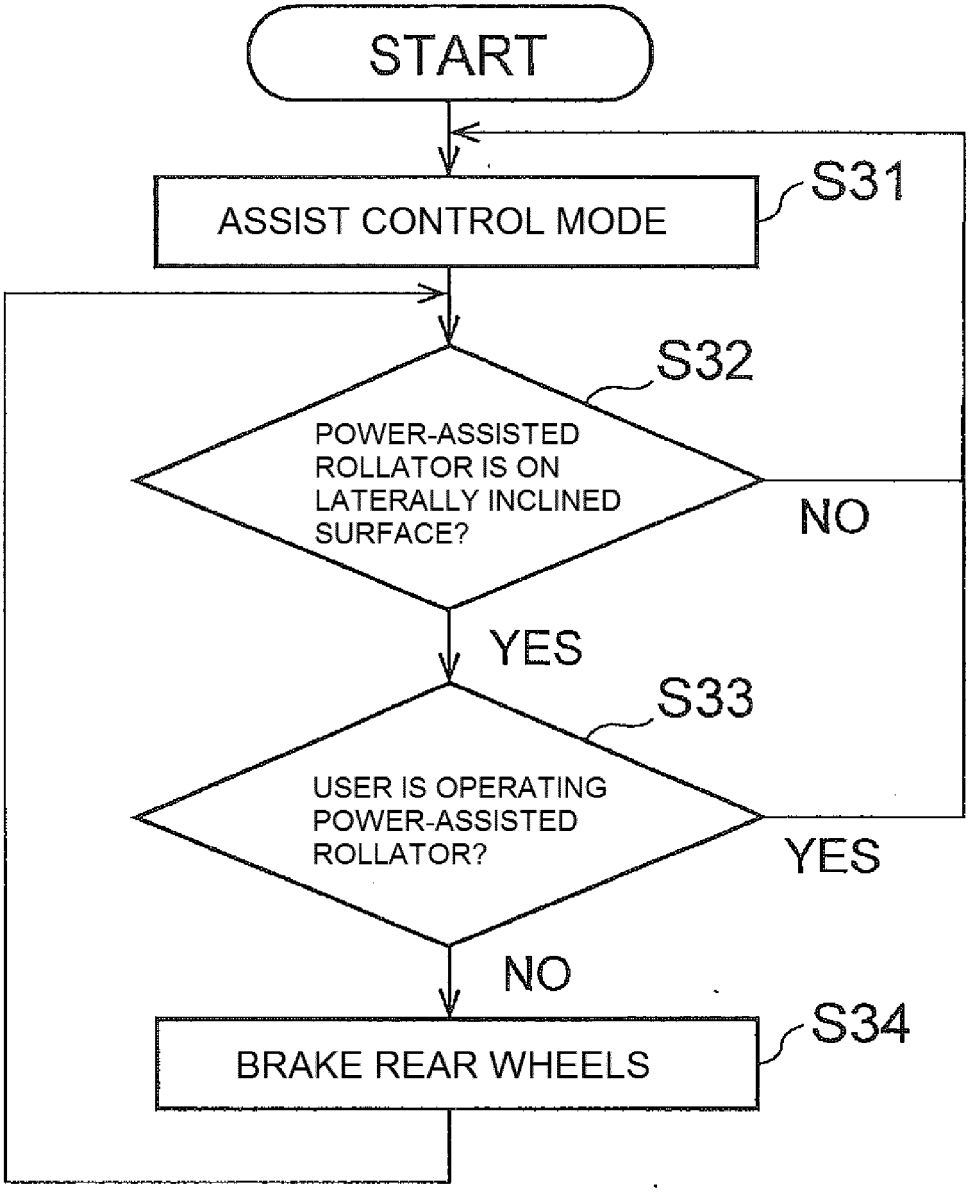

START
ASSIST CONTROL MODE
S31
S32
POWER-ASSISTED ROLLATOR IS ON LATERALLY INCLINED SURFACE?
NO
YES
S33
USER IS OPERATING POWER-ASSISTED ROLLATOR?
YES
NO
BRAKE REAR WHEELS
S34

Fig. 6

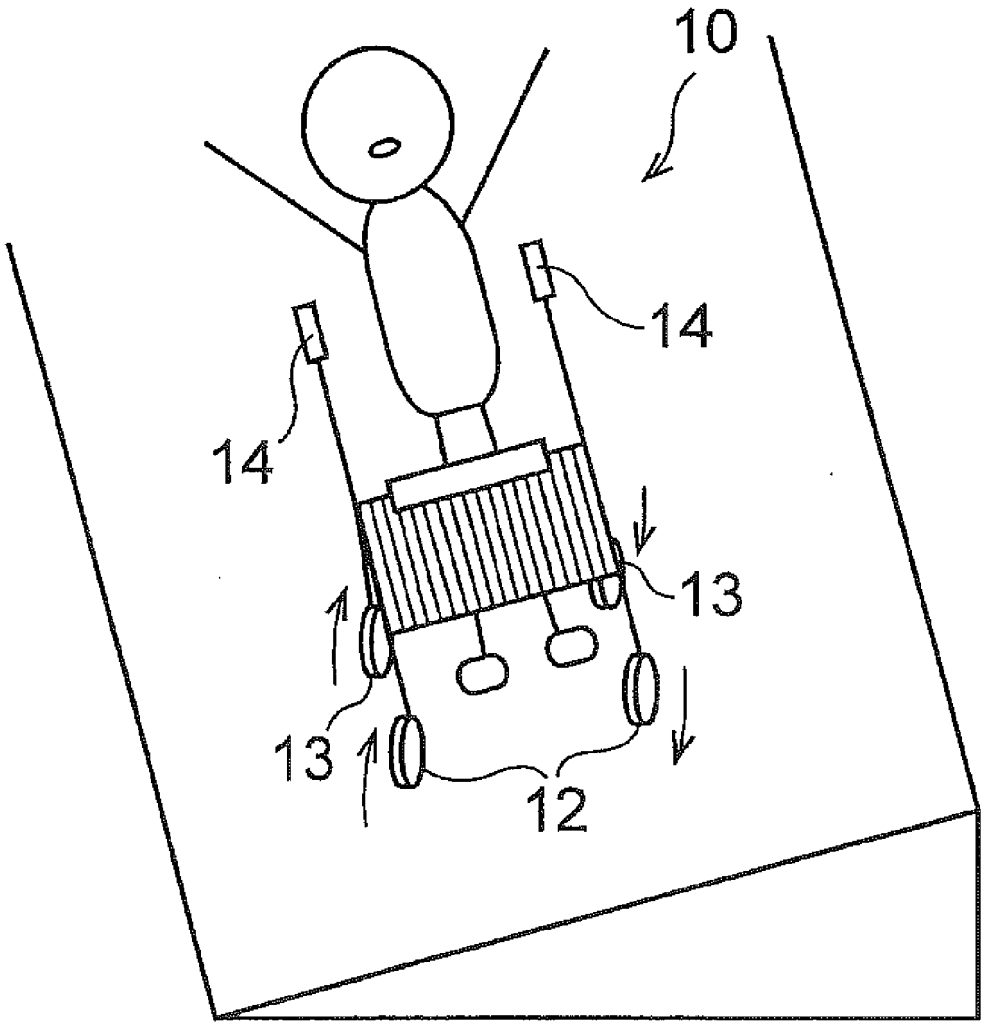



Fig. 7

## REFERENCES CITED IN THE DESCRIPTION

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

### Patent documents cited in the description


- US 2009045021 A1 **[0002] [0003] [0005]**
- JP 2009183407 A **[0002] [0004] [0005]**