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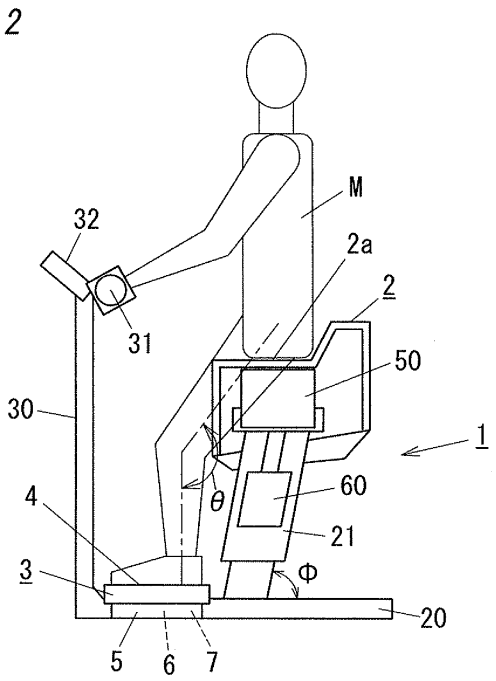
# (54) PASSIVE EXERCISE MACHINE

(57) This aims to provide passive exercise equipment capable of securing constant sense of use so as to avoid variation in depressing feel against sole-surmounted parts irrespective of body type difference among users. The equipment has a seat 2 for resting a user M on the buttocks, right and left footstools 3 for resting the right and left soles of user M sitting on seat 2 on, and a seat driver 5 for changing the position of seat 2 position to change load balance added to seat 2 and footstools 3 by user M, thereby changing the user's own weight acting on the legs. Each footstool 3 includes a sole-surmounted part 4 which a sole is placed on and meanwhile can be moved up and down, an elastic device 6 for biasing sole-surmounted part 4 upward; and a bias adjuster 7 for adjusting an elastic coefficient of elastic device 6.

FIG. 2

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## Description

### TECHNICAL FIELD

**[0001]** The invention relates to passive exercise equipment which, in the condition that the soles of a user are put on footstools and the buttocks of the user are supported by a seat, drives and moves the seat, thereby changing the weight acting on the user's legs by own weight.

### BACKGROUND ART

**[0002]** In the condition that the soles of a user are put on sole-surmounted parts of footstools and the buttocks of the user are supported by a seat, passive exercise equipment suggested conventionally moves the seat through a seat driver, and also moves the sole-surmounted parts up and down so as to substantially stabilize the position relation with the seat (see Japanese Patent Application Publication Nos. 2005-58733 and 2007-89650). In the passive exercise equipment, it is possible to change the weight acting on the user's legs by own weight to contract and relax muscle groups in the femoral regions while hardly bending and stretching the knees which place a burden on the user. Each sole-surmounted part of the footstools is moved up and down through a stretch pantograph mechanism equipped with a footstool driver. However, the pantograph mechanism has a problem of increase in production cost owing to the complicated construction.

**[0003]** Therefore, in order to simplify a mechanism for moving the footstool up and down and reduce the production cost, the present inventors hit on the idea of making an elastic device intervene between a base part of a footstool and a sole-surmounted part. However, a body type differs among users, and thereby it disperses magnitude of load added to each footstool by weight difference of leg and so on and results in differences in depressing feel against the sole-surmounted parts. Accordingly, the passive exercise equipment has a problem that constant sense of use cannot be secured.

### DISCLOSURE OF THE INVENTION

**[0004]** The present invention, conceived in light of the foregoing problems, has an objective to provide passive exercise equipment capable of securing constant sense of use so as to avoid variation in depressing feel against sole-surmounted parts irrespective of body type difference among users.

**[0005]** In order to solve the foregoing problems, the passive exercise equipment of the present invention comprises: a seat 2 configured to rest a user M on the buttocks; right and left footstools 3 configured to rest the right and left soles of the user M sitting on the seat 2 on; and a seat driver 50 configured to change the position of the seat 2 to change load balance added to the seat 2 and the footstools 3 by the user M and thereby to change the user's own weight acting on the legs. Each footstool 3 comprises: a sole-surmounted part 4 which a sole is placed on and meanwhile can be moved up and down; an elastic device 6 configured to bias the sole-surmounted part 4 upward; and a bias adjuster 7 configured to adjust an elastic coefficient of the elastic device 6.

**[0006]** In this invention, an elastic coefficient of each elastic device 6 for biasing a sole-surmounted part 4 upward is adjusted through the bias adjuster 7 in response to body type difference among users. (A relatively high elastic coefficient is set for a user M having heavy legs and so on, while a relatively low elastic coefficient is set for a user M having light legs and so on.) Accordingly, it is possible to secure substantially constant sense of use irrespective of body type difference among users.

**[0007]** Preferably, the passive exercise equipment of the present invention comprises: a body weight input part 8 configured to input body weight of the user M; regulatory drivers 9 configured to drive the bias adjusters 7 to adjust elastic coefficients of the elastic devices 6, respectively; and a controller configured to perform drive control of the regulatory drivers 9 in response to the body weight input though the body weight input part 8.

**[0008]** In this invention, the user M has only to input own body weight through the body weight input part 8, and the controller automatically sets an elastic coefficient of each elastic device 6 based on the body weight. Accordingly, convenient passive exercise equipment 1 can be secured.

**[0009]** Preferably, the passive exercise equipment of the present invention comprises: a body weight detector 10 configured to detect body weight of the sitting user M; regulatory drivers 9 configured to drive the bias adjusters 7 to adjust elastic coefficients of the elastic devices 6, respectively; and a controller configured to perform drive control of the regulatory drivers 9 in response to the body weight detected though the body weight detector 10.

**[0010]** In this invention, if the user M sits, the body weight detector 10 detects the user's body weight and the controller automatically sets an elastic coefficient of each elastic device 6 based on the detected body weight. Accordingly, convenient passive exercise equipment 1 can be secured.

**[0011]** In the passive exercise equipment of the present invention, preferably, said elastic device 6 comprises a plurality of spring members 11 arranged between said sole-surmounted part 4 and a base part 5 of said footstool 3. Said plurality of spring members 11 comprises an unconnected spring member 11a having an unconnected end $11a_1$ which is not connected to said base part 5 or said sole-surmounted part 4 in a nature state. Said bias adjuster 7 comprises a member switchable between states in which the member is connected to and disconnected from both the unconnected end $11a_1$ of said unconnected spring member 11a and said base part 5 or said sole-surmounted part 4.

**[0012]** In this invention, each footstool 3 having a bias

adjuster 7 can be simplified, and the production cost of the passive exercise equipment 1 can be reduced.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]**

FIG. 1A illustrates a perspective plane of a sole-surmounted part of a footstool in a type of passive exercise equipment in an embodiment;
FIG. 1B is a sectional view along line A-A of FIG. 1A
FIG. 2 is a side view of the passive exercise equipment;
FIG. 3 is a plane view of the passive exercise equipment;
FIG. 4 is an exploded perspective view of the passive exercise equipment;
FIG. 5 is an exploded perspective view of a seat driver in ditto;
FIG. 6 is a side view of the seat driver;
FIG. 7A illustrates a perspective plane of a sole-surmounted part of a footstool in a type of passive exercise equipment in an embodiment;
FIG. 7B is a sectional view along line B-B of FIG. 7A
FIG. 8 is a modified example having spring members different in arrangement from ditto;
FIG. 9 is a side view of a type of passive exercise equipment in an embodiment; and
FIG. 10 is a side view of a type of passive exercise equipment in an embodiment.

## BEST MODE FOR CARRYING OUT THE INVENTION

**[0014]** The present invention will be hereinafter explained based on embodiments shown in the accompanying drawings.

**[0015]** A type of passive exercise equipment 1 in a first embodiment of the present invention has an equipment base 20 put on a fixed position such as a flooring as shown in FIGS. a and 3, and is provided with a seat supporter 21 and a handle post 30 on the equipment base 20. The seat supporter 21 is equipped with a seat 2 for supporting buttocks of a user M on its top edge. The handle post 30 is equipped, on its top edge, with a handle 31 which the user M can grip as need arises. A footstool 3 of which top face is used as a sole-surmounted part 4 is placed at a position between the seat supporter 21 and the handle post 30 in the equipment base 20. Two footstools 3 are laid side-by side in a right-left direction, and the sole-surmounted parts 4 are surmounted by the right and left soles of the user M and thereby regulating the right and left feet placement.

**[0016]** The seat supporter 21 is a seat driver 50 for oscillating the seat 2 and an elevating mechanism 60 for moving the seat 2 and the seat driver 50 up and down with respect to the equipment base 20. The configurations of the seat driver 50 and the elevating mechanism 60 are described later.

**[0017]** When a contact face 2a of the seat 2 is surmounted by the buttocks and the sole-surmounted parts 4 of the footstools 3 are surmounted by the soles, the seat driver 50 oscillates the seat 2 with a drive source to change the position of the buttocks, thereby changing the user's own weight acting on the legs of the user M. That is, when the body weight of the user M is supported with the body weight scattered on the buttocks and legs, the position of the buttocks is changed and thereby the user's own weight supported by the seat 2 or the footstools 3 is increased and decreased so that the weight acting on the legs is changed.

**[0018]** At this moment, when the knees are bent by an angle, if the percentage of the body weight supported by the seat 2 is decreased, the loads acting on femoral regions of the user M are increased like bending knees in squat exercise. Muscle groups in the femoral regions can be contracted. That is, when the seat 2 is oscillated through the drive source, the muscle groups in the femoral regions are repeatedly tensed and relaxed by not active exercise of the user M but passive exercise. In short, the muscle groups in the femoral regions can be exercised by oscillating the seat 2 with the seat driver 50.

**[0019]** It is preferable that the oscillation direction should be set so as to prevent shear force from acting on knee joints. In case the buttocks of the user M is supported by the contact face 2a of the seat 2, when the feet of the user M are in a natural position, the distance between the toe sides is larger than that between the heel sides as shown in FIG. 3. The opening angle $\theta 2$ between both feet can be determined by the positions of footstool 3 surmounted by the feet. Therefore, the seat 2 is oscillated in a direction along a central line through a heel and a toe of either foot when the feet are placed on the footstools 3, and thereby enabling to exercise without shear force acted on the knee joints. That is, when the seat 2 is moved forward from a rear end position in an oscillation range, a time period when it is moved right forward and a time period when it is moved left forward are provided. Thereby, the user's own weight can be acted on the femoral regions of the right and left legs without shear force acted on the knee joints.

**[0020]** In an example of FIG. 1, the top face of the seat 2, the contact face 2a is substantially included in a horizontal plane, but it is desirable that the contact face 2a contacted with the buttocks of the user M should slope forward and downward in the oscillation direction of the seat 2 because exercise for inducing contraction of the muscle groups in the femoral regions is performed by changing the user's own weight acting on the legs of the user M. That is, it is desirable that, in the front end part of the seat 2, a region for supporting a right buttock of the user M should slope obliquely downward in right front, while a region for supporting a left buttock of the user M should slope obliquely downward in left front. In such configuration, when the seat 2 is moved forward from the rear end position in the oscillation range, the weight acting on the legs can be easily increased and the exercise

effect can be enhanced.

**[0021]** An operation display device32 is located at the central part of the handle 31 on the top edge of the handle post 30. The operation display device32 performs operator guidance for the seat driver 50 and the elevating mechanism 60, a rough indication about exercise volume, or the like. The user M can stabilize own upper body by gripping the handle 31.

**[0022]** The configuration of the seat supporter 21 is explained in detail. As shown in FIG. 4, the seat supporter 21 has a hollow brace 22 standing on the equipment base 20, and the bottom head of the elevating mechanism 60 is put in the brace 22. The elevating mechanism 60 has an elevating base 61 which can slide with respect to the brace 22 and move up and down, and the seat driver 50 is mounted on the top edge of the elevating base 61. Therefore, the seat driver 50 as well as the seat 2 can move with respect to the equipment base 20.

**[0023]** The central line of the brace 22 is a straight line, and sloped backward with respect to a vertical direction (i.e., sloped upward and backward). The position of the contact face 2a of the seat 2 can be adjusted on the straight line along the central line of the brace 22 with respect to the vertical direction by sliding the elevating base 61 inside the brace 22. In other words, the position of the contact face 2a of the seat 2 is adjusted in the vertical direction and then at the same time is adjusted in a front-back direction and located more backward as it is located more upward. In a configuration of the example, the central line of the brace 22 has an angle $\varphi$ of about 75° with the equipment base 20.

**[0024]** Incidentally, the elevating base 61 is moved up and down through an elevating driver 62 including a drive motor 63. In addition to the drive motor 63, the elevating driver 62 has a columnar fixed member 64 fixed to the equipment base 20 and a movable member 65 including a ball screw threadably mounted on the fixed member 64. The movable member 65 is adapted to project and retreat with respect to the fixed member 64 by decelerating the rotation of the drive motor 63 to rotate the movable member 65. The elevating base 61 is attached to the top edge of the movable member 65 and moves up and down as the movable member 65 projects and retreats with respect to the fixed member 64.

**[0025]** The elevating base 61 has a pedestal 61a on which the seat driver 50 is mounted. A pair of guide panels 61b is provided on the undersurface of the pedestal 61a. The top edge of the movable member 65 in the elevating driver 62 is coupled to the undersurface side of the pedestal 61a. Rollers 61c are also attached on the lateral surface of each guide panel 61b. The rollers 61c are guided by rail parts 22a provided inside the brace 22 and thereby the elevating base 61 can move smoothly with respect to the brace 22. In the configuration, it is provided with a sensor for detecting the projecting and retreating distance of the movable member 65 with respect to the fixed member 64. The rotation of the drive motor 63 is controlled so that a detected value of the sensor agrees with a target value indicated in response to an input from the operation display device 32. However, the further explanation of the configuration is omitted as it is not gist.

**[0026]** A tubular elevating cover 66 is attached to the pedestal 61a of the elevating base 61. The lower part of the elevating cover 66 overlaps with the lateral surface of brace 22 in a range of expansion and contraction of the elevating driver, which prevents the elevating base 61 from being exposed to the outside even if the elevating driver 62 is expanded to be maximized. A mechanism cover 67 formed of fabric flexible material is also attached to the pedestal 61a of the elevating base 61. The mechanism cover 67 covers between the pedestal 61a and the seat 2, and thereby prevents the seat driver 50 from being exposed to the outside.

**[0027]** The seat driver 50 is explained with reference to FIGS. 5 and 6. The seat driver 50 is a mechanism for oscillating the seat 2 as well as the pedestal 61a of the elevating base 61. Pivotal support plates 51a and 51b are stood on the front and the rear of the top face of the pedestal 61a, and the seat driver 50 is pivotally attached to the pivotal support plates 51a and 51b at the pivots 52a and 52b. The pivots 52a and 52b are arranged in front and behind on the same axis. The seat driver 50 rotates around the pivots 52a and 52b, and thereby the seat 2 coupled to the seat driver 50 can oscillate in a right-left direction (the direction indicated by the arrow N in FIG. 4).

**[0028]** The seat driver 50 includes two frame plates 53a and 53b in front and behind. The frame plates 53a and 53b are coupled through right and left of frame side plates 54a and 54b. The lower ends of the front and rear links 55 and 56 are pivotally attached to the frame side plates 54a and 54b at the pivots 55a and 56a, and thereby rotating around an axis of a right-left direction. The upper ends of the front and rear links 55 and 56 are pivotally attached to a support plate 57 at the pivots 55b and 56b. The upper end of the rear link 56 is pivotally attached not to the support plate 57 directly but to a bearing plate 57a fixed to the support plate 57.

**[0029]** The moving range of the support plate 57 is regulated so that the front end part of the support plate 57 can move on a circular arc of which center is the pivot 55a and the rear end part of the support plate 57 can move on a circular arc of which center is the pivot 56a. The rear link 56 is formed to have a longer size than the front link 56, and the front and rear end parts of the support plate 57 are different in a radius of rotation from each other. Thereby, the inclination angle of the top face of the support plate 57 changes as the support plate 57 moves back and forth. Specifically, if the position in FIG. 6 is the rear end position of the moving range in a front-back direction, the front end part of the support plate 57 descends relatively with respect to the rear end part as moving forward and then the inclination angle of the top face becomes large. To the contrary, when it moves backward from the front end position, the front end part of the support plate 57 ascends relatively with respect to the

rear end part as moving forward and then the inclination angle of the top face becomes small. That is, the seat 2 can move in a front-back direction (the direction indicated by the arrow X in FIG. 4). Although FIG. 4 shows a rectilinear movement, it actually becomes a composite displacement of a rectilinear movement in the front-back direction and a rotational movement because the inclination angle in the front-back direction is changed.

**[0030]** The frame side plates 54a and 54b retain a motor 71 that is a drive source for oscillating the support plate 57 with respect to the pedestal 61a. The motor 71 is vertically placed so that its output axis projects upward. A worm 72 is couple to the output axis of the motor 71. The frame side plates 54a and 54b support first and second shafts 73 and 74 so that they can freely rotate, and the first shaft 73 is provided with a worm wheel 75 engaged with the worm 72. The first shaft 73 is also provided with a gear 76 that engages with a gear 77 supplied to the second shaft 74. Eccentric cranks 78 rotating in cooperation with the first shaft 73 are attached to both ends of the first shaft 73. One ends of the arm links 79 are turnably supported by the eccentric cranks 78, respectively, and the other ends are turnably supported by an axial pin 55c projected to the right and left of the front link 55.

**[0031]** In this configuration, if the motor 71 rotates and then the first shaft 73 rotates, the front link 55 reciprocates in a front-back direction around the pivot 55a through the eccentric cranks 78 and the arm links 79, and the anterior part of the support plate 57 oscillates in a front-back direction (the direction indicated by the arrow X in FIG. 4) around the pivot 55a. Because the rear link 56 rotates around the pivot 56a, the support plate 57 moves in the front-back direction and thereby the inclination angle of the top face comes to change.

**[0032]** On the other hand, an eccentric pin 74a is projected from the one end of the second shaft 74. One end of an eccentric rod 80 is turnably supported by the eccentric pin 74a, and the other end is linked to a connecting fitting 81 attached to the pedestal 61a so that it can oscillate. The eccentric pin 74a and the eccentric rod 80 may supplied to any of the right and left of the seat driver 50.

**[0033]** In this configuration, if the motor 71 rotates and the second shaft 74 rotates through the first shaft 73, the eccentric pin 74a changes in height position above the pedestal 61a through the eccentric pin 74a and the eccentric rod 80, and consequently the support plate 57 oscillates from side to side (the direction designated by the arrow N in FIG. 4) around the pivots 52a and 52b.

**[0034]** Incidentally, the motor 71 uses a DC brushless motor or the like, and the drive motor 63 also uses a DC motor. The drive motor 63 is set up in a space surrounded with the frame plates 53a and 53b, the frame side plates 54a and 54b, the pedestal 61a and the support plate 57, while the gears 76 and 77 are also set up in the space. Accordingly, the seat driver 50 is compact.

**[0035]** The seat driver 50 basically makes the seat 2 move downward in right front and downward in left front. However, under suitable configuration of a gear ratio between the gears 76 and 77 and the phase difference between the eccentric crank 78 and the eccentric pin 74a, the seat 2 can have a V-shaped movement locus (reciprocate twice in a front-back direction while reciprocating once in a right-left direction). Besides, the seat 2 can have a W-shaped movement locus (reciprocate four times in a front-back direction while reciprocating once in a right-left direction), an 8-shaped movement locus (reciprocate twice in a front-back direction while reciprocating once in a right-left direction, in which rear end positions are biased to the right and left), or the like.

**[0036]** The operation display device 32 is operated and thereby directing the drive motor 63 and the motor 71 to drive and stop. That is, the operation display device 32 is provided with an operating portion for directing the motor 71 to drive and stop and directing the rotation speed of the motor 71. Thereby, exercise time and exercise intensity can be specified.

A controller (not shown) relates the operating and displaying portions of the operation display device 32 to the operations of the motor 71 and the drive motor 63.

**[0037]** If the user M sitting on the seat 2 drives and moves the seat 2 through the seat driver 50, the load balance added to the seat 2 and the footstool 3 by the user M is changed, and the weight acting on the legs can be changed. Specifically, under the condition of droopy posture that the front side of the seat 2 descends, the barycentric position of the user M is shifted forward and thereby increasing the loads acting on the legs including the femoral regions of the user M by own weight. Under the condition of inclination posture that the seat 2 inclines to one of the right and left of the user M, the load by user's own weight mainly acts on the leg at the inclined side of the seat 2. According to these combinations, the user's own weight acting on the legs of the user M is changed and the muscles of the legs can be trained effectively.

**[0038]** In the passive exercise equipment 1, in order to encourage contracting of muscle groups in the femoral regions of a user M having gonalgia without pain in knee, a bending angle $\theta 1$ of knee requires keeping an appropriate angle. The exercise for keeping an appropriate angle with respect to the bending angle of knee is exercise such that, in squat exercise, the weight acting on femoral regions is changed from the posture knee(s) is previously bent at a predetermined angle. It is desirable that a knee joint agrees with an ankle joint in a vertical direction in order to enhance the loads acting on the femoral regions. That is, it is presupposed that the footstool 3 continues supporting the feet of the user M in use, which can be handled by: suitably extending the brace 22 according to leg length of the user M and thereby suitably setting up the vertical position of the seat 2; and stabilizing the position relation between the sole-surmounted parts 4 and the seat 2 which are driven and moved. Incidentally, the vertical position of the seat 2 is set up by operation of the operating portion for elevating the seat 2 in the

operation display device 32.

**[0039]** As shown in FIG. 1, the footstool 3 is attached to a base part 5 fixed to the equipment base 20 so that the sole-surmounted part 4 can vertically move through guide structure (not shown). The footstool 3 is further provided with elastic device 6 for biasing the sole-surmounted part 4 upward. If the position of the seat 2 is moved through the seat driver 50, the load balance added to the seat 2 and the footstool 3 by the user M is changed, and the user M suitably depress a sole-surmounted part 4 naturally in the teeth of the bias of the elastic device 6. Thereby, the sole-surmounted part 4 vertically moves so as to stabilize the position relation with the seat 2. Accordingly, it is expected that the user M can train the legs while hardly bending and stretching the knees. The elastic device 6 has a function for returning the sole-surmounted part 4 upward, which the user M depresses.

**[0040]** If the load balance added to the footstools 3 by the user M is increased, the user M tries to support the body by depressing the sole-surmounted parts 4. The depressing force against the sole-surmounted parts 4 includes the weight of the legs and so on corresponding to the body type (body weight) of the user M, and accordingly changes by body type difference among users M. The passive exercise equipment 1 is devised to secure constant sense of use so as to avoid variation in depressing feel against sole-surmounted parts irrespective of body type difference among users.

**[0041]** That is, each footstool 3 is provided with a bias adjuster 7 which can adjust the elastic coefficient of an elastic device 6. The footstool 3 is formed of a plurality of (e.g., three) spring members 11 intervened between a sole-surmounted part 4 and the base part 5 of a footstool 3. The plurality of spring members 11 include a plurality of (e.g., two) unconnected spring members 11a each of which has an unconnected end $11a_1$. The unconnected end $11a_1$ is not connected to the base part 5 or the sole-surmounted part 4 (in the embodiment, the sole-surmounted part 5) in a free state in which no external force acts on it.

**[0042]** The bias adjuster 7 is formed of a member (a slide member 12 to be described) switchable between states in which the member is connected to and disconnected from both the unconnected ends $11a_1$ of the unconnected spring members 11a and the base part 5 or the sole-surmounted part 4 (in the embodiment, both the unconnected ends $11a_1$ and the base part 5).

**[0043]** Specifically, as shown in FIG. 1, three spring members 11 are put side by side at intervals in a front (toe side)-back(heel side) direction and suspended on the undersurface of the sole-surmounted part 4. All upper ends of the spring members 11 are connected to the sole-surmounted part 4. The lower end of the spring member 11 at the front end is connected to the base part 5. But each length of the other spring members 11 is set so that its own lower end is not connected to the base part 5 in a free state. That is, these spring members 11 are the aforementioned unconnected spring members 11a, and the lower ends are the aforementioned unconnected ends $11a_1$.

**[0044]** A slide member 12 has substantially the same thickness as the space width between the unconnected end $11a_1$ of an unconnected spring member 11a and the top face of a base part 5, and is placed on the top face of the base part 5 through rail-shaped guide parts 13 so that it can slide in a front-back direction. The slide member 12 is formed with an elastic operating part 14 like a handle projecting backward from the footstool 3. The unconnected spring members 11a can be coupled to the sole-surmounted part 4 and the base part 5, if a user M slides the slide member 12 forward with the elastic operating part 14 and thereby makes the unconnected ends $11a_1$ of the unconnected spring members 11a touch the top face of the slide member 12. According to the slide member 12, it is possible to select the number of unconnected spring members 11a coupled to the sole-surmounted part 4 and the base part 5 by size of slide in front.

**[0045]** Thus, if the user M selects the number of the spring members 11 coupled to the sole-surmounted part 4 and the base part 5 by handling the slide member 12, the user M can adjust and set the whole elastic coefficient of the elastic device 6. Therefore, by adjusting the elastic coefficient of the elastic device 6 biasing the sole-surmounted part 4 upward through the bias adjuster 7 in accordance with body type difference among users M, it is possible to secure substantially constant sense of use irrespective of body type difference among users M. That is, a relatively high elastic coefficient is set for a user M having heavy legs and so on, while a relatively low elastic coefficient is set for a user M having light legs and so on.

**[0046]** A type of passive exercise equipment in a second embodiment is explained. Like kind elements are assigned the same reference numerals as depicted in the first embodiment, and different points from the first embodiment are explained below.

**[0047]** FIG. 7 shows the second embodiment that is another example of a footstool 3, and uses extensible base members 15 in place of the aforementioned slide member 12 as a member switchable between states in which the member is connected to and disconnected from both unconnected ends $11a_1$ and a base part 5. Each extensible base member 15 includes an upper wall 15a which can touch the unconnected end $11a_1$ of an unconnected spring member 11a. The upper wall 15a is placed at the top face of the base part 5 through a parallel linkage, and can be moved up and down. The upper wall 15a is provided with an elastic operating part 14 like a handle projecting outward from the footstool 3 in a right-left direction. In accordance with each location of unconnected spring members 11a, an upper wall 15a is provided. The second embodiment can also produce similar results to the first embodiment.

**[0048]** In the first and second embodiment, the spring members 11 constituting an elastic device 6 are arranged in a linear fashion on a central line of a footstool 3 in a front-back direction. However, as shown in FIG. 8, the

spring members 11 may be arranged in a voluntary fashion such as a triangular fashion in planar view. In FIG. 8, one spring member 11 is located at the front part of the footstool 3, and two unconnected spring members 11a are arranged side by side in a right-left direction at the rear part of the footstool 3. Each elastic operating part 14 of the extensible base members 15 is projected backward from the footstool 3.

**[0049]** FIG. 9 shows a third embodiment. This embodiment has a body weight input part 8 configured to input the body weight of a user M. Each bias adjuster 7 is provided with a regulatory driver 9 for adjusting the elastic coefficient of an elastic device 6. The controller is configured to perform drive control of each regulatory driver 9 in response to the body weight set through the body weight input part 8. For example, the operation display device 32 can include the body weight input part 8. For example, the regulatory driver 9 may be formed of a drive source 16 such as a motor, a solenoid or the like, and a mechanical section 17 that drives and slides the slide member 12 or drives and moves the extensible base members 15 up and down. However, other configuration can be adapted.

**[0050]** In this embodiment, a user M has only to input user's own body weight through the body weight input part 8, and the controller automatically sets an elastic coefficient of each elastic device 6 under the bias adjusters 7 through the regulatory drivers 9 based on the input body weight. Therefore, it is possible to avoid troublesome setting of an elastic coefficient of each elastic device 6 through the bias adjusters 7 by hand operation every in-use like the aforementioned embodiments, and secure convenient passive exercise equipment 1.

**[0051]** FIG. 10 shows a fourth embodiment. This embodiment has a body weight detector 10 for detecting the body weight of a sitting user M. Each bias adjuster 7 is provided with a regulatory driver 7 for adjusting the elastic coefficient of an elastic device 6. The controller is configured to perform drive control of each regulatory driver 9 in response to the body weight detected with the body weight detector 10. For example, the body weight detector 10 may be formed of weight sensors 10a placed on the seat 2 and two footstools 3. If the weight sensors 10a detect each load from buttocks and soles of a user M, the body weight of the user M can be detected from sum of them.

**[0052]** In this embodiment, if a user M sits, the body weight detector 10 detects the body weight of the user M and the controller automatically sets an elastic coefficient of each elastic device 6 under the bias adjusters 7 through the regulatory drivers 9 based on the detected body weight. Therefore, it is possible to avoid troublesome setting of an elastic coefficient of each elastic device 6 through the bias adjusters 7 by hand operation every in-use like the aforementioned embodiments, and secure convenient passive exercise equipment 1.

## Claims

**1.** Passive exercise equipment, comprising:

a seat configured to rest a user on the buttocks;
right and left footstools configured to rest the right and left soles of the user sitting on the seat on; and
a seat driver configured to change the position of the seat to change load balance added to the seat and the footstools by the user and thereby to change the user's own weight acting on the legs,
wherein each footstool comprises:

a sole-surmounted part which a sole is placed on and meanwhile can be moved up and down;
an elastic device configured to bias the sole-surmounted part upward;
and
a bias adjuster configured to adjust an elastic coefficient of the elastic device.

**2.** The passive exercise equipment of claim 1, comprising:

a body weight input part configured to input body weight of the user;
regulatory drivers configured to drive the bias adjusters to adjust elastic coefficients of the elastic devices, respectively; and
a controller configured to perform drive control of the regulatory drivers in response to the body weight input though the body weight input part.

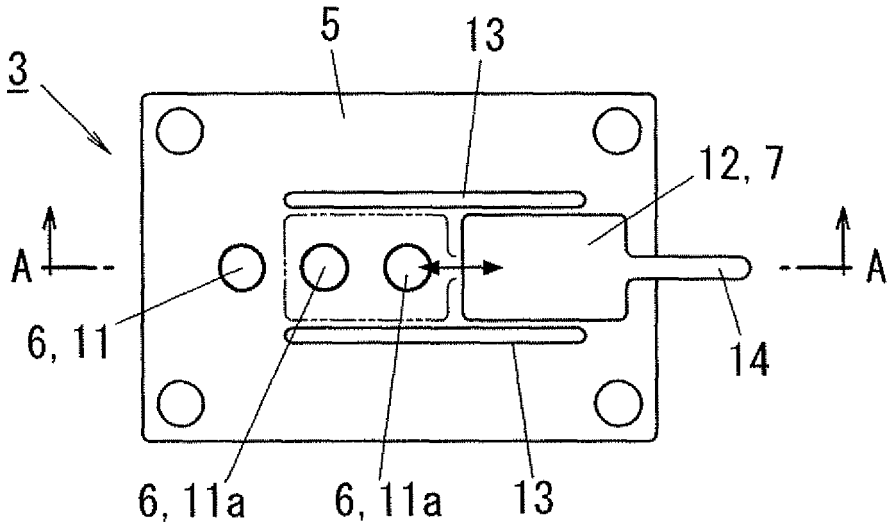
**3.** The passive exercise equipment of claim 1, comprising:

a body weight detector configured to detect body weight of the sitting user;
regulatory drivers configured to drive the bias adjusters to adjust elastic coefficient of the elastic devices, respectively; and
a controller configured to perform drive control of the regulatory drivers in response to the body weight detected though the body weight detector.

**4.** The passive exercise equipment of any one of claims 1-3, wherein said elastic device comprises a plurality of spring members arranged between said sole-surmounted part and a base part of said footstool,
said plurality of spring members comprising an unconnected spring member having an unconnected end which is not connected to said base part or said sole-surmounted part in a nature state,
wherein said bias adjuster comprises a member

switchable between states in which the member is connected to and disconnected from both the unconnected end of said unconnected spring member and said base part or said sole-surmounted part.

FIG. 1A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5
13
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A
A
6, 11
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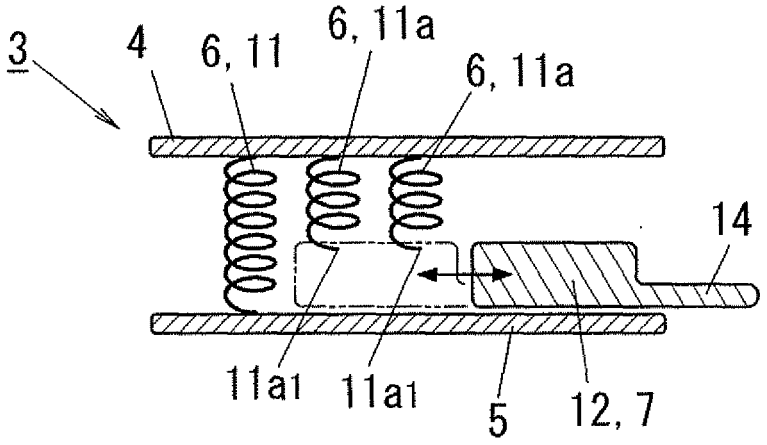
6, 11a
6, 11a
13

FIG. 1B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4
6, 11
6, 11a
6, 11a
14
11a1
11a1
5
12, 7

FIG. 2

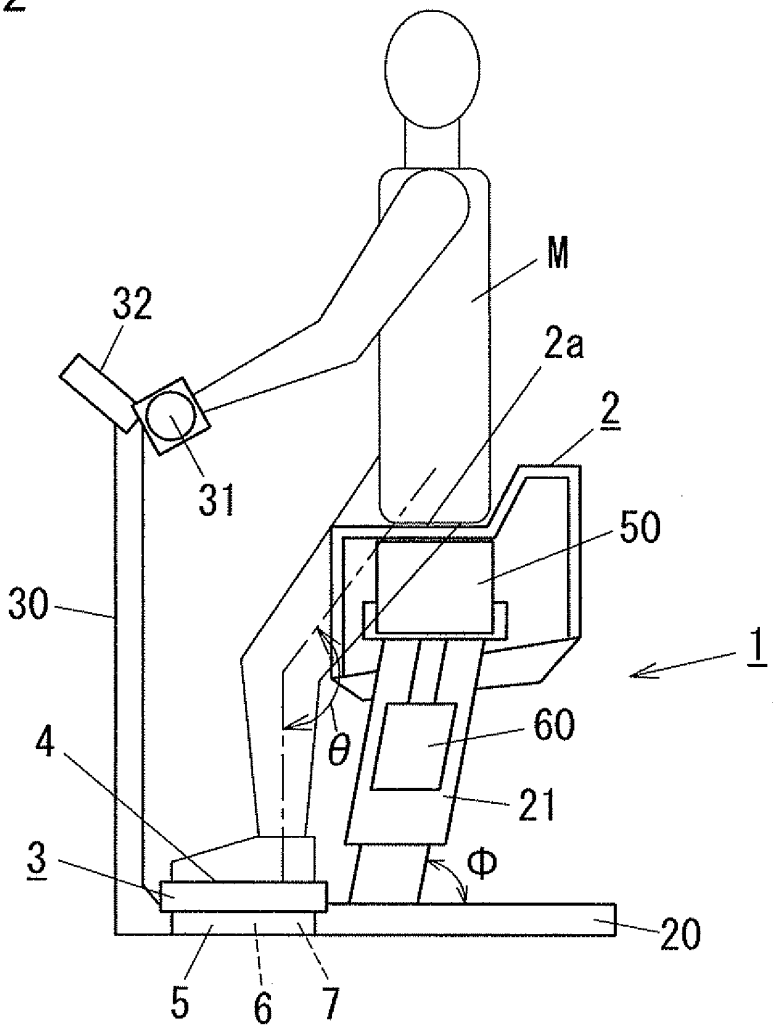



FIG. 3

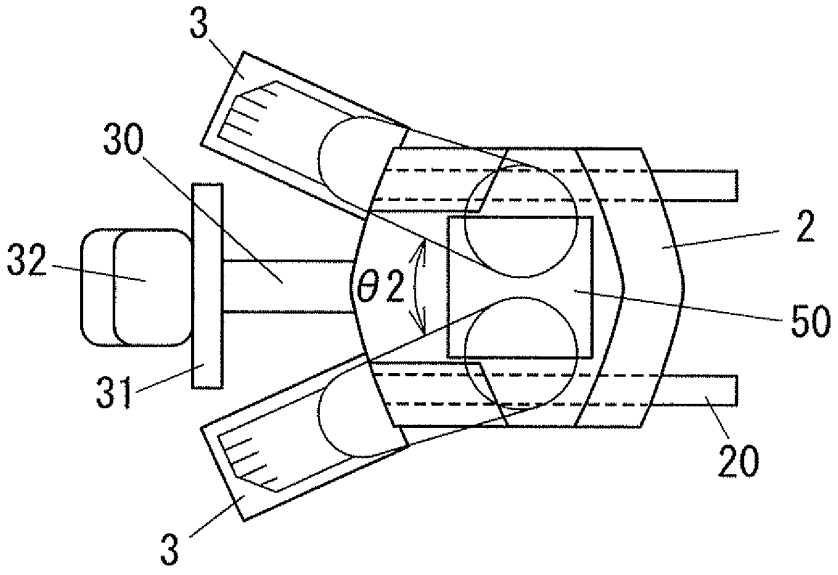
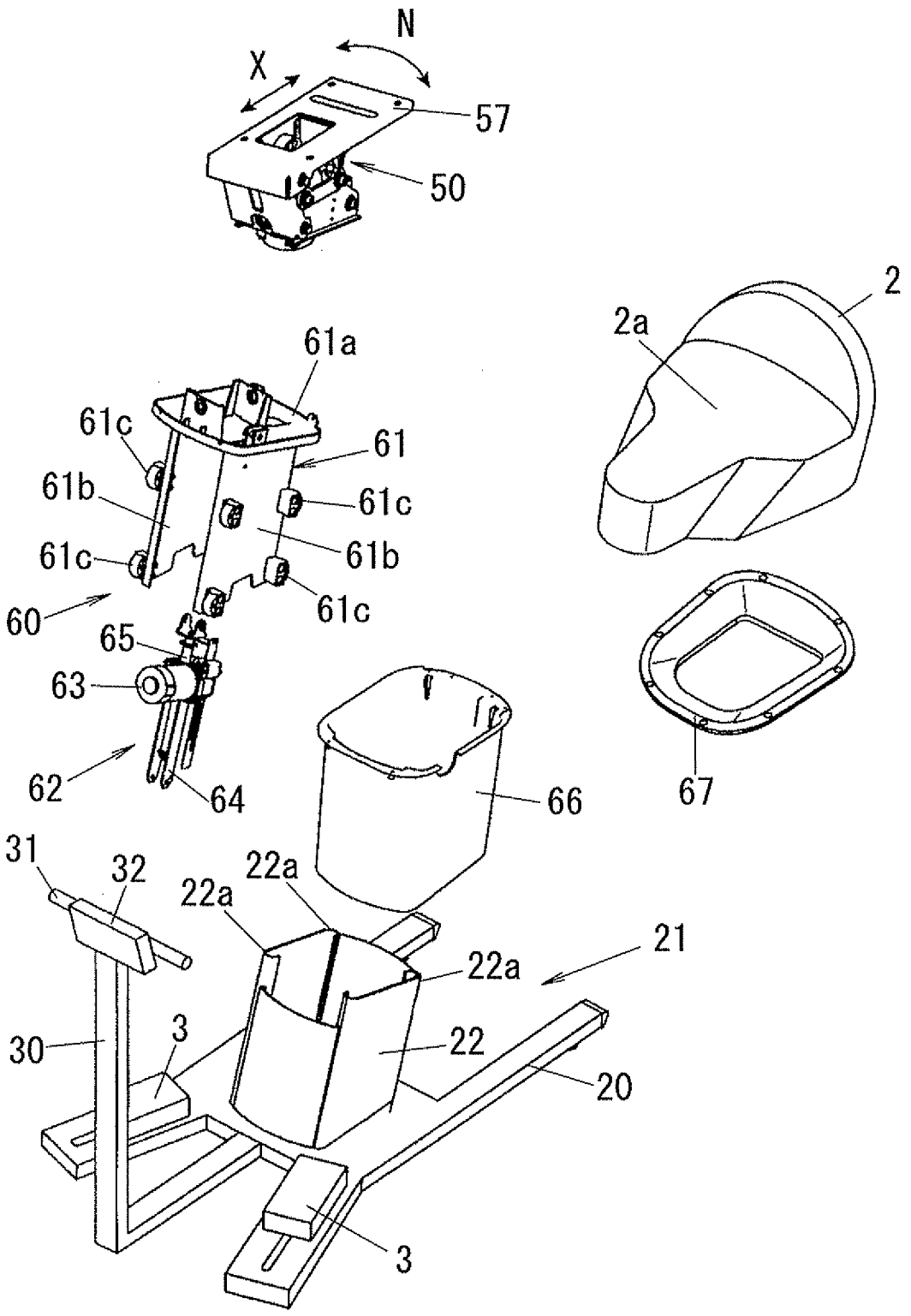


FIG. 4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61c
61c
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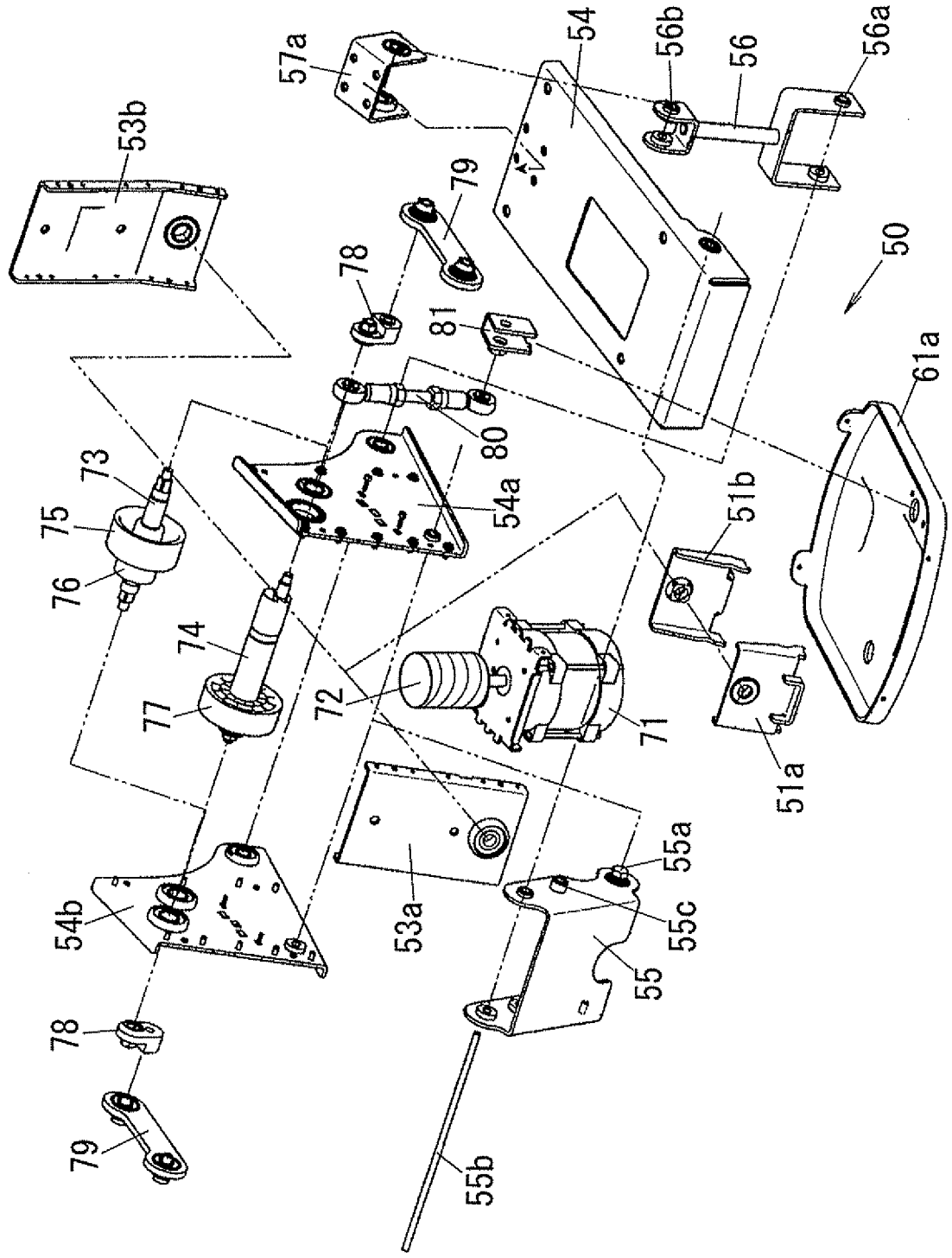
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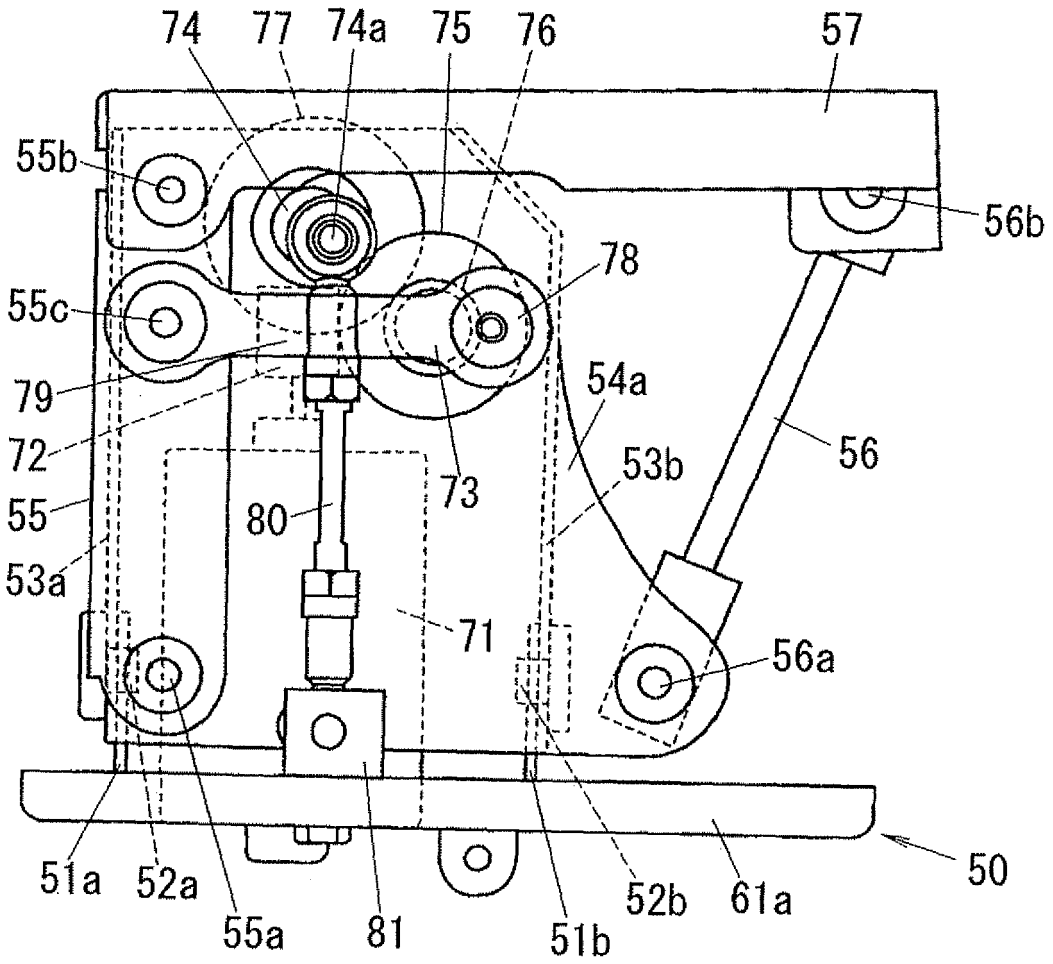
77
51a
55a
54b
53a
55c
55
78
79
55b

FIG. 5

FIG. 6


74
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55c
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55a
81
51b
52b
61a
50

FIG. 7A

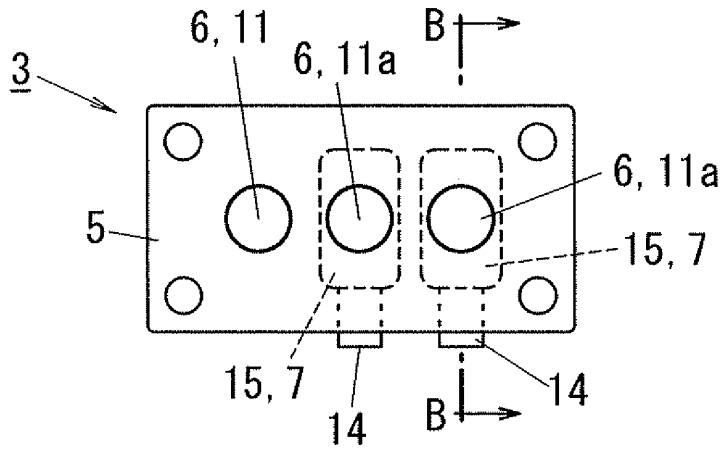



FIG. 7B

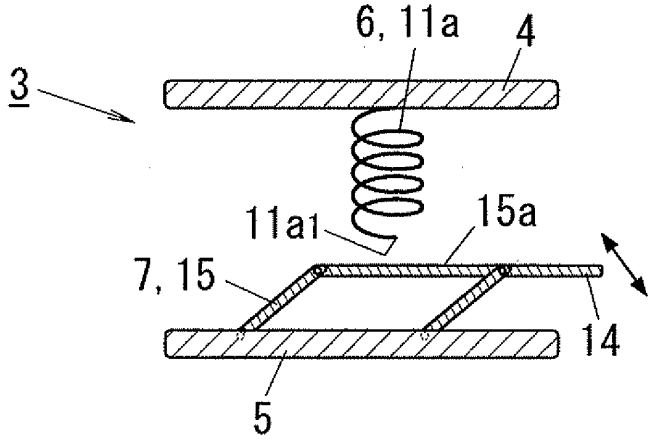



FIG. 8

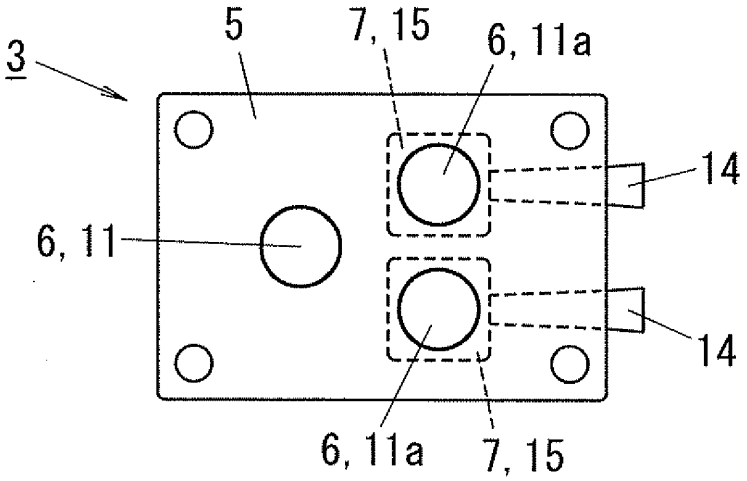


FIG. 9

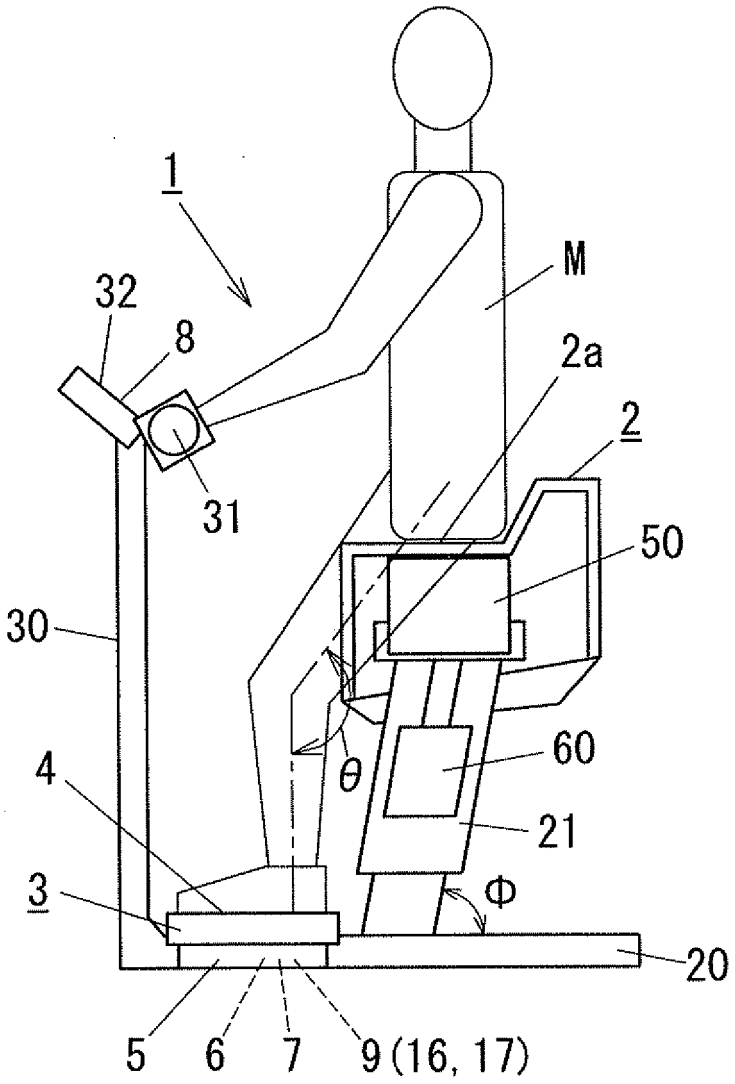
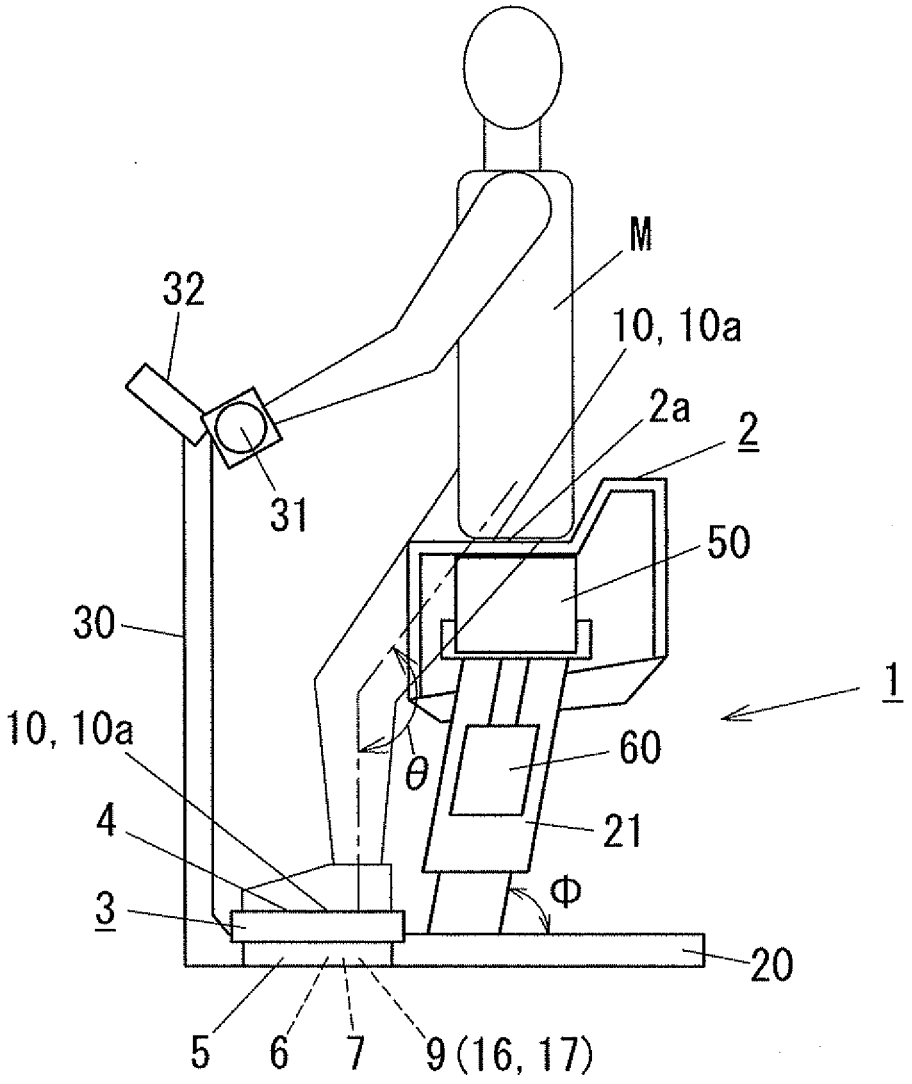


FIG. 10



**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2008/069312

A. CLASSIFICATION OF SUBJECT MATTER
*A61H1/02*(2006.01)i, *A63B23/08*(2006.01)i, *A63B24/00*(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)
A61H1/02, A63B23/08, A63B24/00

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 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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. |
|---|---|---|
| X<br>Y<br>A | WO 2004/110568 A1 (Matsushita Electric Works, Ltd.),<br>23 December, 2004 (23.12.04),<br>Page 5, line 28 to page 6, line 4; page 13, line 28 to page 14, line 6; Figs. 1 to 37<br>& JP 2005-58733 A & JP 2007-181731 A<br>& US 2006/0229170 A1 & EP 1629868 A1<br>& TW 254627 B & KR 10-2006-0015611 A<br>& CN 1809403 A | 1<br>2,3<br>4 |
| Y | JP 11-197266 A (Mutsuo WATANABE),<br>27 July, 1999 (27.07.99),<br>Claims; Par. No. [0081]; Figs. 1 to 12<br>(Family: none) | 2,3 |

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 30 January, 2009 (30.01.09) | 10 February, 2009 (10.02.09) |
| Name and mailing address of the ISA/<br>Japanese Patent Office<br><br>Facsimile No. | Authorized officer<br><br>Telephone No. |

Form PCT/ISA/210 (second sheet) (April 2007)

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2008/069312

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP 2002-78818 A (ATR Media Integration & Communications Research Laboratories), 19 March, 2002 (19.03.02), Claims; Par. Nos. [0010], [0013] to [0016]; Figs. 1 to 5 (Family: none) | 2,3 |
| Y | JP 2006-325989 A (Matsushita Electric Works, Ltd.), 07 December, 2006 (07.12.06), Claims; Par. No. [0010]; Figs. 1 to 5 (Family: none) | 3 |
| A | JP 63-503517 A (Institut Mashinovedenia Imeni A.A. Blagonravova Akademii Nauk SSSR), 22 December, 1988 (22.12.88), Fig. 2 & EP 270673 A1 & WO 1987/007831 A1 | 4 |

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2008/069312

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

The invention of claims 1 - 3 relates to a passive exercise machine comprising elastic means and bias-adjusting means, further comprising adjusting drive means for adjusting the modulus of elasticity of the elastic means, and a control unit for performing the drive control of the adjusting drive means in accordance with the weight of the user.

The invention of claim 4 relates to a passive exercise machine comprising elastic means and bias adjusting means, wherein the elastic means and the bias adjusting means are made to have specific structures.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

the

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2007)

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP 2005058733 A **[0002]**
- JP 2007089650 A **[0002]**