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

(11) **EP 3 417 841 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.12.2019 Bulletin 2019/50

(21) Application number: **16890478.7**

(22) Date of filing: **15.02.2016**

(51) Int Cl.:
A61G 7/10 *(2006.01)*

(86) International application number:
PCT/JP2016/054342

(87) International publication number:
WO 2017/141335 (24.08.2017 Gazette 2017/34)

(54) **ASSISTANCE ROBOT**

HILFSROBOTER

ROBOT D'ASSISTANCE

(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

(43) Date of publication of application:
26.12.2018 Bulletin 2018/52

(73) Proprietor: **Fuji Corporation**
Chiryu-shi, Aichi 472-8686 (JP)

(72) Inventors:
- **HIRAOKA, Takehiro**
  Chiryu-shi, Aichi 472-8686 (JP)
- **NAKANE, Nobuyuki**
  Chiryu-shi, Aichi 472-8686 (JP)
- **NOMURA, Hideaki**
  Chiryu-shi, Aichi 472-8686 (JP)
- **ONO, Kazunari**
  Chiryu-shi, Aichi 472-8686 (JP)

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

(56) References cited:
EP-A1- 2 783 671
EP-A1- 2 954 882
WO-A1-2013/118623
WO-A1-2014/122752
JP-A- 2012 040 200
JP-A- 2012 200 406
JP-A- 2013 090 842
JP-A- 2013 158 386

EP 3 417 841 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present invention relates to an assistance robot.

Background Art

[0002] Patent literature 1 discloses an assistance robot that appropriately moves a holding member that holds the upper body of a care receiver to assist the care receiver in a standing operation and a sitting operation. With such an assistance robot, it is desirable to appropriately position the holding member so as not to cause the care receiver discomfort. The assistance robot of patent literature 1 is provided with different movement paths that each correspond to the standing operation and the sitting operation. Thus, by entering a standing operation or a sitting operation as a requested operation, the assistance robot performs control of the position of the holding member based on a movement path corresponding to the requested operation.

Citation List

Patent Literature

[0003] Patent literature 1: International publication WO2014/122752

Summary of Invention

Technical Problem

[0004] Here, the position of the upper body of the care receiver in a sitting posture varies depending on the seat height and physique of the care receiver. Therefore, the position of the holding member on the assistance robot, in addition to the movement path, is controlled based on, for example, specified values representing the seat height and the physique of the care receiver. Specifically, the holding member is moved during a sitting and standing operation along a standing and sitting path that uses as an end point a height corresponding to a set value. With such a configuration, an appropriate set value must be entered in advance. Also, the set value must be amended as appropriate in cases such as when the seat height is changed or a care receiver with a different physique is to use the assistance robot.

[0005] The present invention takes account of such problems, and an object thereof is to provide an assistance robot that assists standing and sitting operations of a care receiver in various different usage states.

Solution to Problem

[0006] An assistance robot according to claim 1 includes: a base configured to rest on a floor surface; a holding member configured to hold an upper body of a care receiver; a driving device configured to support the holding member so as to be movable in an up-down direction and a front-rear direction and to move the holding member along multiple different movement paths; and a control device configured to control operation of the driving device by executing operation processing for moving the holding member during a sitting operation of the care receiver sitting on a seat based on, among the multiple sitting paths, the sitting path corresponding to the sitting operation. The operation processing based on the sitting path includes: a retracting process for retracting the holding member and lowering or raising the holding member to a fixed sitting position at which a buttock portion of the care receiver is positioned at a specified height from the floor surface and above the seat; and a lowering process for lowering the holding member from the fixed sitting position until the care receiver is sitting on the seat.

Advantageous Effects

[0007] According to the configuration of the invention of claim 1, the holding member, when being moved based on the sitting path, is moved via the fixed sitting position. When the holding member passes the fixed sitting position, the care receiver being held by the holding member is gradually transferred to a sitting posture while being maintained in a state with their buttock portion above the seat. Accordingly, even if the seat height is not fixed, and regardless of the loading posture or physique of the care receiver, it is possible to reliably assist the care receiver to sit down. In this manner, the assistance robot is able assist a sitting operation of a care receiver for various usage situations without the need for entering in advance set values representing a seat height, a physique of the care receiver, and the like.

Brief Description of Drawings

[0008]

Fig. 1
Fig. 1 is a perspective view from the rear side of an assistance robot that is an embodiment of the present disclosure.
Fig. 2
Fig. 2 shows the configuration of the assistance robot and a care receiver in a sitting posture.
Fig. 3
Fig. 3 shows the configuration of the assistance robot and a care receiver in a standing posture.
Fig. 4
Fig. 4 is a block diagram showing a control device and controller of the assistance robot.
Fig. 5
Fig. 5 is a flowchart illustrating operation processing based on a sitting path.

Fig. 6

Fig. 6 illustrates a movement path of the holding member during the operating processing of fig. 5, and the angle of the holding member with respect to the position of the holding member.

Description of Embodiments

Embodiment

Configuration of assistance robot

[0009] Assistance robot 1 assists standing of care receiver M (shown in figs. 2 and 3) from a sitting posture to a standing posture and assists sitting from standing posture to a sitting posture. By supporting the upper body of care receiver M in a standing posture, assistance robot 1 can be maneuvered by only one caregiver such that care receiver M can be moved, for example, to a target location in a care facility. Note that, a "standing posture" means a state in which at least the lower half of care receiver M is upright; it does not necessarily refer to a state in which the upper half of care receiver M is upright.

[0010] As shown in figs. 1 and 4, assistance robot 1 is provided with base 10, supporting device 20, controller 50, and control device 60. In descriptions below, as shown in fig. 1, the front-rear, left-right, and up-down directions are as seen by care receiver M. Base 10 is configured to allow care receiver M to get on and to move in a front-rear direction and a left-right direction while care receiver M is on base 10. As shown in figs. 1 and 2, base 10 is provided with frame 11, support column 12, footrest 13, fixed cover 14, and multiple wheels 15.

[0011] Frame 11 of base 10 is positioned slightly above floor surface 2 (floor or ground) and is substantially horizontal with respect to floor surface 2. Support column 12 is fixed to frame 11 and stands upright on an upper front surface of frame 11. Support column 12 is arranged centrally in the left-right direction towards the front of frame 11. Note that, in the present embodiment, assistance robot 1 includes one support column 12, but two or more support columns 12 may be provided.

[0012] Footrest 13 is fixed to a rear upper surface of frame 11 for care receiver M to load their feet on. Contact marks 13a for the feet of care receiver M are provided on an upper surface of footrest 13. Contact marks 13a act as a foot positioning guide for care receiver M. As shown in fig. 1, fixed cover 14 is fixed to frame 11 or support column 12. Fixed cover 14 covers the range of a lower portion of raising and lowering main body 31 of raising and lowering section 30 in driving device 23, which is described later, and protects the inside of driving device 23. Multiple wheels 15 are provided on base 10 and support base 10 to be movable with respect to floor surface 2.

[0013] Supporting device 20 is provided on base 10 and is configured to support care receiver M in a standing posture (refer to fig. 3). In the present embodiment, supporting device 20 includes holding member 21, lower limb contacting section 22, and driving device 23. Holding member 21 holds the upper body of care receiver M. In the present embodiment, holding member 21 is provided with torso receiving section 21a that contacts the torso of care receiver M and underarm receiving sections 21b that support the underarms of care receiver M. Note that, holding member 21 may be provided with only one of torso receiving section 21a and underarm receiving sections 21b.

[0014] Torso receiving section 21a supports the torso of care receiver M from below. Torso receiving section 21a has a wide surface and is made of a cushion material. Torso receiving section 21a is formed to have an initial shape that matches that of a typical care receiver M, and is flexible to change shape to match the torso of each individual care receiver M. In the present embodiment, torso receiving section 21a contacts care receiver M from the chest to the abdomen.

[0015] Underarm receiving sections 21b are formed to have an arc shape and are provided on the right and left sides of torso receiving section 21a such that the arc opening faces upward. Underarm receiving sections 21b support the underarms of care receiver M from below so as to support the upper body of care receiver M. Further, underarm receiving sections 21b regulate forward and rearward movement of care receiver M by sandwiching both underarm portions of care receiver M from the front and rear. Accordingly, torso receiving section 21a and underarm receiving sections 21b regulate the shoulder position of care receiver M being held by holding member 50.

[0016] Lower limb contacting section 22 contacts a front portion (shin or knee) of the lower limbs of care receiver M in a sitting posture, thereby helping to decide the position and posture of the lower body of care receiver M in a sitting posture. In particular, the positions of the legs are decided to a certain extent. Lower limb contacting section 22 is fixed to support column 12 of base 10. Lower limb contacting section 22 is provided with two support members 22a and lower limb contacting main body 22b.

[0017] Support members 22a are L-shaped. One end of the L shape of support member 22a is fixed to support column 12, and the other end of the L shape of support member 22a is positioned to the rear of support column 12. Lower limb contacting main body 22b is fixed to the other end of support member 22a and is positioned to the rear of raising and lowering cover 33 and below oscillation support section 32. Lower limb contacting main body 22b is a portion for contacting the front of the lower limbs of care receiver M, has a wide surface, and is formed of a cushion material.

[0018] Driving device 23 supports holding member 21 to be movable with respect to the up-down direction and the front-rear direction of base 10, and moves holding member 21 along multiple different movement paths. In the present embodiment, driving device 23 includes raising and lowering section 30 and oscillating section 40.

Raising and lowering section 30 moves in the up-down direction with respect to base 10. Raising and lowering section 30 is provided with raising and lowering main body 31, oscillation support section 32, and raising and lowering cover 33.

[0019] As shown in fig. 2, raising and lowering main body 31 is formed elongated in the up-down direction. Raising and lowering main body 31 is provided on a rear surface of support column 12 to be movable linearly in the up-down direction. Raising and lowering main body 31 is guided by a guide (not shown) on the rear surface of support column 12, and is driven by a linear motion device (not shown). Raising and lowering main body 31 is enclosed by the fixed cover 14. Oscillation support section 32 is provided on an upper end side of raising and lowering main body 31 and includes oscillating shaft center 32a that is parallel to the left-right direction.

[0020] As shown in fig. 1, the raising and lowering cover 33 is fixed to raising and lowering section 30 and encloses raising and lowering main body 31 and oscillation support section 32. Further, raising and lowering cover 33 encloses support column 12 and fixed cover 14. Note that, in the present embodiment, assistance robot 1 includes one raising and lowering section 30 with respect to one support column 12. However, in a case where two or more support columns 12 are provided, a quantity of raising and lowering sections 30 may be provided corresponding to the quantity of support columns 12.

[0021] Oscillating section 40 moves holding member 21 with respect to raising and lowering section 30 in the front-rear direction of base 10, and rotates holding member 21 around an axis parallel to the left-right direction of base 10. Oscillating section 40 is provided with oscillation main body 41, arm 42, and grip 43. Oscillation main body 41 is removably attached to torso receiving section 21a of holding member 21.

[0022] Arm 40 is provided to rotate around oscillating shaft center 32a of oscillation support section 32 of raising and lowering section 30. Arm 42 is rotated by an arm driving device (not shown). When assistance robot 1 performs standing assistance, arm 42 pivots forwards from a state extending to the rear. On the other hand, when assistance robot 1 is performing sitting assistance, arm 42 pivots rearwards to a state extending to the rear.

[0023] Grip 43 is U-shaped as seen from the front-rear direction, and both ends of the U shape of grip 43 are fixed to oscillation main body 41. The center section of grip 43 is positioned to the front of torso receiving section 21a and oscillation main body 41 and is gripped by care receiver M who is being held by holding member 21. Also, grip 43 is used when a caregiver is pulling assistance robot 1 and so on.

[0024] According to the above configuration, oscillating section 40 rotates holding member 21 attached to oscillation main body 41 on the front end of arm 42 around an axis (oscillating shaft center 32a) parallel to the left-right direction of base 10. Oscillating section 40, by rotating holding member 21, oscillates holding member 21 to be at an angle regulated with respect to the position of holding member 21 in the front-rear direction.

[0025] Controller 50 is an input device for receiving inputs by an operator (caregiver or care receiver M). In the present embodiment, as shown in fig. 4, controller 50 includes standing switch 51, sitting switch 52, raising switch 53, and lowering switch 54. Standing switch 51 receives an instruction for an execution request of a standing operation for assisting care receiver M to a standing posture from the current state including the current position and current angle of holding member 21. Sitting switch 52 receives an instruction for an execution request of a sitting operation for assisting care receiver M to a sitting posture from the current state of holding member 21.

[0026] Raising switch 53 receives an instruction for an execution request for a raising operation for raising holding member 21 from the current position. Lowering switch 54 receives an instruction for an execution request for a lowering operation for lowering holding member 21 from the current position. Controller 50 is connected to control device 60 such that communication is possible, and in a case in which only one of the switches is pushed, sends the operation corresponding to the pushed switch as an operation request to control device 60.

[0027] Control device 60 controls operation of driving device 23 such that holding member 21 is lowered and raised and oscillated in accordance with the operation request sent from controller 50. Control device 60 is fixed to frame 11 of base 10 to the side of support column 12. Control device 60 includes memory section 61, path setting section 62, and driving control section 63. Memory section 61 memorizes standing operation data 71 and sitting operation data 72.

[0028] Standing operation data 71 is two-dimensional coordinate data representing standing path 81 (refer to the upper part of fig. 6) that is a movement path of holding member 21 corresponding to standing operation of a care receiver M. Sitting operation data 72 is two-dimensional coordinate data representing sitting path 82 (refer to the lower part of fig. 6) that is a movement path of holding member 21 corresponding to sitting operation of a care receiver M. The origin point of the two-dimensional coordinate data may be a given reference point in the moving range of holding member 21, or the position of the center of gravity of assistance robot 1.

[0029] Here, standing path 81 and sitting path 82 of holding member 21, for example, are paths along which a reference point of holding member 21 is moved by operation of driving device 23. Specifically, as shown in fig. 6, standing path 81 is a curved path from first position P1 to second position P2. Also, sitting path 82 is a path configured from a curved path from second position P2 to third position P3 and a straight path from third position P3 to first position P1.

[0030] Path setting section 62, in a case in which a standing operation or a sitting operation is input as an operation request, sets either of standing path 81 or sit-

ting path 82 as a reference path based on the current state of holding member 21. Driving control section 63 moves holding member 21 based on the set reference path. Specifically, driving control section 63 synchronizes operation of raising and lowering section 30 and oscillating section 40 and controls operation of driving device 23 such that holding member 21 is moved along the reference path.

[0031] According to such a configuration, control device 60, for example, in a case in which sitting switch 52 of controller 50 is pushed, controls movement of holding member 21 along standing path 81 in addition to controlling movement of holding member 21 along sitting path 82 corresponding to the requested sitting operation. Thus, performing operation processing of holding member 21 based on a movement path (standing path 81) that does not correspond to the operation request (sitting operation) is because there are cases in which it is more suitable to go back along a path until the current position depending on the usage state of assistance robot 1, and is thus for optimizing the reference path.

[0032] Also, during sitting operation of care receiver M sitting on seat 91 of chair 90, in a case in which sitting path 82 that corresponds to the operation operation via path setting section 62 is set as the reference path, driving control section 63 of control section 60 executes operation processing for moving holding member 21 based on sitting path 82 (also referred to as "operation processing based on sitting path 82") to control operation of driving device 23. Note that, control device 60 controls operation of driving device 23 while an execution instruction for the sitting operation is being input via sitting switch 52, that is, while sitting switch 52 is being pushed.

[0033] Included in operation processing based on sitting path 82 are a retracting process and a lowering process. The retracting process is for retracting holding member 32 and lowering or raising holding member 21 to fixed sitting position Pf at which buttock portion Mb of care receiver M is positioned at a specified height from floor surface 2 surface and above seat 91. In the present embodiment, fixed sitting position Pf corresponds to the above "third position P3". The specified height of fixed sitting position Pf, in a case in which seat 91 is at the maximum height that can be handled by assistance robot 1, is set to at least a height of holding member 21 at which buttock portion Mb of care receiver M contacts the seat 91.

[0034] The above "maximum height that can be handled by assistance robot 1" corresponds to the maximum value of the range of heights of seat 91 for which it is possible for a care receiver M loaded on assistance robot 1 to appropriately be assisted in sitting down. Further, in the present embodiment, the specified height of fixed sitting position Pf, in a case in which seat 91 is supposed to be at the maximum height, is set to the height of holding member 21 at which buttock portion Mb of care receiver M contacts the seat 91. Also, the position of fixed sitting position Pf in the front-rear direction, in the present embodiment, is set at the rear end of the moving range of holding member 21 in accordance with operation of oscillating section 40.

[0035] According to such a configuration, holding member 21 is retracted in the retracting process by being lowering or raised from the current position. Note that, in a case in which the current height of holding member 21 matches the specified height of fixed sitting position Pf, holding member 21 is retracted in the retracting process while maintaining the current height. Also, the movement path from the current position of holding member 21 to fixed sitting position Pf is appropriately corrected such that care receiver M does not feel discomfort when moving, for example, is set as a smooth arc. Accordingly, in the retracting process, holding member 21 is retracted along a movement path set based on fixed sitting position Pf and the position of holding member 21 during execution of operation processing based on sitting path 82.

[0036] The lowering process included in operation processing based on sitting path 82 is for lowering holding member 21 from fixed sitting position Pf until care receiver M is sitting on seat 91. Note that, because a position in the front-rear direction of fixed sitting position Pf is set at the rear end in the moving range of holding member 21, in the lowering process, holding member 21 is lowered by operation of raising and lowering section 30 only. Also, in the lowering process, holding member 21 is lowered along a fixed movement path. In the present embodiment, because raising and lowering device 30 is driven by a linear driving device, the fixed movement path of the lowering process is set as a straight line extending in the up-down direction.

[0037] According to the above configuration, the lowering process is for lowering holding member 21 such that buttock portion Mb of care receiver M is lowered vertically towards seat 91. Here, "lowered vertically" means a configuration in which holding member 21 is lowered substantially vertically; this allows for some inclination angle to occur based on setting tolerances of driving device 23 and support column 12 of base 10.

Operation processing based on sitting path

[0038] Operation processing based on sitting path 82 by control device 60 is described next with reference to figs. 5 and 6. Operation processing based on sitting path 82 is performed, for example, after sitting switch 52 of controller 50 has been pushed, in a case in which sitting path 82 is set as the reference path of sitting operation by path setting section 62. Note that, when standing path 81 is set as the reference path of sitting operation by path setting section 62, operation processing based on sitting path 82 is not performed.

[0039] Also, when the below operation processing is being performed, sitting switch 52 is being pushed continuously, such that the execution instruction for the sitting operation is always being input. Control device 60 interrupts operation processing at the point when the op-

erator releases sitting switch 52, and stops operation of driving device 23.

[0040] As shown in fig. 5, control device 60, first, acquires the current position of holding member 21 (step 11 [hereinafter "step" is abbreviated to "S"]). The current position of holding member 21 is calculated, for example, based on a detection result of the angle detecting sensor of arm driving device or the linear scale in the linear driving device of driving device 23.

[0041] Next, control device 60 determines whether the current position of holding member 21 is forward of fixed sitting position Pf (S12). Here, a position in the front-rear direction of fixed sitting position Pf is set at the rear end in the moving range of holding member 21. Here, control device 60, distinguishes whether holding member 21 went via fixed sitting position Pf on the way to the current position depending on whether the current position of holding member 21 is at the rear end in the moving region of holding member 21.

[0042] Control device 60, in a case in which the current position of holding member 21 is forward of fixed sitting position Pf (S12: yes), since the holding member 21 is not in a state of having gone via fixed sitting position Pf, performs the retracting process (S13). Thus, holding member 21 is retracted from the current position to fixed sitting position Pf along a specified movement path, and is rotates such that angle θ with respect to the vertical axis is small. When holding member 21 reaches fixed sitting position Pf positioned at the rear end of the moving range in the front-range direction, angle θ of holding member 21 is minimized as shown in the lower part of fig. 6.

[0043] Continuing, control device 60 executes the lowering process (S14). By this, holding member 21 is lowered vertically along a fixed movement path. Specifically, holding member 21 is lowered in a straight line from fixed sitting position Pf until care receiver M is sitting on seat 91. In the lowering process, out of driving device 23, only raising and lowering section 30 is driven; oscillating section 40 is in a stopped state. Thus, angle θ of holding member 21 is maintained in a minimized state during the lowering of holding member 21.

[0044] On the other hand, control device 60, in a case in which the current position of holding member 21 is not forward of fixed sitting position Pf while executing operation processing based on sitting path 82 (S12: no), since the holding member 21 is at fixed sitting position Pf or already gone via fixed sitting position Pf, performs only the lowering processing (S14). By this, holding member 21 is lowered from the current position vertically along a fixed movement path.

[0045] When holding member 21 has been lowered by a certain amount, buttock portion Mb of care receiver M will be sat on seat 91 of chair 90. The operator checks the care receiver M has transferred to a sitting posture, then releases sitting switch 52. The lowering process performed by control device 60 is ended when the operator has released sitting switch 52 or when the lower limit of the moving region in the up-down direction of holding member 21 has been reached.

[0046] According to the above operation processing, because holding member 21 goes via fixed sitting position Pf before the lowering process (S14), during the lowering process (S14), buttock portion Mb of care receiver M is maintained in a position above seat 91. Thus, even if the height of seat 91 is not fixed, and regardless of the physique of care receiver M, it is possible to adjust the height at which lowering is ended by operation of an operator. Also, the operator can execute the processes by simply pushing sitting switch 52.

[0047] Further, after transferring to the lowering process, in a case in which sitting switch 52 is released and then pushed again, the lowering process is restarted and holding member 21 is lowered without moving again to fixed sitting position Pf (S12: no, S14). Accordingly, an operator is able to lower holding member 21 intermittently while checking the state of care receiver M.

Effects of embodiment

[0048] Assistance robot 1 includes: base 10 configured to rest on floor surface 2; holding member 21 configured to hold an upper body of care receiver M; driving device 23 configured to support holding member 21 so as to be movable in an up-down direction and a front-rear direction and to move holding member 21 along multiple different movement paths; and control device 60 configured to control operation of driving device 23 by executing operation processing for moving holding member 21 during a sitting operation of the care receiver M sitting on seat 91 based on, among the multiple sitting paths, sitting path 82 corresponding to the sitting operation. The operation processing based on sitting path 82 includes: a retracting process (S13) for retracting holding member 21 and lowering or raising holding member 21 to fixed sitting position Pf at which buttock portion Mb of the care receiver M is positioned at a specified height from floor surface 2 and above seat 91; and a lowering process (S14) for lowering holding member 21 from fixed sitting position Pf until the care receiver M is sitting on seat 91.

[0049] According to such a configuration, holding member 21, when being moved based on sitting path 82, is moved via fixed sitting position Pf. When holding member 21 passes fixed sitting position Pf, the care receiver M being held by holding member 21 is gradually transferred to a sitting posture while being maintained in a state with their buttock portion Mb above seat 91. Accordingly, even if the seat height is not fixed, and regardless of the loading posture or physique of the care receiver M, it is possible to reliably assist the care receiver M to sit down. In this manner, the assistance robot is able assist a sitting operation of a care receiver for various usage situations without the need for entering in advance set values representing a seat height, a physique of the care receiver M, and the like.

[0050] Also, driving device 23 includes raising and low-

ering section 30 that moves in an up-down direction with respect to base 10, and oscillating section 40 that moves holding member 21 with respect to raising and lowering section 30 in the front-rear direction of base 10, and rotates holding member 21 around an axis parallel to the left-right direction of base 10. The retracting process (S13) retracts holding member 21 to the rear end of the moving region of holding member 21 in accordance with operation of oscillating section 40. The lowering process (S14) lowers holding member 21 by operation of raising and lowering section 30 only. According to such a configuration, operation during the lowering process (S14) is simple, being only operation of raising and lowering section 30. Also, in the lowering process (S14), holding member 21 is lowered while the angle of holding member 21 is maintained.

[0051] Also, in the retracting process (S13), holding member 21 is retracted along a movement path set based on fixed sitting position Pf and the position of holding member 21 during execution of operation processing based on sitting path 82. In the lowering process (S14), holding member 21 is lowered along a fixed movement path. According to such a configuration, in the retracting process (S13), care receiver M is appropriately assisted in a sitting operation along a movement path suited to the conditions. Also, in the lowering process (S14), even if the seat height is not fixed, and regardless of the loading posture or physique of the care receiver M, it is possible to reliably assist the care receiver M to sit down.

[0052] Further, the lowering process (S14) is for lowering holding member 21 such that buttock portion Mb of care receiver M is lowered vertically towards seat 91. According to such a configuration, in the lowering process (S14), buttock portion Mb of care receiver M is reliably maintained in a position above seat 91. Thus, it is possible to sit down at any height, meaning seats 91 with a variety of heights can be handled.

[0053] Also, the specified height of fixed sitting position Pf, in a case in which seat 91 is at the maximum height that can be handled by assistance robot 1, is set to at least a height of holding member 21 at which buttock portion Mb of care receiver M contacts the seat 91. According to such a configuration, it is possible to handle a seat height up to the maximum height of the specifications, and care receiver M can reliably be assisted into a sitting posture by performing the retracting process (S13) and the lowering process (S14).

[0054] Further, control device 60, during operating processing based on sitting path 82, in a case in which the current position of holding member 21 is forward of fixed sitting position Pf while executing operation processing based on sitting path 82 (S12: yes), performs the retracting process and the lowering process (S13 and S14), but in a case in which the current position of holding member 21 is not forward of fixed sitting position Pf while executing operation processing based on sitting path 82 (S12: no), performs only the lowering processing (S14). According to such a configuration, when not having gone via fixed sitting position Pf, holding member 21 is lowered via fixed sitting position Pf. Thus, even if the height of the current position of holding member 21 is lower than the specified height of fixed sitting position Pf, holding member 21 is raised to the specified height of fixed sitting position Pf. On the other hand, if already having gone via fixed sitting position Pf, holding member 21 is lowered to a suitable height with being moved to fixed sitting position Pf. Thus, movement control in accordance with the current state of holding member 21 is possible.

[0055] Also, assistance robot 1 is further provided with sitting switch 52 that receives an operation for an execution instruction of the sitting operation. Control device 60 controls operation of driving device 23 while an execution instruction for the sitting operation is being input via sitting switch 52. According to such a configuration, control device 60 controls operation of raising and lowering section 30 and oscillating section 40 for the period while sitting switch 52 is being pushed. Thus, an operator is able to perform retracting and lowering of holding member 21 simply by operating sitting switch 52. Also, an operator can stop movement of holding member 21 by releasing sitting switch 52. In this manner, care receiver M can reliably be assisted into a sitting posture even if the height of seat 91 is not fixed by simply operating sitting switch 52, without the need for multiple switches.

Alternative embodiments

The necessity of the retracting process

[0056] In the above embodiment, control device 60, by determining whether the current position of holding member 21 is forward of fixed sitting position Pf (S12), determines whether to perform the retracting process and the lowering process (S12: yes, S13 and S14), or only the lowering process (S12: no, S14). Whether the retracting process is necessary may be determined based on other criteria.

[0057] Specifically, in addition to the position of holding member 21 in the front-rear direction, the position of holding member 21 in the up-down direction may be considered. Also, whether it is necessary to perform the retracting process may be determined based on the distance between the current position and fixed sitting position Pf, or the angle of a straight line passing through the current position and fixed sitting position Pf. Accordingly, it is possible to prevent going via fixed sitting position Pf unnecessarily, and care receiver M can be assisted in a sitting operation without discomfort being felt by care receiver M or an operator operating assistance robot 1.

Lowering process movement path

[0058] In the above embodiment, the movement path of holding member 21 during the lowering process (S14) was such so as to lower holding member 21 along a fixed movement path. However, control device 60 may correct

the movement path of holding member 21 during the lowering process (S14) considering factors such as the physique of care receiver M and the current state of holding member 21.

[0059] Also, control device 60 lowers holding member 21 during the lowering process (S14) such that buttock portion Mb of care receiver M is lowered straight down towards seat 91. However, if it is possible to maintain a state in which buttock portion Mb of care receiver M is positioned above seat 91, control device 60 may, for example, lower holding member 21 while retracting holding member 21 from fixed sitting position Pf.

Fixed sitting position Pf

[0060] In the above embodiment, the position of fixed sitting position Pf in the front-rear direction is set at the rear end of the moving range of holding member 21 in accordance with operation of oscillating section 40. However, in a case in which holding member 21 is moved to the position, if buttock portion Mb of care receiver M can be positioned above seat 91, fixed sitting position Pf may be set forward of the rear end of the moving region of holding member 21.

Forms of the driving device

[0061] In the above embodiment, driving device 23 is configured from raising and lowering section 30 that moves in an up-down direction with respect to base 10, and oscillating section 40 that oscillates holding member 21. However, driving device 23 may come in various forms so long as it supports holding member 21 to be movable with respect to the up-down direction and the front-rear direction of the base, and moves holding member 21 along multiple different movement paths.

[0062] Specifically, oscillating section 40, in addition to rotating arm 42 and rotating oscillation main body 41 around an axis while moving oscillation main body 41 in the front-rear direction, for example, may be configured to support oscillation main body 41 by a rail inclined in the front-rear direction on an upper section of raising and lowering section 30. With such a configuration, due to the movement of oscillation main body 41 along the rail, it is possible to move holding member 21 attached to oscillation main body 41 in the front-rear direction and to make holding member 21 inclined.

[0063] Further, driving device 23 may be configured from a rotation member provided on base 10 that rotates around an axis that is parallel to the left-right direction, and an extending arm that is provided on the rotation member and is extendable in the diameter direction of the rotation member. Also, driving device 23 may be configured including a first rotation member that rotates around a shaft parallel to the left-right direction, and a second rotation member that is provided on the first rotation member and that rotates around an axis parallel to the rotation axis of the first rotation member.

[0064] According to such a configuration, by holding member 21 being attached to the extending arm or the second rotation member, holding member 21 is able to move in the up-down direction and the front-rear direction of base 10, and is able to move in accordance with multiple movement paths. Further, in a case of executing operation processing based on sitting path 82 from the multiple movement paths, by appropriately performing the retracting process and the lowering process, similar effects as the first embodiment are achieved.

Sitting switch

[0065] In the first embodiment, sitting switch 52 is provided on controller 50. However, so long as it is capable of receiving an operation for an execution instruction of a sitting operation, various forms of sitting switch may be used. Specifically, for example, an operation pedal that is operated by a leg of an operator may be provided on base 10 or the like, or an operation lever provided on grip 43 or the like and capable of being operated by being gripped by an operator may be used as a sitting switch.

Reference Signs List

[0066]

1: assistance robot; 2: floor surface;

10: base;

11: frame; 12: support column;

13: footrest; 13a: contact mark;

14: fixed cover; 15: wheel;

20: supporting device;

21: holding member; 21a: torso receiving section; 21b: underarm receiving section;

22: lower limb contacting section; 22a: support member; 22b; lower limb contacting main body;

23: driving device;

30: raising and lowering section;
31: raising and lowering main body; 32: oscillation support section; 32a: oscillating shaft center; 33: raising and lowering cover;
40: oscillating section;
41: oscillation main body; 42: arm; 43: grip;

50: controller;

51: standing switch; 52: sitting switch;
53: raising switch; 54: lowering switch;

60: control device;

61: memory section; 62: path setting section; 63: driving control section;
71: standing operation data; 72: sitting operation data;

81: standing path; 82: sitting path;
90: chair; 91: seat;
M: care receiver; Mb: buttock portion (of care receiver)
P1: first position; P2: second position; P3: third position;
Pf: fixed sitting position

Claims

1. An assistance robot (1) comprising:

a base (10) configured to rest on a floor surface (2);
a holding member (21) configured to hold an upper body of a care receiver (M);
a driving device (23) configured to support the holding member (21) so as to be movable in an up-down direction and a front-rear direction and to move the holding member (21) along multiple different movement paths including a sitting path (82); and
a control device (60) configured to control operation of the driving device (23) by executing operation processing for moving the holding member (21) during a sitting operation of the care receiver (M) to sit down on a seat (91) based on, among the multiple movement paths, the sitting path (82) corresponding to the sitting operation,
wherein
the operation processing based on the sitting path (82) includes

a retracting process for retracting the holding member (21) and lowering or raising the holding member (21) to a fixed sitting position (Pf) at which a buttock portion of the care receiver (M) is positioned at a specified height from the floor surface (2) and above the seat (91), and
a lowering process for lowering the holding member (21) from the fixed sitting position (Pf) until the care receiver (M) is sitting on the seat (91), **characterized in that** the retracting process includes retracting the holding member (21) on a movement path set based on the fixed sitting position (Pf) and a position of the holding member (21) while the operation processing is being performed based on the sitting path (82), and
the lowering process includes lowering the holding member (21) on a fixed movement path.

2. The assistance robot according to claim 1, wherein the driving device (23) includes

a raising and lowering section (30) configured to move in an up-down direction with respect to the base (10), and
a pivoting section (40) configured to move the holding member (21) in a front-rear direction of the base (10) with respect to the raising and lowering section (30) and to rotate the holding member (21) around an axis parallel to a left-right direction of the base (10),

wherein
the retracting process includes retracting the holding member (21) to a retract end in a movement region of the holding member (21) in accordance with operation of the pivoting section (40), and
the lowering process includes lowering the holding member (21) by only operation of the raising and lowering section (30).

3. The assistance robot according to any one of the claims 1 to 2, wherein
the lowering process includes lowering the holding member (21) such that the buttock portion (Mb) of the care receiver (M) is lowered perpendicularly towards the seat.

4. The assistance robot according to any one of the claims 1 to 3, wherein
the specified height of the fixed sitting position (Pf), in a case in which the seat (91) is at a maximum height that can be handled by the assistance robot (1), is set to at least a height of the holding member (21) at which the buttock portion (Mb) of the care receiver (M) contacts the seat (91).

5. The assistance robot according to any one of the claims 1 to 4, wherein
the control device (60), during the operation processing based on the sitting path (82), executes the retracting process and the lowering process in a case in which a current position of the holding member (21) is forward of the fixed sitting position (Pf), and executes only the lowering processing in a case in which the current position of the holding member (21) is not forward of the fixed sitting position (Pf).

6. The assistance robot according to any one of the

claims 1 to 5, further comprising
a sitting switch (52) configured to receive an instruction for an execution request of the sitting operation, wherein
the control device (60) is configured to control operation of the driving device (23) while the execution request of the sitting operation is being input via the sitting switch (52).

Patentansprüche

1. Assistenzroboter (1), der umfasst:

einen Träger (10), der so eingerichtet ist, dass er auf einer Bodenfläche (2) steht;
ein Halteelement (21), das so eingerichtet ist, dass es einen Oberkörper eines Pflegebedürftigen (M) hält;
eine Antriebsvorrichtung (23), die so eingerichtet ist, dass sie das Halteelement (21) so trägt, dass es in einer vertikalen Richtung und in einer Längsrichtung bewegt werden kann, und das Halteelement (21) auf mehreren verschiedenen Wegen, einschließlich eines Sitz-Weges (82), bewegt; sowie
eine Steuerungsvorrichtung (60), die so eingerichtet ist, dass sie Funktion der Antriebsvorrichtung (23) steuert, indem sie Betätigungs-Verarbeitung ausführt, durch die das Halteelement (21) während eines Sitzvorgangs des Pflegebedürftigen (M) zum Setzen auf einen Sitz (91) auf Basis des dem Sitzvorgang entsprechenden Sitz-Weges (82) von den mehreren Wegen bewegt wird, wobei
die Betätigungs-Verarbeitung auf Basis des Sitz-Weges (82) einschließt:

einen Einfahr-Prozess zum Einfahren des Halteelementes (21) und zum Absenken oder Anheben des Halteelementes (21) an eine feste Sitzposition (Pf), an der ein Gesäßabschnitt des Pflegebedürftigen (M) in einer vorgegebenen Höhe über der Bodenfläche (2) und über dem Sitz (91) positioniert ist, sowie
einen Absenk-Prozess zum Absenken des Halteelementes (21) von der festen Sitzposition (Pf), bis der Pflegebedürftige (M) auf dem Sitz (91) sitzt, **dadurch gekennzeichnet, dass** der Einfahr-Prozess Einfahren des Halteelementes (21) auf einem Weg einschließt, der auf Basis der festen Sitzposition (Pf) und einer Position des Halteelementes (21) eingestellt wird, während die Betätigungs-Verarbeitung auf Basis des Sitz- Weges (82) durchgeführt wird, und
der Absenk-Prozess Absenken des Halteelementes (21) auf einem festen Weg einschließt.

2. Assistenzroboter nach Anspruch 1, wobei
die Antriebsvorrichtung (23) enthält:

einen Anhebe-und-Absenk-Abschnitt (30), der so eingerichtet ist, dass er sich in einer vertikalen Richtung in Bezug auf den Träger (10) bewegt, sowie
einen Schwenk-Abschnitt (40), der so eingerichtet ist, dass er das Halteelement (21) in einer Längsrichtung des Trägers (10) in Bezug auf den Anhebe-und-Absenk-Abschnitt (30) bewegt und das Halteelement (21) um eine Achse parallel zu einer Querrichtung des Trägers (10) dreht,

wobei
der Einfahr-Prozess Einfahren des Halteelementes (21) bis zu einem Einfahr-Ende in einem Bewegungsbereich des Halteelementes (21) entsprechend der Betätigung des Schwenk-Abschnitts (40) einschließt, und
der Absenk-Prozess Absenken des Halteelementes (21) lediglich durch Betätigung des Anhebe-und-Absenk-Abschnitts (30) einschließt.

3. Assistenzroboter nach einem der Ansprüche 1 bis 2, wobei
der Absenk-Prozess einschließt, dass das Halteelement (21) so abgesenkt wird, dass der Gesäßabschnitt (Mb) des Pflegebedürftigen senkrecht auf den Sitz zu abgesenkt wird.

4. Assistenzroboter nach einem der Ansprüche 1 bis 3, wobei
die vorgegebene Höhe der festen Sitzposition (Pf), wenn sich der Sitz (91) in einer maximalen Höhe befindet, die von dem Assistenzroboter (1) gehandhabt werden kann, wenigstens auf eine Höhe des Halteelementes (21) eingestellt ist, bei der der Gesäßabschnitt (Mb) des Pflegebedürftigen (M) den Sitz (91) berührt.

5. Assistenzroboter nach einem der Ansprüche 1 bis 4, wobei
die Steuerungsvorrichtung (60) während der Betätigungs-Verarbeitung auf Basis des Sitz-Weges (82) den Einfahr-Prozess und den Absenk-Prozess dann ausführt, wenn eine aktuelle Position des Halteelementes (21) vor der festen Sitzposition (Pf) liegt, und nur den Absenk-Prozess dann ausführt, wenn die aktuelle Position des Halteelementes (21) nicht vor der festen Sitzposition (Pf) liegt.

6. Assistenzroboter nach einem der Ansprüche 1 bis 5, der des Weiteren umfasst:

einen Sitz-Schalter (52), der zum Empfangen einer Anweisung für eine Ausführungs-Anforderung des Sitz-Vorgangs eingerichtet ist,
wobei
die Steuerungsvorrichtung (60) so eingerichtet ist, dass sie Funktion der Antriebsvorrichtung (23) steuert, während die Ausführungs-Anforderung des Sitz-Vorgangs über den Sitz-Schalter (52) eingegeben wird.

Revendications

1. Robot d'assistance (1) comprenant :

une base (10) configurée pour reposer sur une surface de plancher (2) ;
un élément de maintien (21) configuré pour maintenir un corps supérieur d'un receveur de soin (M) ;
un dispositif d'entraînement (23) configuré pour supporter l'élément de maintien (21) afin d'être mobile dans un sens haut-bas et un sens avant-arrière et pour déplacer l'élément de maintien (21) le long de multiples trajets de mouvement différents comprenant un trajet d'assise (82) ; et
un dispositif de commande (60) configuré pour commander le fonctionnement du dispositif d'entraînement (23) en exécutant le traitement d'opérations pour déplacer l'élément de maintien (21) durant une opération d'assise du receveur de soin (M) pour s'asseoir sur un siège (91) sur la base, parmi les multiples trajets de mouvement, le trajet d'assise (82) correspondant à l'opération d'assise,
où
le traitement d'opérations basé sur le trajet d'assise (82) comprend

un procédé de rétractation pour rétracter l'élément de maintien (21) et abaisser ou élever l'élément de maintien (21) vers une position d'assise fixe (Pf) à laquelle une partie fesse du receveur de soin (M) est positionnée à une hauteur spécifiée depuis la surface de plancher (2) et au-dessus du siège (91), et
un procédé d'abaissement pour abaisser l'élément de maintien (21) depuis la position d'assise fixe (Pf) jusqu'à ce que le receveur de soin (M) soit assis sur le siège (91), **caractérisé en ce que**
le procédé de rétractation comprend la rétractation de l'élément de maintien (21) sur un trajet de mouvement défini sur la base de la position d'assise fixe (Pf) et d'une position de l'élément de maintien (21) tandis que le traitement d'opérations est effectué sur la base du trajet d'assise (82), et
le procédé d'abaissement comprend l'abaissement de l'élément de maintien (21) sur un trajet de mouvement fixe.

2. Robot d'assistance selon la revendication 1, dans lequel
le dispositif d'entraînement (23) comprend

une section d'élévation et d'abaissement (30) configurée pour se déplacer dans un sens haut-bas par rapport à la base (10), et
une section pivotante (40) configurée pour déplacer l'élément de maintien (21) dans un sens avant-arrière de la base (10) par rapport à la section d'élévation et d'abaissement (30) et pour faire tourner l'élément de maintien (21) autour d'un axe parallèle au sens gauche-droite de la base (10),

où
le procédé de rétractation comprend la rétractation de l'élément de maintien (21) vers une extrémité de rétractation dans une région de mouvement de l'élément de maintien (21) selon le fonctionnement de la section pivotante (40), et
le procédé d'abaissement comprend l'abaissement de l'élément de maintien (21) uniquement par le fonctionnement de la section d'élévation et d'abaissement (30).

3. Robot d'assistance selon l'une quelconque des revendications 1 à 2, dans lequel
le procédé d'abaissement comprend l'abaissement de l'élément de maintien (21) de sorte que la partie fesse (Mb) du receveur de soin (M) est abaissée perpendiculairement vers le siège.

4. Robot d'assistance selon l'une quelconque des revendications 1 à 3, dans lequel
la hauteur spécifiée de la position d'assise fixe (Pf), dans un cas dans lequel le siège (91) se trouve à une hauteur maximale qui peut être manipulée par le robot d'assistance (1), est définie à au moins une hauteur de l'élément de maintien (21) auquel la partie fesse (Mb) du receveur de soin (M) entre en contact avec le siège (91).

5. Robot d'assistance selon l'une quelconque des revendications 1 à 4, dans lequel
le dispositif de commande (60), durant le traitement d'opérations sur la base du trajet d'assise (82), exécute le procédé de rétractation et le procédé d'abaissement dans un cas dans lequel une position présente de l'élément de maintien (21) est vers l'avant de la position d'assise fixe (Pf), et exécute uniquement le traitement d'abaissement dans un cas dans lequel la position présente de l'élément de maintien

(21) ne se trouve pas vers l'avant de la position d'assise fixe (Pf).

6. Robot d'assistance selon l'une quelconque des revendications 1 à 5, comprenant en outre un commutateur d'assise (52) configuré pour recevoir une instruction pour une requête d'exécution de l'opération d'assise,
où
le dispositif de commande (60) est configuré pour commander le fonctionnement du dispositif d'entraînement (23) tandis que la requête d'exécution de l'opération d'assise est émise par l'intermédiaire du commutateur d'assise (52).

FIG. 1

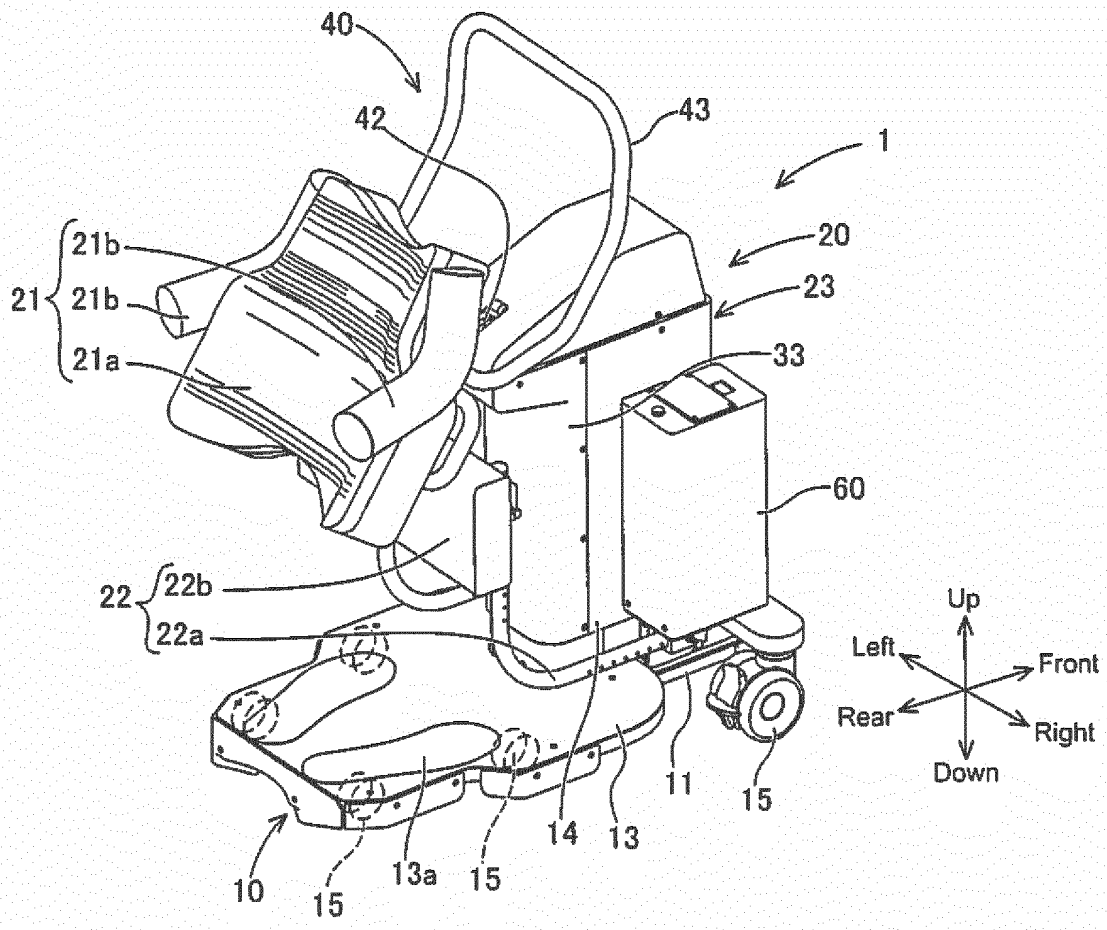

40
42
43
1
20
23
33
60
21
21b
21b
21a
22
22b
22a
Up
Left
Front
Rear
Right
Down
10
15
13a
15
14
13
11
15

FIG. 2

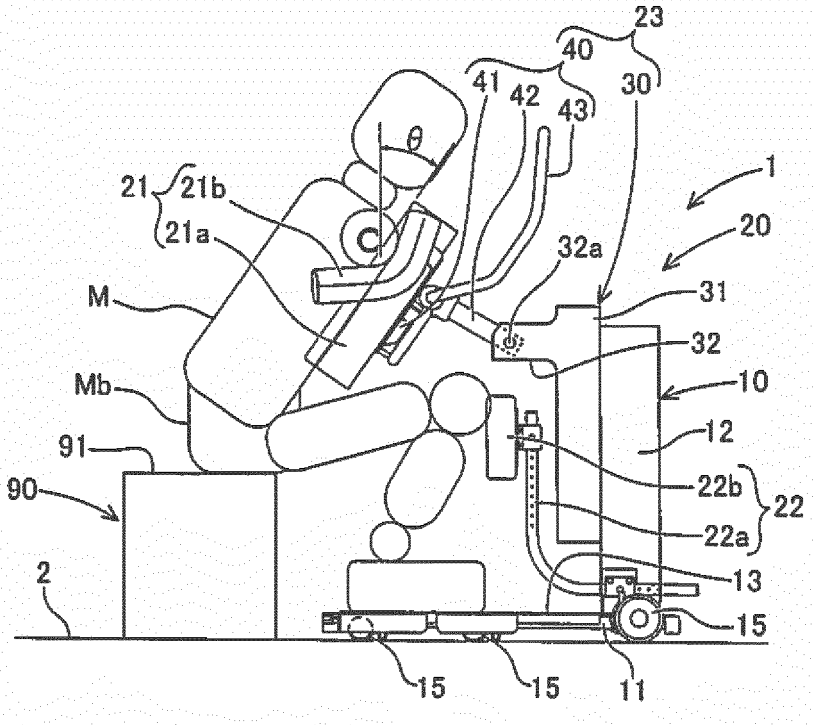

23
40
41
42
43
30
θ
1
21
21b
21a
20
32a
M
31
32
Mb
10
12
91
22b
22
90
22a
2
13
15
15
15
11

FIG. 3

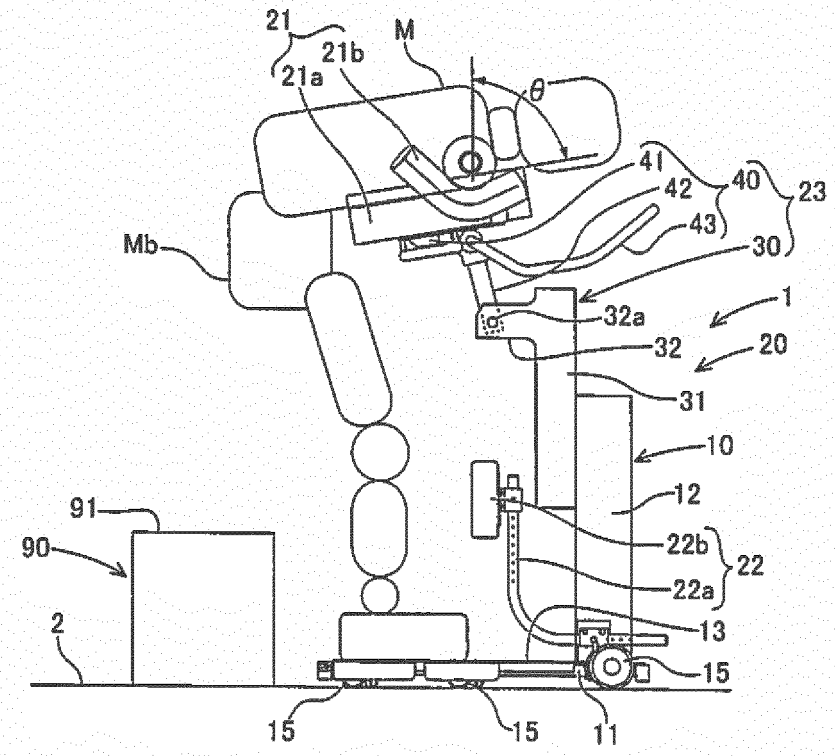

21
21b
21a
M
θ
41
42
40
23
43
Mb
30
1
32a
32
20
31
10
12
91
22b
22
90
22a
2
13
15
15
15
11

FIG. 4

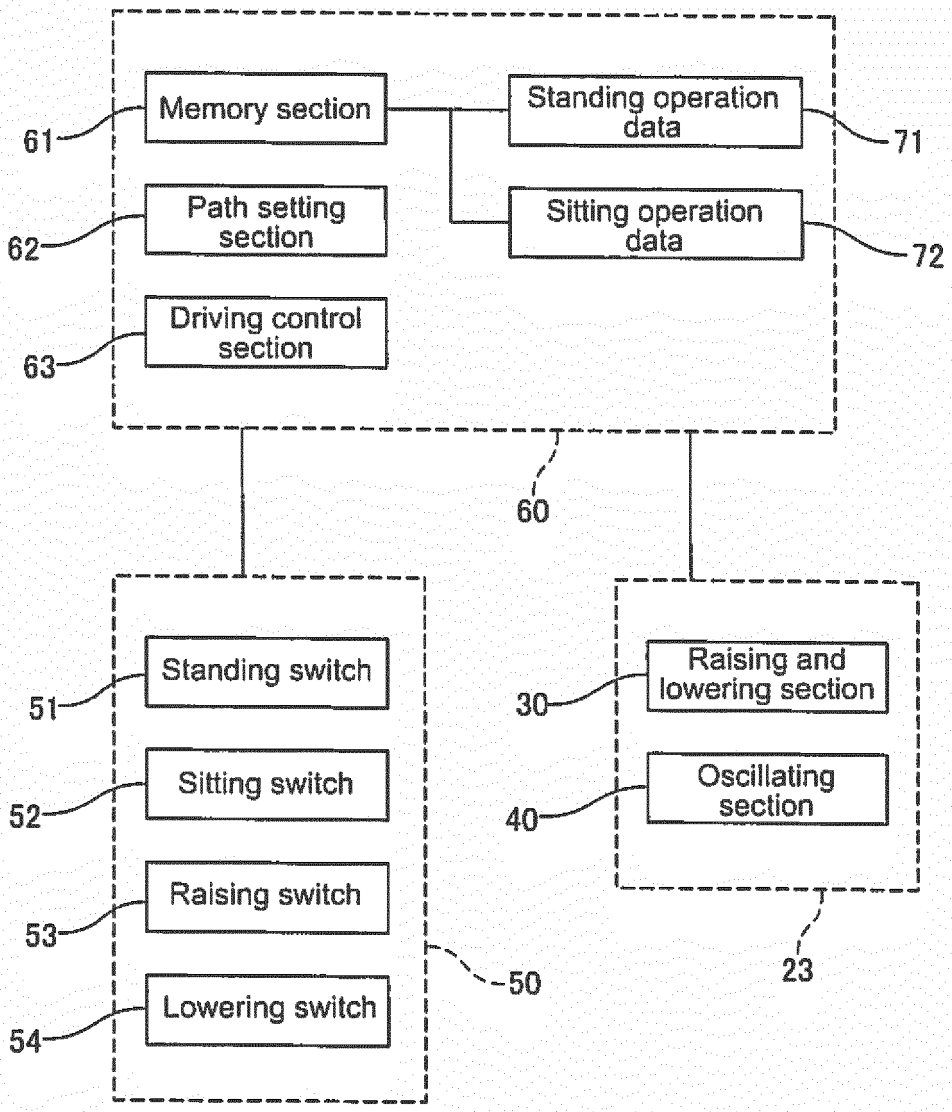

Memory section
61
Path setting section
62
Driving control section
63
Standing operation data
71
Sitting operation data
72
60
Standing switch
51
Sitting switch
52
Raising switch
53
Lowering switch
54
50
Raising and lowering section
30
Oscillating section
40
23

FIG. 5

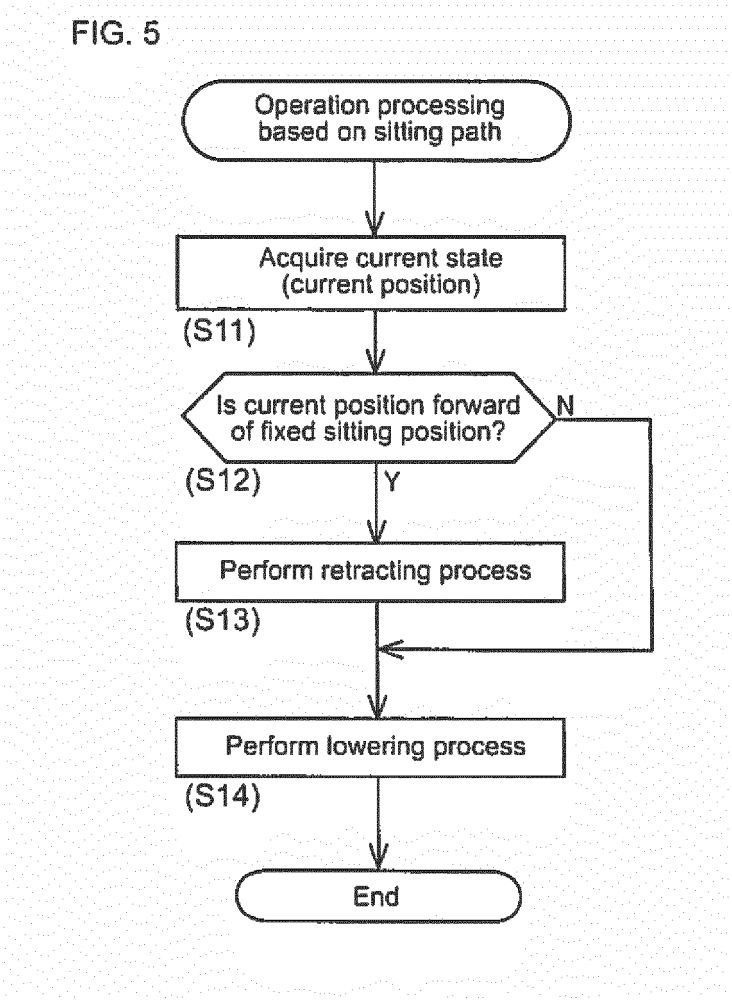
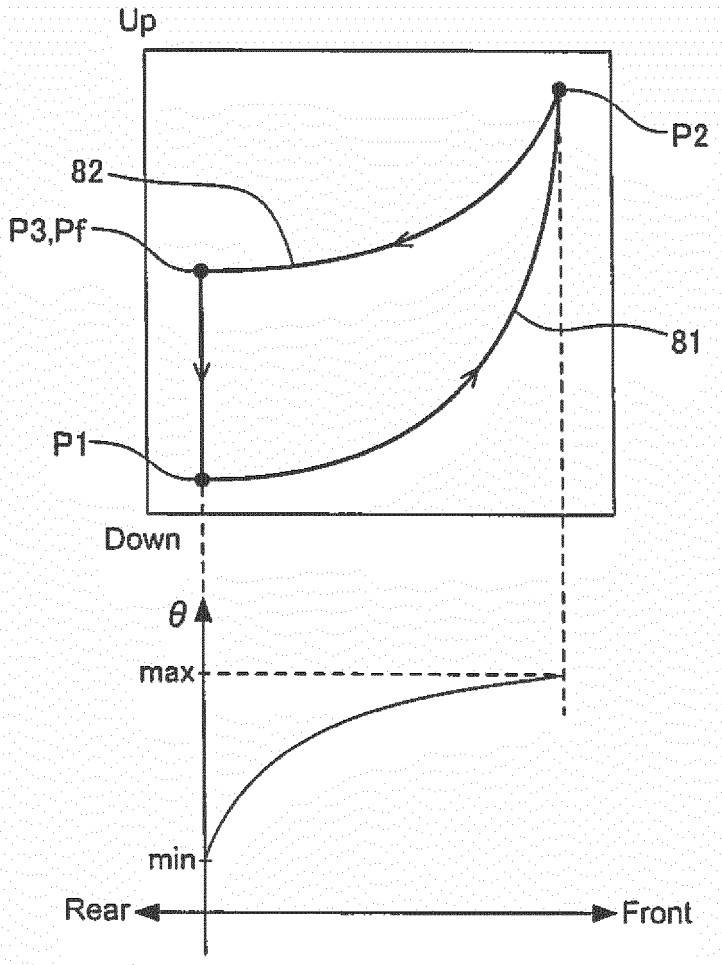

Operation processing based on sitting path
Acquire current state (current position)
(S11)
Is current position forward of fixed sitting position?
N
(S12)
Y
Perform retracting process
(S13)
Perform lowering process
(S14)
End

FIG. 6



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

- WO 2014122752 A **[0003]**