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(54) **PATIENT CARE ROBOT**

(57) A care robot (1) is provided with a base (10), and a pair of underarm holding sections (65a and 65b) provided on the base (10) and capable of holding the underarms of a care receiver (M1), and the care robot assists the care receiver (M1) to stand up or sit down. Further, the pair of underarm holding sections (65a and 65b) are provided to be swingable around a fulcrum (C) provided further away from the care receiver (M1) than portions (S) that hold at least the underarms of the care receiver (M1).

FIG. 6A

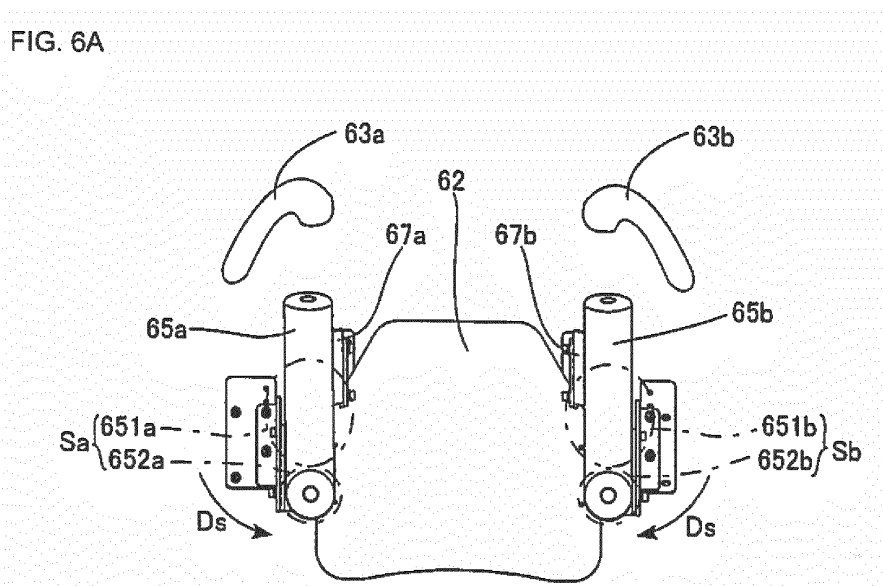
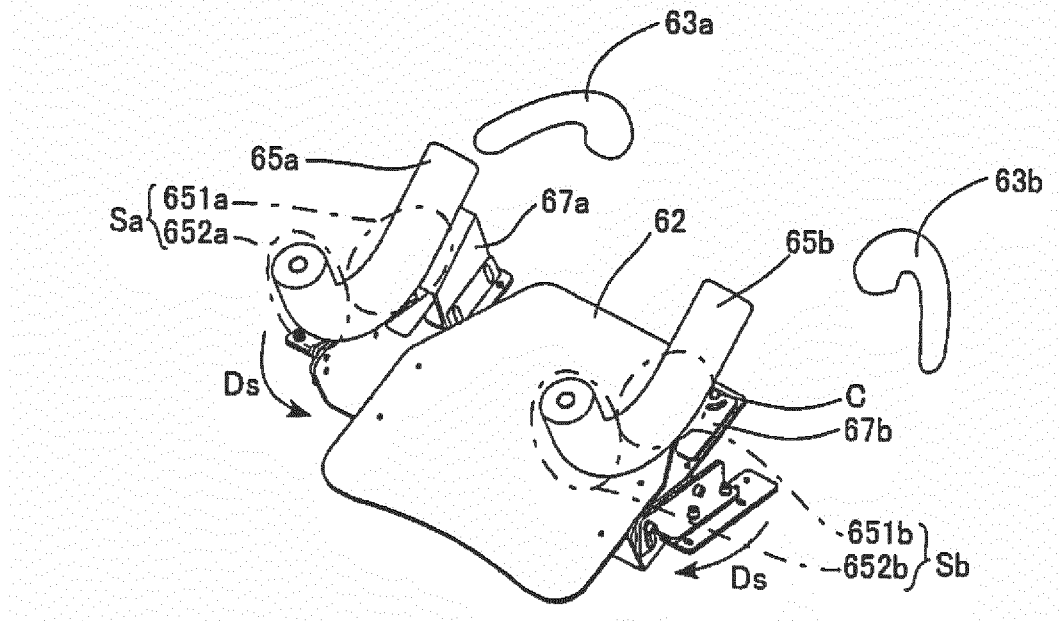


FIG. 6B



Description**Brief Description of Drawings**

Technical Field

[0008]

[0001] The present invention relates to a care robot.

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Background Art

[0002] A care robot disclosed in patent literature 1 is a care robot for assisting a care receiver to stand up or sit down, and is provided with a pair of underarm holding sections (swing arms) that hold a care receiver under both arms. Left and right slidable slide members are attached to the leading end of each of the pair of underarm holding sections, and by adjusting the left-right positions of the slide members, it is possible to align them with the body of the care receiver.

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Citation List

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Patent Literature

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[0003] Patent Literature 1: JP-A-2008-36392

Summary of Invention

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Technical Problem

[0004] With a conventional care robot, it is possible to align the pair of underarm holding sections with the body of a care receiver by adjusting the left-right positions of slide members, but depending on the state of the care receiver, it may be difficult to slide the slide members.

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[0005] An object of the present invention is to provide a care robot for which adjustment of a pair of underarm holding sections is easy.

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Solution to Problem

[0006] A care robot including: a base; and a pair of underarm holding sections provided on the base and configured to each hold under both arms of a care receiver; wherein the care robot is configured to assist the care receiver to stand up or sit down, and the pair of underarm holding sections are each configured to be swingable around a fulcrum provided further away from the care receiver than at least a portion that supports the underarm of the care receiver.

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[0007] Accordingly, when a care receiver inserts the underarm holding sections under each arm, the underarm holding sections are swung around a fulcrum point provided at the front side such that a portion that holds the underarms of the care receiver is aligned with a position under the arms of the care receiver. Thus, the care receiver can easily align with their own body the portion of the underarm holding sections that holds the underarms.

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[Fig. 1] Fig. 1 shows a care robot of an embodiment from the right side in the traveling direction. The traveling direction is toward the right side of the figure.

[Fig. 2] Fig. 2 is a plan view of the care robot of fig. 1. The traveling direction is toward the right side of the figure.

[Fig. 3] Fig. 3 shows the care robot of fig. 1 from the back side in the traveling direction.

[Fig. 4] Fig. 4 shows the care robot of fig. 1 from the front side in the traveling direction.

[Fig. 5] Fig. 5 shows the care robot of fig. 1 from the right side in the traveling direction in a state with the holding sections raised.

[Fig. 6A] Fig. 6A is a plan view showing the arrangement of the underarm holding sections, grips, and torso pad of the care robot of fig. 1. The traveling direction is toward the top side of the figure.

[Fig. 6B] Fig. 6B is a perspective view of the items of fig. 6A seen diagonally from the rear in the traveling direction.

[Fig. 7A] Fig. 7A shows the underarm holding sections of fig. 6A swung to the outside.

[Fig. 7B] Fig. 7B is a perspective view of the items of fig. 7A seen diagonally from the rear in the traveling direction.

[Fig. 8A] Fig. 8A is a plan view showing the swinging configuration of the underarm holding section on the right side in the traveling direction of the care robot of fig. 1. The traveling direction is toward the top side of the figure.

[Fig. 8B] Fig. 8B shows the swinging configuration of the underarm holding section of fig. 8A swung to the outside.

[Fig. 8C] Fig. 8C is a cross section of line A-A of fig. 8B.

[Fig. 9] Fig. 9 shows the care robot from the right side in the traveling direction when a care receiver is in a sitting position.

[Fig. 10] Fig. 10 shows the care robot from the right side in the traveling direction when a care receiver is in a standing position.

[Fig. 11] Fig. 11 shows a different example of an underarm holding section from the right side in the traveling direction. The traveling direction is toward the right side of the figure.

[Fig. 12] Fig. 12 shows a plan view of another different underarm holding section. The traveling direction is toward the top side of the figure.

Description of Embodiments

1. Overall configuration of care robot

[0009] The overall configuration of a care robot of an embodiment will be described with reference to figs. 1 to 5. Care robot 1 assists care receiver M1 (refer to figs. 9 and 10) to stand up and sit down by supporting a portion of the body (for example, the upper body) of care receiver M1. As shown in figs. 1 to 5, care robot 1 is provided with base 10, raising and lowering arms 20 and 30, raising and lowering section 40, holding section 50, attachment 60, raising and lowering actuators 70 and 80, forward and backward movement actuators 90 and 100, and control device 120. In the following descriptions, forwards, backwards, left, and right are set based on forwards being the traveling direction of care robot 1.

[0010] Base 10 is a portion installed on the floor. As shown in fig. 2, base 10 is formed in a U-shape open to the rear when seen from above. Base 10 is provided with four wheels 15 to 18, and is capable of moving forwards and backwards. Base 10 is covered by cover 11.

[0011] Raising and lowering arms 20 and 30 are each provided on the left and right on an upper surface of base 10, and are extendable upwards. As shown in figs. 1 to 5, an upper end of raising and lowering arms 20 and 30 extends and retracts in a straight line in a diagonal direction forwards with respect to a lower end of raising and lowering arms 20 and 30. Raising and lowering section 40 is provided on an upper end of raising and lowering arms 20 and 30. Raising and lowering section 40 is raised and lowered with respect to base 10 by raising and lowering arms 20 and 30 being extended and retracted in a vertical direction. That is, as shown in figs. 1 to 5, raising and lowering section 40 moves in a straight line in a forwards direction as it is raised with respect to base 10. Raising and lowering arms 20 and 30 are each covered by covers 25 and 35.

[0012] Holding section 50 is positioned on an upper side of raising and lowering section 40, and is supported by raising and lowering section 40. Holding section 50 moves forwards and backwards and diagonally with respect to raising and lowering section 40. Holding section 50 holds a portion of the body of care receiver M1. Holding section 50 is provided with attachment 60 that is exchangeable in accordance with care receiver M1. Attachment 60 is described in detail later.

[0013] Raising and lowering actuators 70 and 80 drive the raising and lowering operation of raising and lowering section 40 with respect to base 10. Raising and lowering actuators 70 and 80 respectively drive the extending and retracting of the corresponding raising and lowering arms 20 and 30. That is, by the driving of raising and lowering actuators 70 and 80, raising and lowering section 40 is operated to advance and retract with respect to base 10 from the state shown in fig. 1 to the upper position and advanced position shown in fig. 5, and in the reverse direction. Raising and lowering actuators 70 and 80 are

provided straddling base 10 and raising and lowering arms 20 and 30.

[0014] Forward and backward movement actuators 90 and 100 drive holding section 50 forwards and backwards and tilted with respect to raising and lowering section 40. That is, by the driving of forward and backward movement actuators 90 and 100, holding section 50 is moved forwards and backwards and tilted with respect to raising and lowering section 40 from the state shown in fig. 1 to the advanced position and tilted state shown in fig. 5, and in the reverse direction. Forward and backward movement actuators 90 and 100 are provided straddling raising and lowering section 40 and holding section 50. Control device 120 controls raising and lowering actuators 70 and 80 and forward and backward movement actuators 90 and 100 in accordance with operations of care receiver M1.

2. Construction of attachment 60

[0015] Attachment 60 will be described with reference to figs. 1 to 5. Attachment 60 is provided with main body section 61, torso pad 62, left and right grips 63a and 63b, left and right elbow rests 64a and 64b, left and right underarm holding sections 65a and 65b, and operation section 66. Main body section 61 is removably attached to main body frame 51 of holding section 50.

[0016] Torso pad 62 is formed of a cushion material and is roughly plate-shaped. Torso pad 62 is positioned on an upper surface of main body section 61 at a central portion in the left-right direction and a central portion in the forwards-backwards direction of the entire attachment 60. Torso pad 62 is provided such that the upper surface is slightly inclined towards the rear. Torso pad 62 supports almost the entire torso of care receiver M1, that is, from the chest to the stomach, and from near the left underarm to near the right underarm. Particularly, torso pad 62 is formed such that the width at the upper half corresponding to the chest is narrower than the lower half corresponding to the stomach. Therefore, care receiver M1 is able to position their underarms without discomfort and feel that their stomach area is stably supported. Further, an upper edge of torso pad 62 is concave so as not to impede movement of the head of care receiver M1. A lower edge of torso pad 62 is concave to allow legs to be inserted and such that the waist is stably supported.

[0017] Grips 63a and 63b are formed of plastic or metal and with a convex upper side in an arc shape (upside-down U-shape). Grips 63a and 63b are arranged forward of main body section 61 on the left and right sides respectively. One end of grips 63a and 63b is fixed to main body section 61, and the other end is a free end arranged to face to the outside and to the rear of main body section 61 from the fixed end. Therefore, care receiver M1 can support themselves while moving by extending both arms and gripping grips 63a and 63b with both hands.

[0018] Elbow rests 64a and 64b are made of cushion

material and are cuboid. Elbow rests 64a and 64b are arranged backward of main body section 61 on the left and right sides respectively. Therefore, care receiver M1 can support themselves while moving and rest their arms by resting both elbows on elbow rests 64a and 64b in a state with both elbows bent at approximately right angles.

[0019] Underarm holding sections 65a and 65b are made of plastic or metal covered on the surface with cushion material, and are formed in an arc shape (U-shaped) concave downwards. As shown in figs. 6A, 6B, 7A, and 7B, underarm holding sections 65a and 65b are provided with portions Sa and Sb that include underarm support sections 651a and 651b that support an underarm of care receiver M1 from below, and upright sections 652a and 652b that raise up from underarm support sections 651a and 651b. Underarm holding sections 65a and 65b are arranged to be swingable around main body section 61 to the left and the right of torso pad 62 via brackets 67a and 67b. In other words, underarm holding sections 65a and 65b are provided to be swingable with respect to care receiver M1 forward of grips 63a and 63b and above elbow rests 64a and 64b. Therefore, care receiver M1, by inserting underarm holding sections 65a and 65b under both arms, can support themselves when moving, while the forwards and backwards movement of care receiver M1 is restricted.

[0020] Underarm holding sections 65a and 65b are provided to be swingable around a fulcrum point to and from an open state (the state shown in figs. 7A and 7B) and a closed state (the state shown in figs. 6A and 6B) via brackets 67a and 67b that are swingably provided on main body section 61. An open state is a state in which upright sections 652a and 652b are positioned further to the outside than the shoulder width of care receiver M1 such that it is easy for care receiver M1 to get to the holding position on torso pad 62 between underarm holding sections 65a and 65b. A closed state is a state in which portions Sa and Sb that hold the underarms of care receiver M1 are positioned below the underarms.

[0021] By this, care receiver M1, by swinging underarm holding sections 65a and 65b in opening direction Do (refer to figs. 7A and 7B) around a fulcrum, moves upright sections 652a and 652b out of the way further to the outside than the shoulder width of care receiver M1, thus maintaining arm-passing region A (refer to figs. 7A and 7B) between care receiver M1 and grips 63a and 63b. Thus, care receiver M1 can load both arms on underarm supporting sections 651a and 651b of underarm holding sections 65a and 65b without upright sections 652a and 652b in front of U-shaped underarm holding sections 65a and 65b getting in the way. Also, because care receiver M1 can extend their arms through arm-passing region A, care receiver M1 can easily grip grips 63a and 63b with both hands. Further, care receiver M1, by inserting underarm holding sections 65a and 65b under both arms, swings underarm holding sections 65a and 65b in closing direction Ds (refer to figs. 6A and 6B) around the fulcrum, and can easily align portions Sa and Sb that hold the

underarms of care receiver M1 with a position under the arms of care receiver M1.

[0022] Brackets 67a and 67b that fix and support underarm holding sections 65a and 65b are provided to be swingable around fulcrum C provided further away from care receiver M1 than portions Sa and Sb that hold both underarms of care receiver M1 at underarm holding sections 65a and 65b (only the bracket 67b side is shown in fig. 6B, but bracket 67a has a similar configuration). In detail, as shown in figs. 8A, 8B, and 8C, swing pin 2 that forms fulcrum C, and elongated hole 4 into which guide pin 3 is inserted so as to be guided in a swinging path are provided on bracket 67b. The configuration of bracket 67a is similar. By this, underarm holding sections 65a and 65b have a restricted swinging stroke and cannot swing more than necessary. Also, the swinging mechanism of underarm holding sections 65a and 65b is simple, thus curtailing costs.

[0023] Further, provided on each of brackets 67a and 67b is an elastic member for biasing each in the closing direction, and an engaging stopping member for temporarily stopping brackets 67a and 67b as each is swung in opening direction Do against the biasing force of the elastic member. In detail, as shown in figs. 8A, 8B, and 8C, as the elastic member, extension coil spring 5 is attached so as to bias bracket 67b in closing direction Ds. As the engaging stopping member, recess 7 into which a ball of ball plunger 6 engages is provided on main body section 61. The configuration of bracket 67a is similar. The elastic force of coil spring 5 is adjusted such that underarm holding sections 65a and 65b can be easily swung in the opening direction when care receiver M1 pushes underarm holding sections 65a and 65b open with both hands. Also, the elastic force of ball plunger 6 is adjusted such that it is easy to release recess 7 of brackets 67a and 67b from the ball of ball plunger 6 when care receiver M1 inserts underarm holding sections 65a and 65b under both arms.

[0024] By this, when care receiver M1 swings underarm holding sections 65a and 65b in opening direction Po around fulcrum C, underarm holding sections 65a and 65b are prevented from swinging in closing direction Pc against the biasing force of coil spring 5 by ball plunger 6. Thus, care receiver M1 can easily pass both arms through arm-passing region A without pushing underarm holding sections 65a and 65b, therefore can easily grip grips 63a and 63b with both hands. Then, care receiver M1, by inserting underarm holding sections 65a and 65b under both arms, releases the engagement of ball plunger 6, and swinging in the closing direction is assisted by the biasing force of coil spring 5, therefore, care receiver M1 can easily align portions Sa and Sb that hold the underarms of care receiver M1 with a position under the arms of care receiver M1.

[0025] Operation section 66 is provided with buttons that are operated by care receiver M1 or a caregiver, including a raising and lowering button. When care receiver M1 operates the raising and lowering button at

operation section 66, raising and lowering operation of raising and lowering section 40 is performed, and in conjunction with the raising and lowering operation of raising and lowering section 40, holding section 50 moves forwards and backwards and tilts.

[0026] Note that, with attachment 60, torso pad 62, left and right grips 63a and 63b, left and right elbow rests 64a and 64b, underarm holding sections 65a and 65b, and operation section 66 can each be exchanged individually. Also, attachment 60 does not have to be provided with all of torso pad 62, left and right grips 63a and 63b, left and right elbow rests 64a and 64b, underarm holding sections 65a and 65b, and operation section 66; attachment 60 may be configured from only appropriately selected items.

3. Movement of care receiver and care robot

[0027] Care receiver M1 assumes a sitting posture and grips underarm holding sections 65a and 65b with both hands. Then, care receiver M1 swings underarm holding sections 65a and 65b left and right around fulcrum C so as to open underarm holding sections 65a and 65b. By this, the space between care receiver M1 and grips 63a and 63b is opened wider as arm-passing region A. Then, care receiver M1 separates both hands from underarm holding sections 65a and 65b, extends both arms to pass inside the U-shape of underarm holding sections 65a and 65b in arm-passing region A, and grips grips 63a and 63b with both hands.

[0028] Next, care receiver M1 inserts underarm holding sections 65a and 65b under both arms and pushes their chest against torso pad 62. When care receiver M1 inserts underarm holding sections 65a and 65b under each arm, underarm holding sections 65a and 65b are swung around fulcrum point C provided at the front side such that portions that hold the underarms of the care receiver are aligned with a position under the arms of care receiver M1. Thus, care receiver M1 can easily align with their own body the portions of underarm holding sections 65a and 65b that hold the underarms. Therefore, care receiver M1 does not need to raise or extend their arms up after gripping grips 63a and 63b with both hands.

[0029] Also, as shown in fig. 9, control device 120 first drives forward and backward movement actuators 90 and 100, so as to tilt and move holding section 50 forwards and backwards. Then, control device 120 drives forward and backward movement actuators 90 and 100 while driving raising and lowering actuators 70 and 80. In other words, as shown in fig. 10, holding section 50 is raised and lowered while being tilted and moved forwards and backwards. The raising and lowering heights of holding section 50 are set in accordance with the height of care receiver M1. Also, in a case in which care receiver M1 moves from a standing posture to a sitting posture, in a similar manner, when raising and lowering operation is performed by raising and lowering actuators 70 and 80, tilting and forward and backward movement by for-

ward and backward movement actuators 90 and 100 are performed together. In figs. 9 and 10, it is assumed that care receiver M1 has a reasonable amount of leg power, therefore care receiver M1 is able to stand without the underarms of care receiver M1 being supported by underarm holding sections 65a and 65b. However, in a case in which care receiver M1 does not have much leg power, care receiver M1 stands up by being supported under the arms by underarm holding sections 65a and 65b. In this case, the underarms of care receiver M1 are supported from below by underarm support sections 651a and 651b, and care receiver M1 is prevented from slipping backwards by upright sections 652a and 652b.

4. Other

[0030] Note that, in an embodiment above, underarm holding sections 65a and 65b are formed in an arc shape (U-shape) concave downwards, but any shape that allows insertion under the arms of care receiver M1 is acceptable. For example, as shown in the side view of fig. 11, upper surface 68s of underarm holding section 68 only may be formed in a U-shape. Also, as shown in the plan view of fig. 12, the underarm holding sections may be formed in an arc shape such that inner surface 69s of each underarm holding section 69 is concave in a left-right direction with respect to care receiver M1, thereby being able to hold the sides of care receiver M1. Also, the shape of underarm holding sections 65a and 65b may be an L-shape such that only the rear side is upright.

[0031] Also, in an embodiment above, swing pin 2 that acts as fulcrum C and elongated hole 4 into which guide pin 3 is inserted such that swinging is guided are provided on underarm holding sections 65a and 65b, but the configuration is not limited to guide pin 3 and elongated hole 4 so long as the swinging of underarm holding sections 65a and 65b can be guided. Also, extension coil spring 5 is provided on underarm holding sections 65a and 65b, but another means may be used so long as the elastic member biases the pair of underarm holding sections 65a and 65b in the closing direction, for example, another form of spring (such as a compression spring or a torsion spring), rubber, or the like. Also, the elastic member may be configured to bias each of the pair of underarm holding sections 65a and 65b in the opening direction. By this, the original position is with underarm holding sections 65a and 65b in the open position, therefore care receiver M1 does not have to open underarm holding sections 65a and 65b when getting on to care robot 1.

[0032] Also, recess 7 is formed on brackets 67a and 67b, and ball plunger 6 is formed on main body section 61, but ball plunger 6 may be provided on brackets 67a and 67b, and recess 7 may be provided on main body section 61. Also, the configuration is not limited to ball plunger 6 and recess 7, so long as the pair of underarm holding sections 65a and 65b can be stopped when open.

5. Effects

[0033] Care robot 1 of an embodiment is provided with base 10, and a pair of underarm holding sections 65a and 65b provided on base 10 and capable of holding the underarms of care receiver M1, and care robot 1 assists care receiver M1 to stand up and sit down. Further, the pair of underarm holding sections 65a and 65b are provided to be swingable around fulcrum C provided further away from care receiver M1 than portions Sa and Sb that hold at least the underarms of care receiver M1.

[0034] Thus, when care receiver M1 inserts underarm holding sections 65a and 65b under each arm, underarm holding sections 65a and 65b are swung around fulcrum point C provided at the front side such that portions that hold the underarms of the care receiver are aligned with a position under the arms of care receiver M1. Thus, care receiver M1 can easily align with their own body the portions of underarm holding sections 65a and 65b that hold the underarms.

[0035] Also, portions Sa and Sb that hold the underarms include underarm supporting sections 651a and 651b that support the underarms of care receiver M1 from below, and upright sections 652a and 652b that raise up underarm support sections 651a and 651b, and the pair of underarm holding sections 65a and 65b are swung open such that the pair of upright sections 652a and 652b are positioned wider than the shoulder width of care receiver M1. Thus, care receiver M1 can load both arms on underarm supporting sections 651a and 651b of underarm holding sections 65a and 65b without upright sections 652a and 652b in front of U-shaped underarm holding sections 65a and 65b getting in the way.

[0036] Also, a pair of grips 63a and 63b that care receiver M1 can grip with both hands while inserting the pair of underarm holding sections 65a and 65b under both arms are provided on base 10 further away from care receiver M1 than the pair of underarm holding sections 65a and 65b. Thus, when the pair of underarm holding sections 65a and 65b are swung open around fulcrum C, arm-passing region A is maintained between care receiver M1 and the pair of grips 63a and 63b. Thus, because care receiver M1 can extend their arms through arm-passing region A, care receiver M1 can easily grip grips 63a and 63b with both hands. Also, because biasing member 5 that biases the pair of underarm holding sections 65a and 65b is provided on the pair of underarm holding sections 65a and 65b, care receiver M1 can easily align portions Sa and Sb that hold the underarms of care receiver M1 with a position under the arms of care receiver M1.

[0037] And, because engaging stopping member 6 that temporarily stops the pair of underarm holding members 65a and 65b when underarm holding members 65a and 65b are swung in the open direction against the biasing force of elastic member 5 is provided on the pair of underarm holding members 65a and 65b, care receiver M1 can easily perform the next movement without need-

ing to push underarm holding members 65a and 65b. Also, if an elastic member that biases the pair of underarm holding members 65a and 65b open is provided instead of elastic member 5 that biases the pair of underarm holding members 65a and 65b closed, the original position is with underarm holding sections 65a and 65b in the open position, therefore care receiver M1 does not have to open underarm holding sections 65a and 65b when getting on to care robot 1. Also, because swing pin 2 that acts as fulcrum C and elongated hole 4 into which guide pin 3 is inserted such that swinging is guided are provided on underarm holding sections 65a and 65b, the swinging stroke is restricted and excess swinging can be prevented. Also, the swinging mechanism of underarm holding sections 65a and 65b is simple, thus curtailing costs.

Reference Signs List

[0038] 1: care robot; 2: swing pin; 3: guide pin; 4: elongated hole; 5: extension coil spring (elastic member); 6: ball plunger (engaging stopping member); 7: recess (engaging stopping member); 10: base; 20, 30: raising and lowering arm; 40: raising and lowering section; 50: holding section; 60: attachment; 63a, 63b: grip; 65a, 65b: underarm holding section; 70, 80: raising and lowering actuator; 90, 100: forward and backward movement actuator; 120: control device; M1: care receiver; C: fulcrum; A: arm-passing region

Claims

1. A care robot comprising:

a base; and
a pair of underarm holding sections provided on the base and configured to each hold under both arms of a care receiver;
wherein
the care robot is configured to assist the care receiver to stand up or sit down, and
the pair of underarm holding sections are each configured to be swingable around a fulcrum provided further away from the care receiver than at least a portion that supports the underarm of the care receiver.

2. The care robot according to claim 1, wherein
the portion that holds the underarm includes an underarm support section configured to support the underarm of the care receiver from below, and an upright section that raises up from the underarm holding section, and
the pair of underarm holding sections swings such that a pair of the upright sections is expandable to a position further to the outside than a shoulder width of the care receiver.

3. The care robot according to claim 1 or 2, wherein
a pair of grips configured to be held by both hands
of the care receiver so as to insert the pair of under-
arm holding sections under both arms are each pro- 5
vided on the base further away from the care receiver
than the pair of underarm holding sections,
such that,
when the pair of underarm holding sections are
swung around the fulcrum in an opening direction,
an arm-passing region is maintained between the 10
care receiver and the pair of grips.

4. The care robot according to any one of the claims 1
to 3, wherein
an elastic member configured to bias each of the pair 15
of underarm holding sections in a closing direction
is provided on the pair of underarm holding sections.

5. The care robot according to claim 4, wherein
an engaging stopping member configured to tempo- 20
rarily stop the pair of underarm holding sections
against the biasing force of the elastic member when
the underarm holding sections are swung in an open-
ing direction is provided on the pair of underarm hold-
ing sections. 25

6. The care robot according to any one of the claims 1
to 3, wherein
an elastic member configured to bias each of the pair
of underarm holding sections in an opening direction 30
is provided on the pair of underarm holding sections.

7. The care robot according to any one of the claims 1
to 6, wherein
a swing pin acting as the fulcrum, and an elongated 35
hole configured to guide the swinging of a guide pin
that is inserted into the elongated hole are provided
on the underarm holding sections.

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FIG. 1

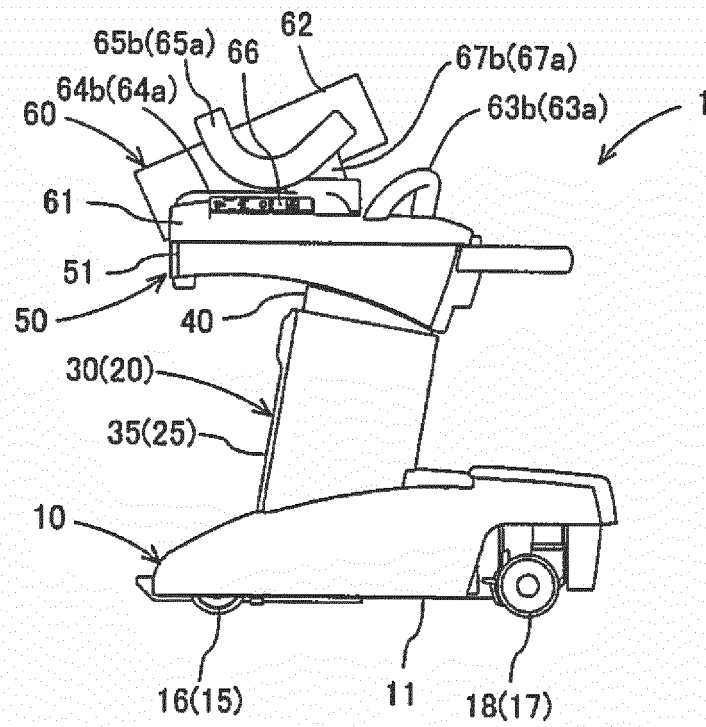


FIG. 2

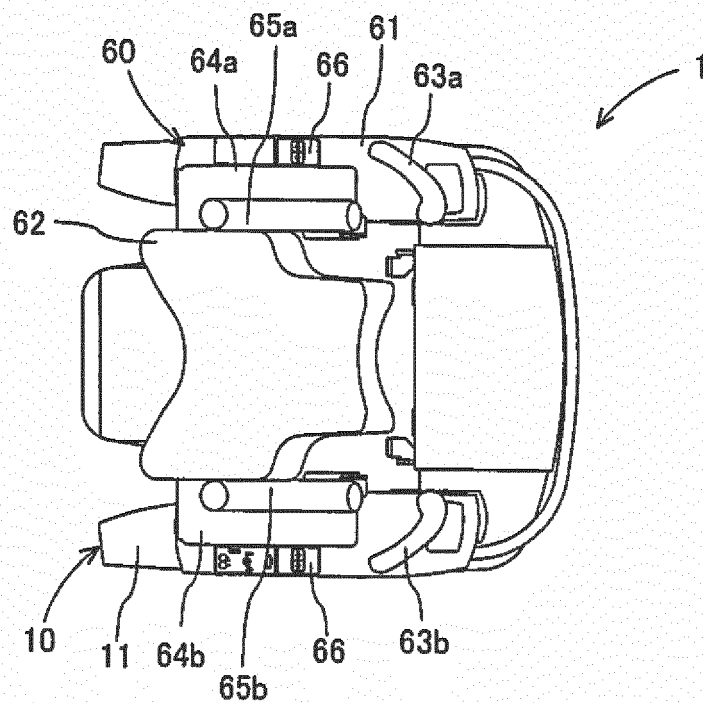


FIG. 3

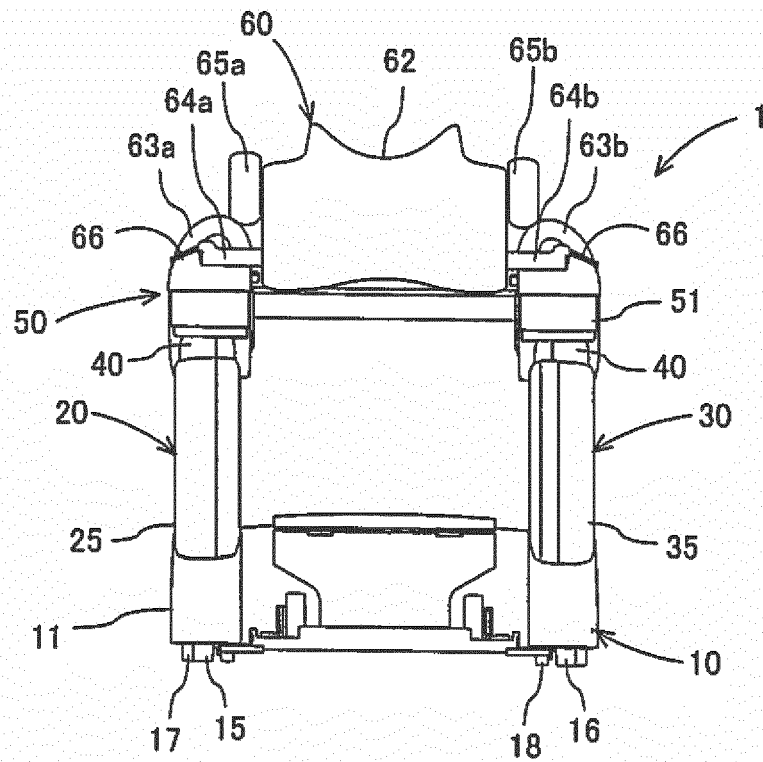


FIG. 4

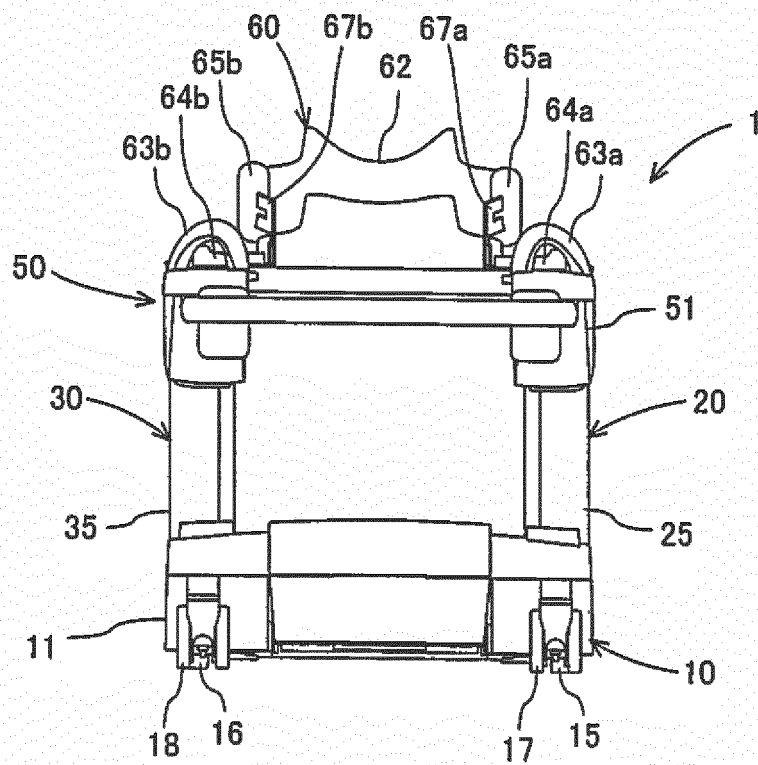


FIG. 5

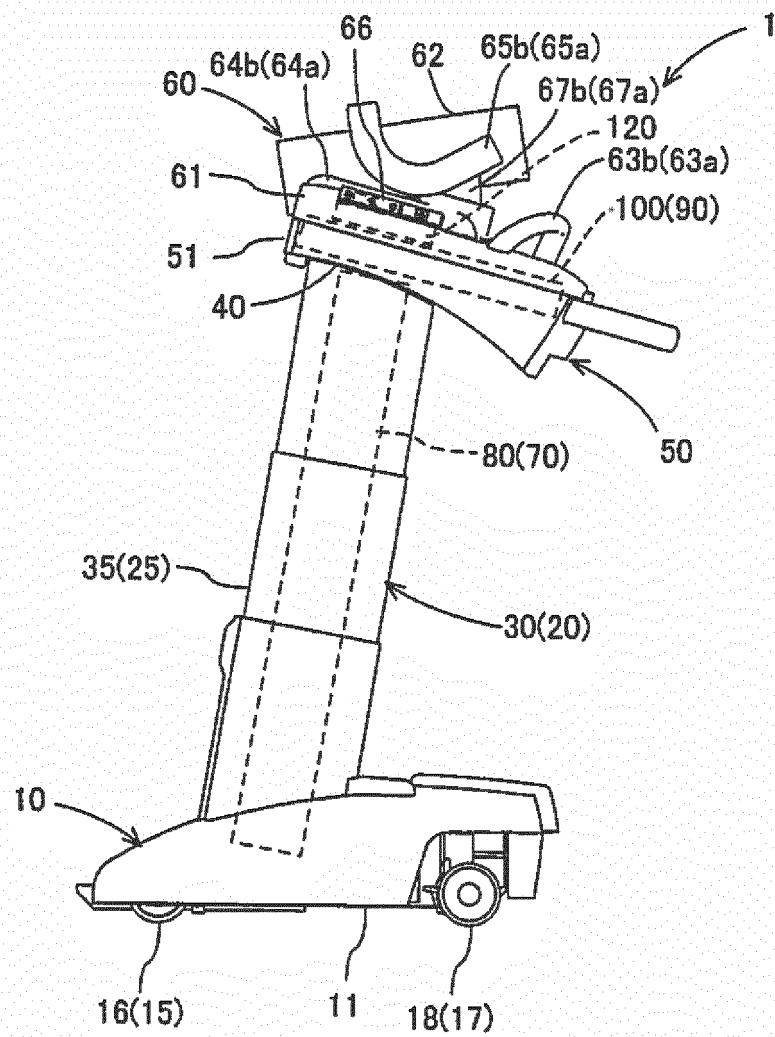


FIG. 6A

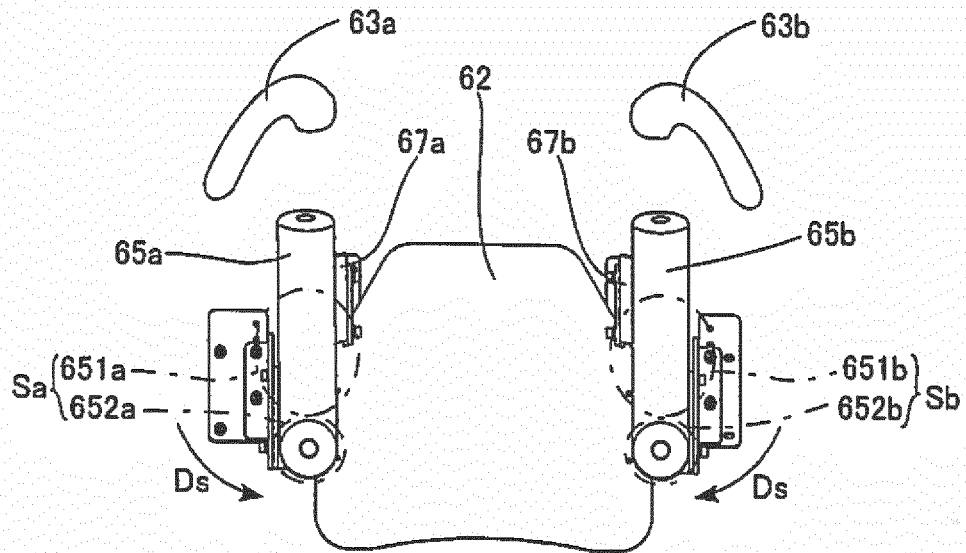


FIG. 6B

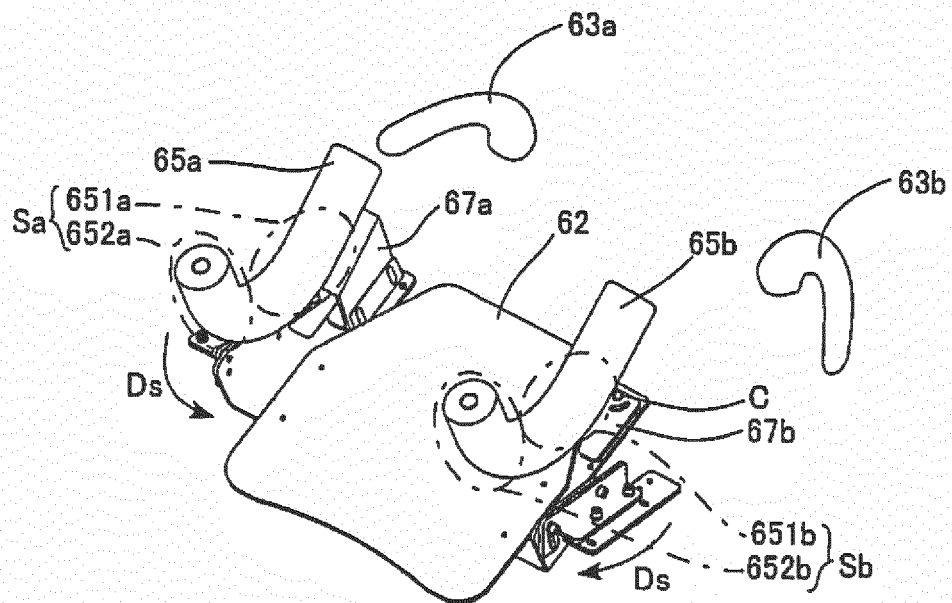


FIG. 7A

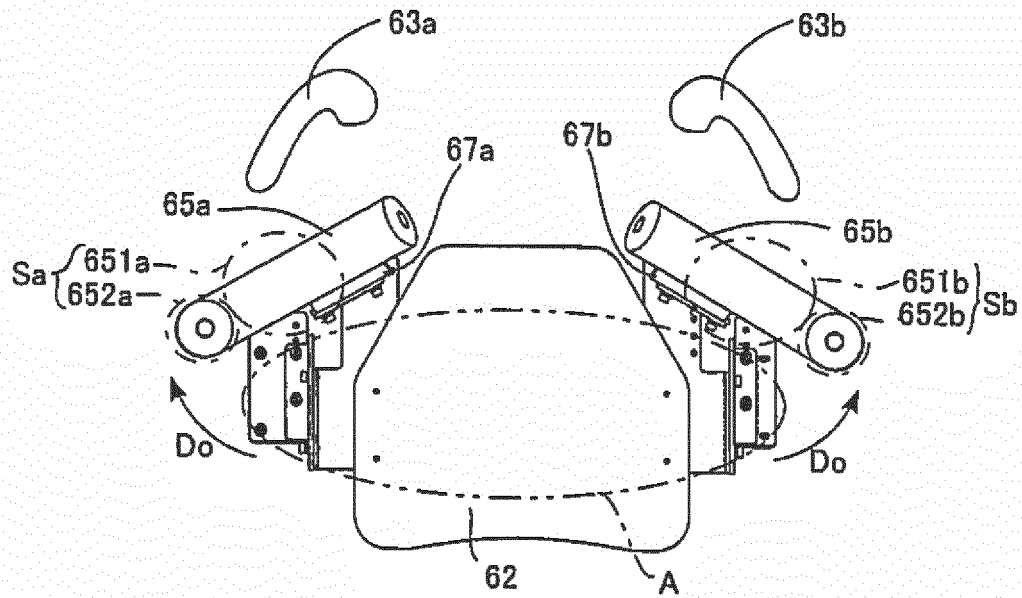


FIG. 7B

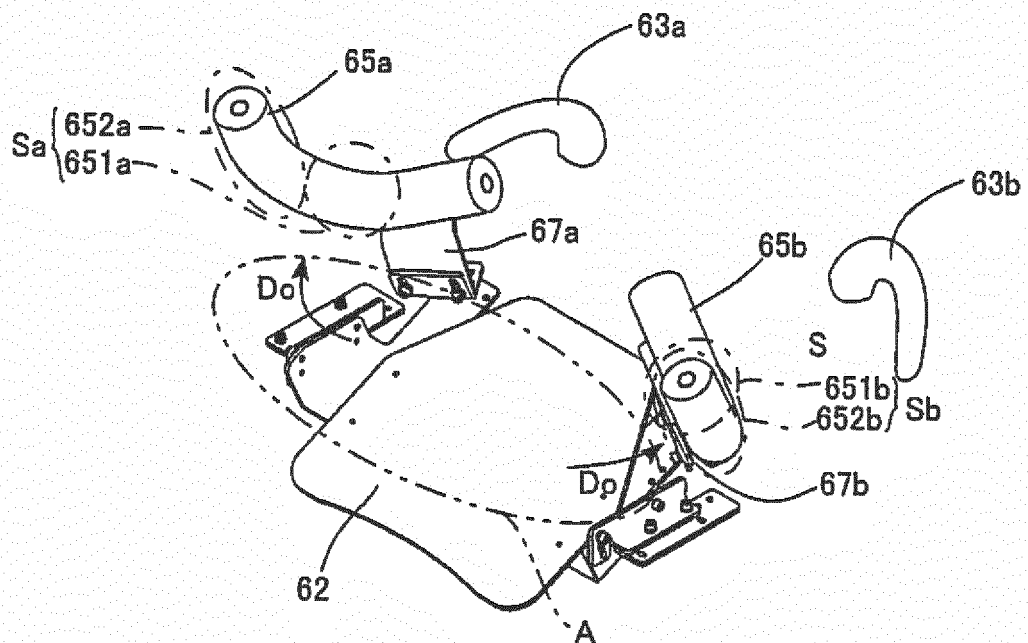


FIG. 8A

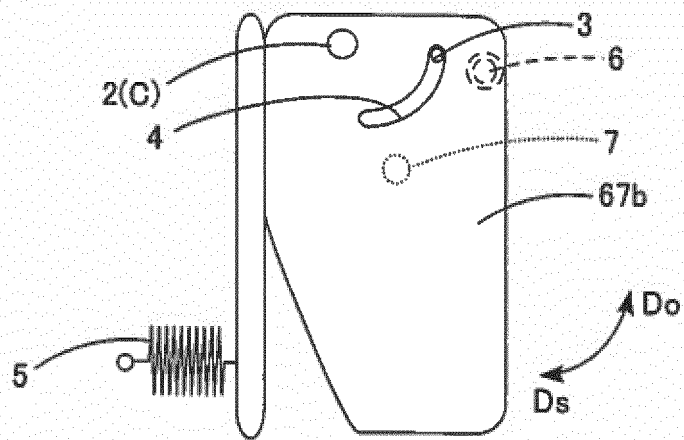


FIG. 8B

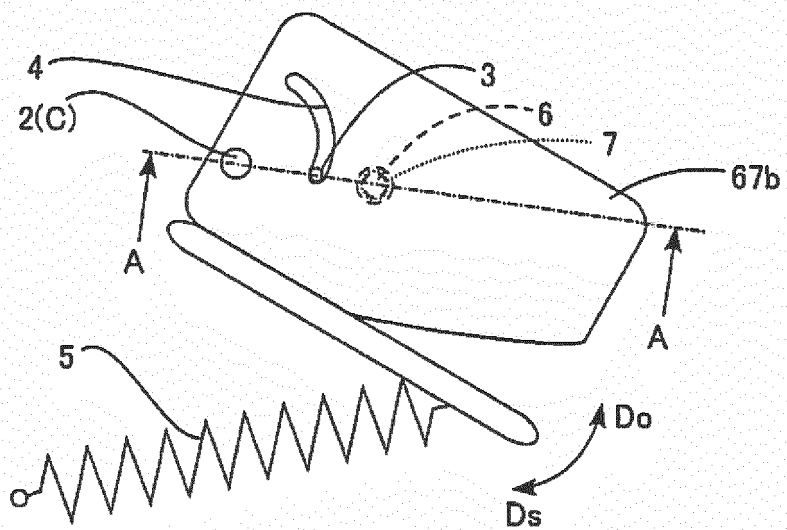


FIG. 8C

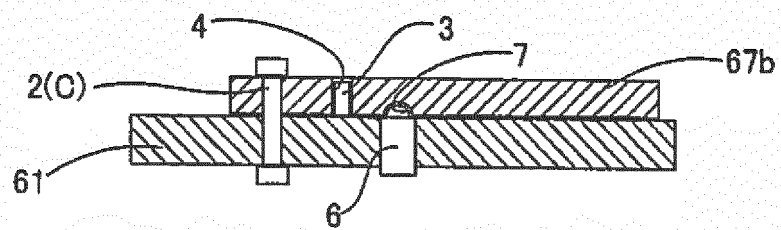


FIG. 9

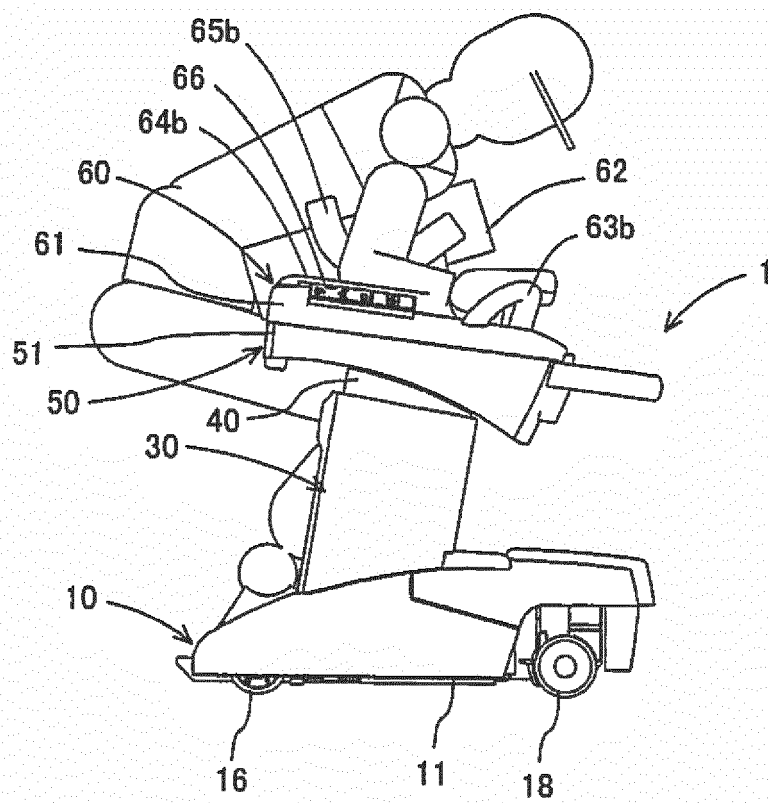


FIG. 10

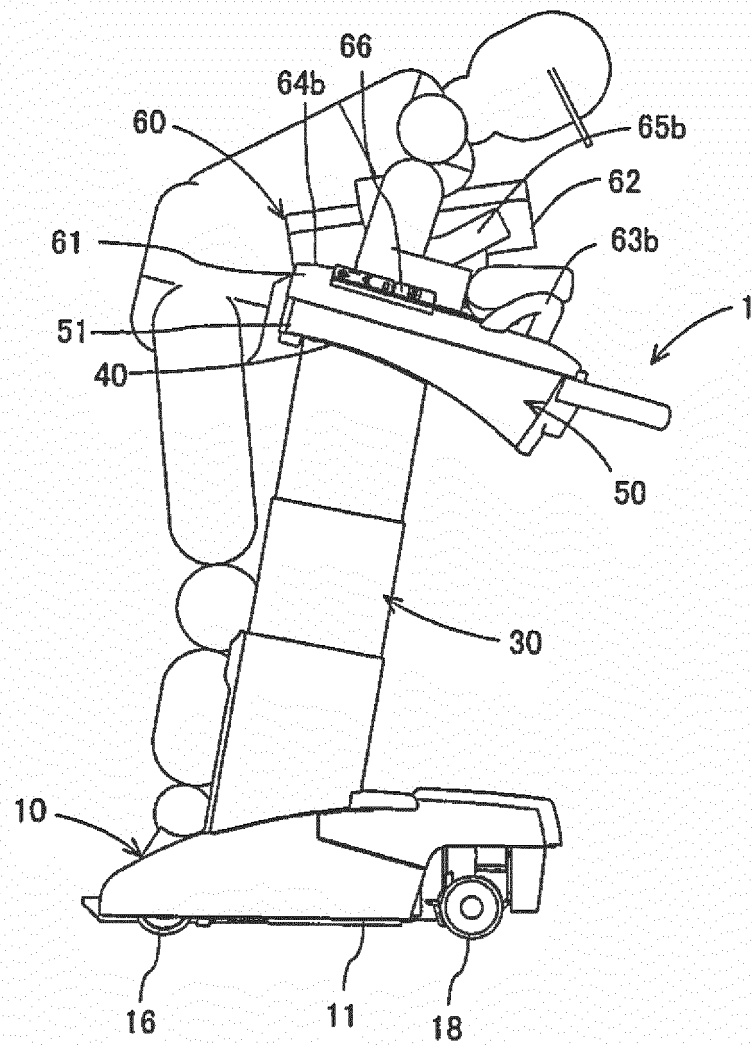


FIG. 11

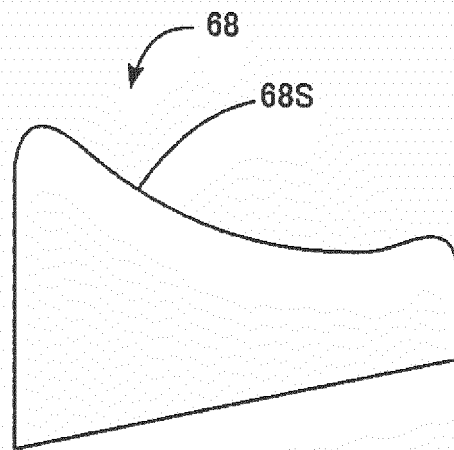
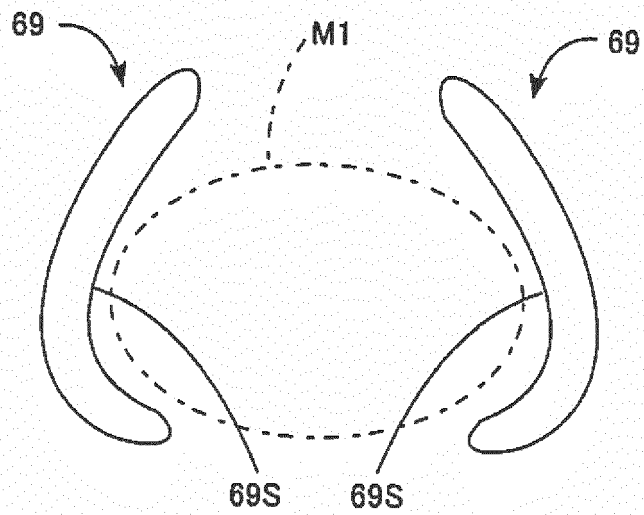


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/070134

A. CLASSIFICATION OF SUBJECT MATTER

A61G5/00(2006.01) i, A61G7/10(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61G5/00, A61G7/10

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-36392 A (E.ZEL Inc.), 21 February 2008 (21.02.2008), paragraphs [0001] to [0042]; fig. 1 to 6 (Family: none)	1-7
A	JP 61-87552 A (David Richard James), 02 May 1986 (02.05.1986), pages 1 to 24; fig. 1 to 5 & US 4656679 A & GB 2164918 A & DE 3533626 A1 & FR 2570945 A & CH 664891 A5	1-7
A	JP 2001-29392 A (Sankyo Aluminium Industry Co., Ltd.), 06 February 2001 (06.02.2001), paragraphs [0001] to [0017]; fig. 1 to 6 (Family: none)	1-7

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
20 August 2015 (20.08.15)Date of mailing of the international search report
01 September 2015 (01.09.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/070134

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-227162 A (Toyota Motor Corp.), 14 October 2010 (14.10.2010), paragraphs [0001] to [0047]; fig. 1 to 8 (Family: none)	1-7

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008036392 A [0003]