EXERCISE ASSISTING APPARATUS

Inventors: Kazuhiro Ochi, Osaka-shi (JP); Youichi Shinomiya, Ibaraki-shi (JP); Takahisa Ozawa, Hikone-shi (JP)

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ABSTRACT

An exercise assisting apparatus (1) comprises: a seat (13) on which buttocks of a user (2) is sit; a stationary support base (12) for supporting the seat (13); a burden regulator (14) provided between the support base (12) and the seat (13), and for regulating a ratio of self weight of the user which is supported by the seat (13) so that a load due to the self weight of the user acting on leg portion of the user; and a driving mechanism (16) for driving the burden regulator (14) so that the ratio of self weight of the user supported by the seat varies as time passes. The burden regulator (14) couples the support base (12) and the seat (13) in a manner so that a portion of the seat (13) to which the buttocks of the user is sit is tilted between a first state where the portion becomes horizontal and a second state where the portion is slanted downward toward the foot side in a plane including one of femoral regions and the buttocks of the user. Thus, a space necessary for using the exercise assisting apparatus (1) can be narrowed, and strength of a material of the support base (12) can be lowered.
EXERCISE ASSISTING APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to an exercise assisting apparatus which enables contracting of muscle of a user with regulating a burden due to own weight of the user acting on legs of the user under a state that buttocks of the user is sit on a seat, although it is relatively comfortable posture.

BACKGROUND ART

[0002] Generally, it is known that contraction of muscle occurs when stimulus of exercise due to external force is applied to a muscle of a user even if the user does not move a body voluntarily. In other words, although stimuli of exercise are caused by external force, when the muscle of the user repeats contraction, glucose is taken in the muscle, so that glucose metabolism rises, and thereby glucose will be consumed. Therefore, it may contribute to recover from diseases of adults such as diabetes, corpulence or hyperlipemia, as a result that hyperglycosemia, hyperinsulinemia are improved.

[0003] In order to perform the glucose metabolism due to contraction of muscle effectively, it is desirable to generate the contraction of muscle in a muscle having a large volume such as red muscle or slow muscle which contributes to aerobic exercise in particular. Thus, it is found to be effective for contracting muscles of femoral region or back. In a conventional exercise assisting apparatus for inducing contraction of muscle in the femoral region, for example, shown in Japanese Laid-Open Patent Publication No. 2005-58733, a support base is provided for supporting buttocks of a user at an upper end portion thereof while the user sits, and the support base is constituted to be tilted.

[0004] In the above conventional exercise assisting apparatus, it is constituted to tilt the support base, so that relatively wide space is needed to tilt the support base. Furthermore, a relatively large moment due to self weight of the user acts on a lower end portion of the support base, so that it is necessary to give relatively high strength to the support base. As a result, an occupation space necessary for establishment of the exercise assisting apparatus becomes wider, so that the position of establishment of the exercise assisting apparatus may be limited. Still furthermore, it is necessary to increase strength of a material of the support base or a member enabling to tilt the support base, so that the exercise assisting apparatus becomes expensive.

DISCLOSURE OF INVENTION

[0005] A purpose of the present invention is to provide an exercise assisting apparatus which enables to reduce restriction of installation location with diminishing necessary space at the point of use, and to reduce the strength of the material of the support base, in comparison with the configuration of the conventional exercise support apparatus.

[0006] For accomplishing the above-mentioned purpose, an exercise assisting apparatus in accordance with an aspect of the present invention comprises:

[0007] a seat on which buttocks of a user is sit;
[0008] a stationary support base for supporting the seat;
[0009] a burden regulator provided between the support base and the seat, and for regulating a ratio of self weight of the user which is supported by the seat so that a load due to the self weight of the user acting on leg portion of the user; and
[0010] a driving mechanism for driving the burden regulator so that the ratio of self weight of the user supported by the seat varies as time passes;
[0011] the burden regulator coupling the support base and the seat in a manner so that a portion of the seat to which the buttocks of the user sit is tilted between a first state where the portion becomes horizontal and a second state where the portion is slanted downward toward the foot side in a plane including one of femoral regions and the buttocks of the user.

[0012] According to this constitution, the burden acting on the foot portion of the user is varied with varying slanting angle of the seat with respect to the support base, so that it is possible to stimulate the contraction of muscle of the foot of the user, mainly. Thus, muscle strength of foot can be strengthened, or glucose metabolism can be raised by uptake of glucose to muscle due to the contraction of muscle.

[0013] Furthermore, only the seat to which the buttocks of the user is sit is moved but the support base is not moved, so that a space necessary for movement of the apparatus becomes relatively smaller. Thus, the space necessary for establishment of the apparatus can be narrowed in comparison with the conventional constitution where the support base is slanted.

[0014] Still furthermore, the support base is stationary and the slanting angle of the seat with respect to the support base is varied, so that a moment due to self weight of the user acts on around of a portion coupling the support base and the seat. Thus, since the moment acting on around the lower end portion of the support base is largely reduced, the strength of the portion coupling the seat with the support base can be lowered than the strength of the portion which supports the lower end of the support base enabling to tilt in the conventional structure, and thereby cost down of the exercise assisting apparatus is enabled.

BRIEF DESCRIPTION OF DRAWINGS

[0015] FIG. 1A is a side view showing a first state of an exercise assisting apparatus in accordance with a first embodiment of the present invention.
[0016] FIG. 1B is a side view showing a second state of the exercise assisting apparatus in accordance with the first embodiment in.
[0017] FIG. 2A is a perspective view showing the exercise assisting apparatus in the first state shown in FIG. 1A, which is frontally observed.
[0018] FIG. 2B is a perspective view showing a state that a seat is slanted in a plane including buttocks and the right foot among the second states shown in FIG. 1B.
[0019] FIG. 3A is a side view showing a state that a main seat portion is extended in an anteroposterior direction in the exercise assisting apparatus in accordance with the first embodiment.
[0020] FIG. 3B is a side view showing a state that the main seat portion is contracted in the anteroposterior direction.
[0021] FIG. 4A is a side view showing a state that an angle of an auxiliary seat portion with respect to the main seat portion is decreased lowered in a modification of the exercise assisting apparatus in accordance with the first embodiment.
[0022] FIG. 4B is a side view showing a state that the angle of the auxiliary seat portion with respect to the main seat portion is increased in the above modification in the first embodiment.
[0023] FIG. 5A is a side view showing a first state of an exercise assisting apparatus in accordance with a second embodiment of the present invention.

[0024] FIG. 5B is a side view showing a second state of the exercise assisting apparatus in accordance with the second embodiment.

[0025] FIG. 6A is a side view showing a modification of the exercise assisting apparatus in accordance with the second embodiment.

[0026] FIG. 6B is a perspective view showing the above modification in the second embodiment.

[0027] FIG. 7A is a side view showing a first state of an exercise assisting apparatus in accordance with a third embodiment of the present invention.

[0028] FIG. 7B is a side view showing a second state of the exercise assisting apparatus in accordance with the third embodiment.

[0029] FIG. 8 is a plain view showing a constitution of a step portion in a modification of the exercise assisting apparatus in accordance with the third embodiment.

[0030] FIG. 9 is a perspective view showing an exercise assisting apparatus in accordance with a fourth embodiment of the present invention.

[0031] FIG. 10 is a perspective view showing a modification of the exercise assisting apparatus in accordance with the fourth embodiment.

BEST MODE FOR CARRYING OUT THE INVENTION

First Embodiment

[0032] An exercise assisting apparatus in accordance with a first embodiment of the present invention is described with reference to the drawings. FIG. 1A shows a first state of the exercise assisting apparatus 1 in accordance with the first embodiment, and FIG. 1B shows a second state of the exercise assisting apparatus 1.

[0033] As shown in FIGS. 1A and 1B, the exercise assisting apparatus 1 comprises a pedestal 11 which is established on an establishment face such as a floor face, a stationary support base such as a pole brace 12 provided to stick up at a predetermined position on the pedestal 11, and a seat 13 disposed at an upper end of the support base 12 to which buttocks of a user is sit. The seat 13 further comprises a main seat portion 13a to which buttocks of the user is sit, and an auxiliary seat portion 13b obliquely extended downward from the main seat portion 13a. Front portion of the auxiliary seat portion 13b is formed to be two-forked so that femoral regions of the user 2 are positioned thereon. In other words, an angle between the main seat portion 13a and the auxiliary seat portion 13b is set so that femoral regions of the user 2 are supported by the auxiliary seat portion 13b, when the user 2 sits on the seat 13 with his or her legs spread out in a manner so that roots of the femoral regions are aligned at portions near to the boundary between the main seat portion 13a and the auxiliary seat portion 13b.

[0034] The seat 13 is connected to the support base 12 via a burden regulator 14 so as to be supported by the support base 12. The burden regulator 14 connects the seat 13 to the support base 12 in a manner so that the seat 13 can be lifted between a first state where a top face of the main seat portion 13a becomes horizontal as shown in FIG. 1A and a second state where the top face of the main seat portion 13a is slanted downwardly toward foot side from the buttocks as shown in FIG. 1B.

[0035] FIG. 2A shows the first state of the exercise assisting apparatus which is frontally observed. FIG. 2B shows the second state of the exercise assisting apparatus, in particular, a state that the top face of the main seat portion 13a of the seat 13 is slanted in a plane including the buttocks and the right foot. Hereupon, the term “second state” includes two states, one is the above mentioned state that the top face of the main seat portion 13a of the seat 13 is slanted in a plane including the buttocks and the right foot shown in FIG. 2B, and the other is a state that the top face of the main seat portion 13a of the seat 13 is slanted in a plane including the buttocks and the left foot (slanted in the opposite direction to the state shown in FIG. 2B). In the following description, the former case is called “second state (right)” and the latter case is called “second state (left)”.

[0036] A pair of steps 15, to which both feet of the user 2 are posited, is formed on the pedestal 11. The steps 15 are used so that feet of the user 2 are posited thereon in both of the first state and the second state. Therefore, self weight of the user 2 is received with the seat 13 and the steps 15.

[0037] Burden acting on the seat 13 due to the self weight of the user 2 in the first state is larger than that in the second state, and burden acting on the steps 15 due to the self weight of the user 2 in the second state is larger than that in the first state. In other words, burden acting to leg portions of the user 2 due to the self weight of the user 2 varies corresponding to the tilt of the seat 13, so that it is possible to provoke the contraction of muscle in the leg portions of the user 2.

[0038] The exercise assisting apparatus 1 comprises a driving mechanism 16 having a driving source such as a motor for driving the burden regulator 14. When the burden regulator 14 is driven by the driving mechanism 16, the above mentioned first state and the second state are alternately repeated. Specifically, the seat 13 is moved against the support base 12 in an order of first state→second state (left)→first state→second state (right)→first state.

[0039] For realizing this motion of the seat 13, a pair of cranks which are coupled to the seat 13 is provided on both sides of the burden regulator 14, and links coupled to the cranks are provided on the driving mechanism 16. The motor of the driving mechanism 16 is controlled activation and deactivation and rotation speed thereof by a control unit which is not illustrated.

[0040] When the driving mechanism 16 is activated, the first state shown in FIG. 1A where the buttocks of the user 2 is supported with the main seat portion 13a of the seat 13 and femoral regions of the user 2 are supported with the auxiliary seat portion 13b and the second state shown in FIG. 1B where femoral regions of the user 2 are hardly supported with the auxiliary seat portion 13b even though buttocks of the user 2 is supported by the main seat portion 13a are repeated.

[0041] In the first state, since most of the self weight of the user 2 is received with the main seat portion 13a of the seat 13, the burden acting on the leg portion of the user 2 is relatively small. On the other hand, in the second state, since the main seat portion 13a of the seat 13 is slanted forward and downward, a component of force acts on buttocks of the user 2 forward along the top face of the main seat portion 13a, and thereby, the burdens acting on the leg portions of the user increase. Therefore, by repeating the first state and the second
state alternately, the contraction of muscle occurs in the muscle of the leg portions of the user 2.

In the second state, the seat 13 is slanted in either of right and left side of the user 2, in other words, it is slanted in a plane including the support base 12 and either of the steps 15 so as not to act a force in right or left hand on knee joints of the user 2. Even the user 2 who has a pain toward a knee joint can use this exercise assisting apparatus 1 according to such motions. Furthermore, since the burden due to the self weight of the user 2 acts on one of legs of the user 2 in each of the second state (right) and the second state (left), it is possible to apply a larger burden to each leg than that in the case where burdens act on both legs simultaneously.

When there is a pain in a knee joint, it is known that the pain becomes worse, if a bending angle of the knee joint from an extension state is raised larger than a predetermined angle (for example, 40 degrees). Thus, the gradient angle of the seat 13 is limited so that the bending angle of the knee joint is kept lower than a predetermined angle. Specifically, the gradient angle of the main seat portion 13a of the seat 13 is limited to be equal to or smaller than 20 degrees (0 to 20 degrees) with respect to horizontal plane.

According to the exercise assisting apparatus 1 in the first embodiment, since only the seat 13 is tilted with respect to the support base 12 which is provided to stick up at a predetermined position on the pedestal 11, a moment acting on the burden regulator 14 around a rotation center of the seat 13 becomes smaller, in comparison with a constitution to tilt the pedestal like the conventional apparatus, so that the driving power of the driving mechanism 16 can be lowered. Furthermore, a space necessary for moving the exercise assisting apparatus 1 becomes smaller than that of the conventional apparatus.

By the way, a contacting area of the seat and buttocks of the user 2 when the user sits on the seat 13 is different corresponding to physical size of the user 2. Thus, the burden acting on the leg portion in the second state may be varied due to the physical size of the user 2, so that there may be the case that expected exercise effect is not obtained or the exercise becomes over load to the user 2. In addition, it is necessary to regulate the burden acting on the leg portion corresponding to muscular strength of the user 2 as well as difference of physical size.

Thus, the burden regulator 14 is constituted so that the seat 13 is slidable in an anteroposterior direction with respect to the support base 12. As an example of concrete constitution, the burden regulator 14 comprises a guide rail for guiding the seat 13 in the anteroposterior direction, and a lever for switching between a state to move the seat 13 along the rail and a state to fix the seat so as not to move to in the anteroposterior direction. As for the lever, a cam chuck having substantially the same structure as quick release lever used for bicycle widely can be used.

Alternatively, it is possible to constitute that the main seat portion 13a of the seat 13 is divided into two parts of a front portion and a rear portion, and the front portion and the rear portion are coupled with an extension and contraction mechanism like a pantograph so as to vary the area of the main seat portion 13a. With such a configuration, a area of the main seat portion 13a supporting buttocks of the user 2 can be adjusted between the extended state where the main seat portion 13 is extended in the anteroposterior direction as shown in FIG. 3A and the contracted state where the main seat portion 13 is contracted in the anteroposterior direction as shown in FIG. 3B. As a result, the ratio of the burden supported by the seat 13 is varied by adjusting the area of the main seat portion 13a, so that the burden acting on the leg portion of the user 2 can be increased and decreased.

Furthermore, it is possible to constitute that an angle of the auxiliary seat portion 13b with respect to the main seat portion 13a is changeable as shown in FIGS. 4A and 4B, as for the method for increasing and decreasing the burden acting of the leg portion of the user 2. FIG. 4A shows a state that the angle of the auxiliary seat portion 13b with respect to the main seat portion 13a is decreased, so that the burden acting on the auxiliary seat portion 13b from the femoral portions of the user 2 is increased. FIG. 4B shows a state that the angle of the auxiliary seat portion 13b with respect to the main seat portion 13a is increased, so that the burden acting on the auxiliary seat portion 13b from the femoral portions of the user 2 is decreased. In this way, it is possible to regulate the burden acting on the auxiliary seat portion 13b from the femoral portions of the user 2 with varying the angle of the auxiliary seat portion 13b with respect to the main seat portion 13a, and thereby, the burden acting on the leg portion of the user 2 can be increased and decreased. In addition, the constitution to slide the seat 13, and the constitution to extend and contract the main seat portion 13a, and the constitution to vary the angle of the auxiliary seat portion 13b with respect to the main seat portion 13a can be put together appropriately.

Second Embodiment

A second embodiment of the present invention is described with reference to the drawings. In the second embodiment, an upper body supporting member for restricting a part of the upper body of the user 2 is provided on the exercise assisting apparatus 1 so as to prevent the upper body of the user 2 from tilting forward or backward more than required. In other words, when the upper body of the user 2 is tilted forward more than supposed in the second state of the seat 13, the burden acting on the leg portion becomes superabundant. On the contrary, when the upper body of the user 2 is tilted backward more than supposed, the burden acting on the leg portion becomes insufficient. Thus, the upper body is limited for acting an expected burden on the leg portion of the user 2 in the second embodiment.

FIG. 5A shows the first state of the exercise assisting apparatus 1 in accordance with the second embodiment, and FIG. 5B shows the second state of the exercise assisting apparatus 1. As shown in FIGS. 5A and 5B, in the exercise assisting apparatus 1 in accordance with the second embodiment, an upper body supporting member 17 of a form of backrest, which contacts waist back of the user 2 who sits buttocks on the seat 13, is coupled with the seat 13. The seat 13 and the upper body support member 17 are coupled through a second driving mechanism 18 having a motor as a driving source. The driving mechanism 18 is controlled to adjust an angle of the upper body support member 17 with respect to the seat 13 in conjunction with the tilt of the seat 13 with the driving mechanism 16.

According to such a constitution, although the upper body supporting member 17 and the driving mechanism 18 are newly necessary, and the constitution of the exercise assisting apparatus 1 becomes complicated, it is possible to prevent that the upper body of the user 2 inclines backward, and thereby, expected burden can be acted on the leg portion of the user 2. This constitution, however, does not prevent that
the upper body of the user 2 inclines forward, so that the burden acting on the leg portion may be overabundant when the upper body of the user 2 inclines forward too much. Thus, it is desirable that the user 2 turns both arms to rear face of the upper body supporting member 17 at the point of use so as to prevent the forward inclination of the upper body of the user 2.

A modified example of the exercise assisting apparatus 1 in accordance with the second embodiment is shown in FIGS. 6A and 6B. As can be seen from FIGS. 6A and 6B, an arrester 17a, which contacts a front face of the upper body of the user 2 for restricting forward movement of the upper body, is further added to the upper body supporting member 17 in this modification. The arrester 17a has a single arm 17b, an end of which is rotatable borne on the seat 13, and a supporting bar 17c, which is connected to the other end of the arm 17b and contacts abdomen of the user 2. The user 2 will enter his or her waist into a space between the seat 13 and the arrester 17a from an opening between the supporting bar 17c and the seat 13 so as to sit on the seat 13. Since the arrester 17a is rotatably borne on the seat 13, it is possible to adjust the position of the arrester corresponding to the waistline of user 2.

According to the above modified constitution having the arrester 17a, when the top face of the seat 13 is slanted so that it is located in the second state as shown in FIG. 6A, it is possible to prevent that the buttocks of the user 2 becomes slippery forward. Furthermore, since the arrester 17a contacts the abdomen of the user 2, it is possible to prevent that the upper body of the user 2 slants forward.

The arrester 17a is not necessarily rotatably borne on the seat 13, and it may directly be fixed on the seat 13. Furthermore, the shape of the arrester 17a is not limited to the above mentioned one, and it may be, for example, a seat belt like of that of the airplane. Still furthermore, the upper body supporting member 17 is not necessarily connected to the seat 13. However, when the upper body supporting member 17 is connected to the seat 13, the exercise assisting apparatus 1 is not bulky and enables space-saving.

Still furthermore, since it is sufficient that the arrester 17a prevents the forward movement of the abdomen of the user 2, an arrester 17a having Tee-shape may be provided at a center portion of a front end of the seat 13. In such a case, it is possible to adopt a constitution that the arrester 17a can be fallen forward when the user 2 sits on the seat 13, and raised and adjusted the location thereof after the user 2 sits on the seat 13. Other constitutions and action of the exercise assisting apparatus 1 in the second embodiment are similar to those in the above mentioned first embodiment.

Third Embodiment

Subsequently, an exercise assisting apparatus in accordance with a third embodiment of the present invention is described with reference to the drawings. FIG. 7A shows a first state of an exercise assisting apparatus 1 in accordance with the third embodiment, and FIG. 7B shows a second state of the exercise assisting apparatus 1. As shown in FIGS. 7A and 7B, each step 15 is constituted by a plurality of, for example, two partial steps 15a and 15b in the exercise assisting apparatus 1 in the third embodiment.

The partial steps 15a and 15b are movable with respect to the pedestal 11 each. In addition, each step 15 has a driving unit 20 for driving the partial steps 15a and 15b with a driving source such as a motor. Since the motions of the partial steps 15a and 15b are in conjunction with the motion of the seat 13, it is no need to provide a driving source with respect to each of the partial steps 15a and 15b, and it may drive a plurality of the partial steps 15a and 15b with a single driving source.

Each of the partial steps 15a and 15b is constituted so that at least one of elevation, location in the anteroposterior direction (in a direction parallel to the arrangement of FIGS. 7A and 7B), location in the widthwise direction (in a direction perpendicular to a paper sheet of FIGS. 7A and 7B) and tilt angle (at least one of rotation around an axis in the anteroposterior direction and rotation around an axis in the widthwise direction) with respect to the pedestal 11 is variable.

In the example shown in FIGS. 7A and 7B, the partial steps 15a and 15b arranged in the anteroposterior direction are constituted so that locations of them in the anteroposterior direction and the tilt angles of them around the axis in the widthwise direction can be varied. In the first state shown in FIG. 7A, the anterior partial step 15a is tilted with respect to the posterior partial step 15b so that a sole of the user 2 is detached from the partial step 15a. While the exercise assisting apparatus 1 moves from the first state shown in FIG. 7A to the second state shown in FIG. 7B, the posterior partial step 15b is gradually slanted so as to detach the sole of the user 2 therefrom, and the anterior partial step 15a is gradually raised to horizontal so as to approach the sole of the user 2. Following to his motion, a point of action of burden between the sole of the user 2 and the step 15, to which the burden due to self weight of the user acts, moves from heel to tip-toe. Alternatively, when the exercise assisting apparatus 1 moves from the second state to the first state, the point of action of burden between the sole of the user 2 and the step 15 moves from tip-toe to heel.

In the second state shown in FIG. 7B, since the burden due to self weight of the user 2 is concentrated to tip-toe portion side on the foot, it is possible to contract muscular group on rear side of the foot. In other words, it is possible to stimulate not only the contraction of biceps femoris muscle on the rear side of femoral region, but also the contraction of sural muscle.

Since the above mentioned motions of the partial steps 15a and 15b are examples, similar advantageous effects can be expected by moving the partial steps 15a and 15b up and down instead of varying the tilt angles of the partial steps 15a and 15b. Furthermore, it is possible to constitute that locations of the partial steps 15a and 15b are adjustable so as to change the kind of muscle which is contracted or to reduce the burden acting on toe joint or ankle joint. Other constitutions and action of the exercise assisting apparatus 1 in the third embodiment are similar to those in the above mentioned first and second embodiments.

Subsequently, a modified example of the exercise assisting apparatus 1 in accordance with the third embodiment is described. In this modification, a load sensor is provided on each of the partial steps 15a and 15b, and locations of the partial steps 15a and 15b are regulated by feedback control so as to approach loads detected with the load sensors to target values. With performing such feedback control, it is possible to maintain the burden acting on the leg portion of the user 2 in a proper range. As for the load sensor, a load cell comprising piezoelectric elements or a differential transformer can be used.

Although the step 15 is comprised of two partial steps 15a and 15b in the above mentioned example, the step
15 in another modified example shown in FIG. 8 is comprised of many, for example, nine partial steps 15c. When a load sensor is provided on each partial step 15c, and location of each partial step 15c is regulated with feedback control on the basis of a load detected by the load sensor, it is possible to simulate the burdens acting on the sole in walk. With simulation of the burdens acting on the sole in walk, nervous system acting in walk may be stimulated, so that the exercise may be a kind of walking training.

Fourth Embodiment

[0064] Subsequently, an exercise assisting apparatus in accordance with a fourth embodiment of the present invention is described with reference to the drawings. Since the exercise assisting apparatus 1 varies the burden due to self weight of the user 2 acting on the leg portions with varying the tilt angle of the seat 13 as mentioned above, when balance facility of the user falls such as a senior citizen, the user 2 may have worry about the use of the exercise assisting apparatus 1. Thus, a handrail 21 that the user 2 can hold is provided on the exercise assisting apparatus 1 in the fourth embodiment, as shown in FIG. 9. The hand rail 21 is a T-shaped member comprised of a pole brace 21a sticking up on the pedestal 11, and a gripper 21b provided at a top end of the pole brace 21a that the user 2 holds. With providing the handrail 21, it is possible to clear the user’s worry about to sit on the tilted seat 13.

[0065] A modified example of the exercise assisting apparatus 1 in the fourth embodiment is shown in FIG. 10. In the conventional constitution shown in FIG. 9, since the handrail 21 is fixed on the pedestal 11, relative location of the hand rail 21 with respect to the user 2 varies following to the tilting motion of the seat 13. According to such variation of relative location of the hand rail 21 with respect to the user 2, the contraction of muscle of upper body of the user 2 can be stimulated. The handrail 21, however, is provided for giving a sense of ease to the user 2 whose balance facility has fallen, so that there may be the case that the relative location of the handrail 21 with respect to the user 2 is not varied.

[0066] In the modification shown in FIG. 10, hand rails 21 are integrally provided on the seat 13. Specifically, a pair of handrails 21 is integrally provided in the vicinities of both sides on the front end of the seat 13 in the widthwise direction. Since the user 2 can hold the handrails 21 with both hands and the handrails 21 are moved with the seat 13, the relative locations of the handrails 21 with respect to the user 2 may not be varied. Thus, it is possible to increase the sense of ease of the user 2 when the user 2 uses this exercise assisting apparatus 1. Although the handrails 21 are provided on right and left sides of the seat 13 in the modification shown in FIG. 10, it is possible to provide a handrail 21 at the center of the seat 13 in the widthwise direction so as to be held by a hand or both hands of the user 2. Other constitutions and action of the exercise assisting apparatus 1 in the fourth embodiment are similar to those in the above mentioned first to third embodiments.

[0067] The present invention, however, is not limited to the constitutions of the above mentioned embodiments, and it is sufficient that an exercise assisting apparatus in accordance with an aspect of the present invention comprises: a seat on which buttocks of a user is sit; a stationary support base for supporting the seat; a burden regulator provided between the support base and the seat, and for regulating a ratio of self weight of the user which is supported by the seat so that a load due to the self weight of the user acting on leg portion of the user; and a driving mechanism for driving the burden regulator so that the ratio of self weight of the user supported by the seat varies as time passes. The burden regulator couples the support base and the seat in a manner so that a portion of the seat to which the buttocks of the user is sit is tilted between a first state where the portion becomes horizontal and a second state where the portion is slanted downward toward the foot side in a plane including one of femoral regions and the buttocks of the user.

[0068] According to this constitution, the burden acting on the foot portion of the user is varied with varying slanting angle of the seat with respect to the support base, so that it is possible to stimulate the contraction of muscle of the foot of the user, mainly. Thus, muscle strength of foot can be strengthened, or glucose metabolism can be raised by uptake of glucose to muscle due to the contraction of muscle.

[0069] Furthermore, only the seat to which the buttocks of the user is sit is moved but the support base is not moved, so that a space necessary for movement of the apparatus becomes relatively smaller. Thus, the space necessary for establishment of the apparatus can be narrowed in comparison with the conventional constitution where the support base is slanted.

[0070] Still furthermore, the support base is stationary and the slanting angle of the seat with respect to the support base is varied, so that a moment due to self weight of the user acts on around of a portion coupling the support base and the seat. Thus, since the moment acting on around the lower end portion of the support base is largely reduced, the strength of the portion coupling the seat with the support base can be lowered than the strength of the portion which supports the lower end of the support base enabling to tilt in the conventional structure, and thereby cost down of the exercise assisting apparatus is enabled.

[0071] In the above mentioned constitution, it is possible that an upper body supporting member, which restricts a range of a position of upper body of the user by restricting a part of the upper body of the user who sits his or her buttocks on the seat, is further provided and the range of the position of the upper body is variable in conjunction with the driving mechanism. Thereby, it is possible to prevent that the upper body of the user is inclined forward or backward unecessarily. Consequently, the burden acting on the leg portion of the user can be limited in a desired proper scope.

[0072] Furthermore, it is possible that the upper body supporting member has a portion which contacts a front face of the upper body of the user who sits the buttocks on the seat. Thereby, when the exercise assisting apparatus is in the second state, it is possible to prevent to move the position of the buttocks of the user on the seat, and thereby to prevent that the user slips off from the seat by accident.

[0073] Still furthermore, it is possible that at least one of an area that the seat contacts with the user and a position of the seat in a horizontal plane is variable. Thereby, it is possible to regulate a ratio of a burden acting of a leg portion of the user against a burden received by the seat among self weight of the user. Consequently, it is possible to adjust difference of the burden acting on the leg portion caused by the difference of physical size of the user so as not to become the burden acting on the leg portion excessively.

[0074] Still furthermore, it is possible that steps, on which the user puts his or her feet in a state that the buttocks of the user is sit on the seat, are further provided, and each step has a plurality of partial steps respectively contacting a plurality
of portions of a sole and independently moving so as to vary a contacting area between the step and the sole, and a driving source for moving the partial steps. Thereby, a dimension of the burden acting on the sole or a position on the sole on which the burden acts can be regulated with moving the partial steps. Consequently, the burden acting on each joint of the leg portion of the user, in particular, a toe joint and an ankle joint can be regulated, and a muscular on which the burden acts can be changed.

Still furthermore, it is possible that a handrail, which is held by the user in a state that the buttocks of the user is sit on the seat, is further provided. Thereby, even the user whose balance facility is deteriorated can use the exercise assisting apparatus with holding the handrail, so that a sense of ease can be given the user.

This application is based on Japanese patent applications 2005-154707 filed in Japan, the contents of which are hereby incorporated by references.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be understood that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

1. An exercise assisting apparatus comprising:
   a seat on which buttocks of a user is sit;
   a stationary support base for supporting the seat;
   a burden regulator provided between the support base and
   the seat, and for regulating a ratio of self weight of the
   user which is supported by the seat so that a load due to
   the self weight of the user acting on leg portion of the
   user; and
   a driving mechanism for driving the burden regulator
   so that the ratio of self weight of the user supported by the
   seat varies as time passes;
   the burden regulator coupling the support base and the seat
   in a manner so that a portion of the seat to which the
   buttocks of the user is sit is tilted between a first state
   where the portion becomes horizontal and a second state
   where the portion is slanted downward toward the foot
   side in a plane including one of femoral regions and the
   buttocks of the user.

2. The exercise assisting apparatus in accordance with
   claim 1, wherein
   an upper body supporting member, which restricts a range
   of a position of upper body of the user by restricting a
   part of the upper body of the user who sits his or her
   buttocks on the seat, is further provided; and
   the range of the position of the upper body is variable in
   conjunction with the driving mechanism.

3. The exercise assisting apparatus in accordance with
   claim 2, wherein
   the upper body supporting member has a portion which
   contacts a front face of the upper body of the user who
   sits the buttocks on the seat.

4. The exercise assisting apparatus in accordance with
   claim 1, wherein
   at least one of an area that the seat contacts with the user
   and a position of the seat in a horizontal plane is variable.

5. The exercise assisting apparatus in accordance with
   claim 1, wherein
   steps, on which the user puts his or her foots in a state that
   the buttocks of the user is sit on the seat, are further
   provided, and each step has a plurality of partial steps
   respectively contacting a plurality of portions of a sole
   and independently moving so as to vary a contacting
   area between the step and the sole, and a driving source
   for moving the partial steps.

6. The exercise assisting apparatus in accordance with
   claim 1, wherein
   a handrail, which is held by the user in a state that the
   buttocks of the user sit on the seat, is further provided.

7. The exercise assisting apparatus in accordance with
   claim 1, wherein
   the seat further comprises a main seat portion to which the
   buttocks of the user is sit, and an auxiliary seat portion
   obliquely extended downward from the main seat portion.

8. The exercise assisting apparatus in accordance with
   claim 7, wherein
   a front portion of the auxiliary seat portion is formed to be
   two-forked so that femoral regions of the user are pos-
   ited thereon.

9. The exercise assisting apparatus in accordance with
   claim 7, wherein
   an angle of the auxiliary seat portion with respect to the
   main seat portion is variable.

10. The exercise assisting apparatus in accordance with
    claim 4, wherein
    the seat is slidable in an anteroposterior direction with
    respect to the support base.

11. The exercise assisting apparatus in accordance with
    claim 4, wherein
    a main seat portion of the seat is divided into two parts of
    a front portion and a rear portion, and the front portion
    and the rear portion are coupled with an extension and
    contraction mechanism so as to vary the area of the main
    seat portion.

12. The exercise assisting apparatus in accordance with
    claim 2, wherein
    the upper body supporting member is a form of backrest,
    which contacts waist back of the user who sits buttocks
    on the seat, and coupled with the seat.

13. The exercise assisting apparatus in accordance with
    claim 12, wherein
    the seat and the upper body support member are coupled
    through a second driving mechanism which is controlled
    to adjust an angle of the upper body support member
    with respect to the seat in conjunction with the tilt of
    the seat with the driving mechanism.

14. The exercise assisting apparatus in accordance with
    claim 3, wherein
    the portion of the upper body supporting member which
    contacts a front face of the upper body of the user is an
    arrester having a single arm, an end of which is rotate-
    ably borne on the seat, and a supporting bar, which is con-
    nected to the other end of the arm and contacts to abdo-
    men of the user.

15. The exercise assisting apparatus in accordance with
    claim 3, wherein
    the portion of the upper body supporting member which
    contacts a front face of the upper body of the user is a seat
    belt.

16. The exercise assisting apparatus in accordance with
the portion of the upper body supporting member which contacts a front face of the upper body of the user is an arrester having Tee-shape provided at a center portion of a front end of the seat.

17. The exercise assisting apparatus in accordance with claim 5, wherein each of the partial steps is constituted so that at least one of elevation, location in the anteroposterior direction, location in the widthwise direction and tilt angle with respect to a pedestal is variable.

18. The exercise assisting apparatus in accordance with claim 5, wherein a load sensor is provided on each of the partial steps, and locations of the partial steps are regulated by feedback control so as to approach loads detected with the load sensors to target values.

19. The exercise assisting apparatus in accordance with claim 6, wherein the handrail has a Tee-shape comprised of a pole brace sticking up on a pedestal, and a gripper provided at a top end of the pole brace that the user holds.

20. The exercise assisting apparatus in accordance with claim 6, wherein a pair of handrails is integrally provided in vicinities of both sides on a front end of the seat in a widthwise direction.

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