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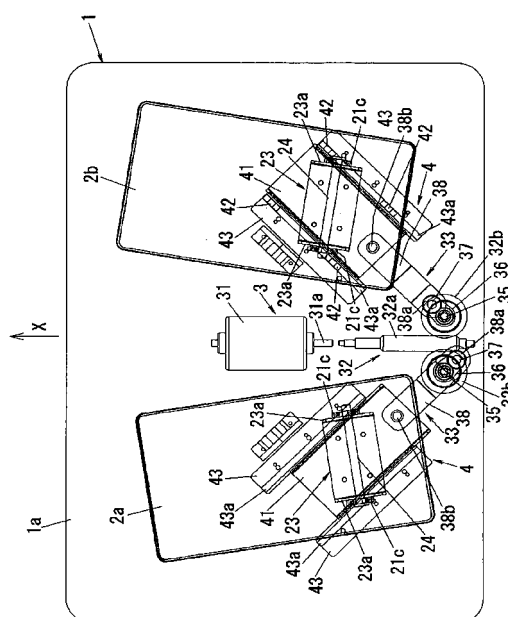
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(54) **EXERCISE AID DEVICE**

(57) A housing 1 is provided with a left foot support 2a and a right foot support 2b respectively for mounting user's left foot and right foot. The left foot support 2a and the right foot support 2b are respectively driven to move along a rail which defines a travel path. The housing 1 is provided with a motor 31 having an output shaft 31a which generates a rotary motion which is distributed into two routes by a worm gear 32a and two worm wheels 32b. Rotary motions of each of the worm wheels 32b are respectively transmitted to the left foot support 2a and the right foot support 2b by a crank rod 38, thereby the rotary motions of each of the worm wheels 32b act as driving forces which respectively reciprocate the left foot support 2a and the right foot support 2b. Accordingly, this configuration makes it possible to provide an exercise assisting device being configured to stimulate leg muscles by only one driving force for generation of the driving forces.

Fig.1



## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to an exercise assisting device which assists a user to stretch one's leg muscles with an aid of external forces mainly in a standing posture.

### BACKGROUND ART

**[0002]** In the past, there have been proposed various types of passive exercise assisting devices which assist a user to stretch one's muscles without effort but with an aid of external forces being applied to the user in order to give an exercise effect. The devices are known to be classified into two types, one being configured to apply a force of bending joints of the user for stretching the muscles associated with the joints, and the other configured to apply a stimulus to a user's body to cause a nervous reflex by which associated muscles are forced to stretch.

**[0003]** Further, the devices are designed to require the user to take different postures depending upon the muscles to be stretched. One example of the devices is to simulate a walking by the user at a standing posture mainly for the purpose of preventing osteoarthritis or walk-training, as proposed in JP 2003-290386 A and JP10-55131 A. Hereinafter, JP 2003-290386 A and JP10-55131 A are respectively called as PATENT DOCUMENT 1 and PATENT DOCUMENT 2.

**[0004]** PATENT DOCUMENT 1 discloses a training device which includes a pair of steps bearing thereon left and right feet of the user, and is configured to interlock the reciprocating movements of the left and right steps for providing a skating simulation exercise to the user. This device is designed to adjust a phase difference of 0 to 360 degrees between the left and right steps with regard to the forward/rearward movements as well as to the lateral movements, and is initially set to have the phase difference of 180 degrees and to vary the phase difference in a direction of increasing a period in which the left and right steps move forward/rearward together. The steps are driven by a driving unit to move so that the user can enjoy the passive exercise simply by placing one's feet on the steps and without making an effort or active movement.

**[0005]** The device of PATENT DOCUMENT 1 is configured to vary user's center of gravity forward/rearward and leftward/rightward in order to cause the neural reflex for keeping balance of the user. According to the neural reflex, the user's muscles are stretched. Therefore, the exercise assisting device is designed to move the steps along the trajectory being approximately paralleled such that the user's steps move forward/rearward as well as leftward/rightward at the same time.

**[0006]** The device of PATENT DOCUMENT 2 is designed for walking training or virtual-reality exercise, and

includes a pair of left and right foot plates driven by a horizontal driving unit, and means for rotating the foot plates in left-and-right directions in order to vary their position with respect to the forward/rearward direction as well as to vary their orientation, and also for varying the height and the inclination of the foot plates.

**[0007]** By the way, the device of PATENT DOCUMENT 1 comprises a driving mechanism for moving the left and right steps leftward and rightward, and a driving mechanism for moving the left and right steps frontward and rearward. These driving mechanisms are arranged with respect to each step. Both driving mechanisms have servomotors. Therefore, the device requires four servomotors. The four servomotors makes it possible to move the steps frontward/rearward and leftward/rightward with freedom. However, the device faces a problem that the device requires the four servomotors.

**[0008]** On the other hand, the device of PATENT DOCUMENT 2 is configured to simulate walking so as to stretch the user's leg muscles. Therefore, the device comprises extremely complicated components for moving the left and right steps. Consequently, there is a necessity that the device requires a plurality of the driving unit for generating driving force.

### DISCLOSURE OF THE INVENTION

**[0009]** This invention is achieved to solve the above problems. An object in this invention is to provide an exercise assisting device which is configured to stimulate the leg muscles, while the device comprises a single driving source for generating driving force.

**[0010]** An exercise assisting device in claim 1 comprising a left foot support, a right foot support, a guide, a driving unit, and a frame. The left foot support and the right foot support are respectively configured to bear a user's left foot and right foot. The guide is configured to restrict travel paths respectively of the left foot support and the right foot support. The driving unit is configured to move the left and right foot supports in a mutually linked manner. A frame mounts the left foot support, the right foot support, the guide, and the driving unit. The driving unit comprises a driving source, a router, and a reciprocator. The driving source is configured to generate a driving force. The router is configured to provide two routes for distributing the driving force respectively to the left foot support and the right foot support. The reciprocator is configured to reciprocate the left and right foot supports in at least one of a forward/rearward direction and a lateral direction by the driving force.

**[0011]** With this arrangement in claim 1, the driving force of the single driving source is distributed into two routes. The divided driving force allows the left foot support and the right foot support to reciprocate. On the other hand, the right foot support and the left foot support respectively have the travel path which is restricted by the guide. Therefore, the exercise assisting device with the single driving source is capable of stimulating each of

the leg muscles individually. Consequently, the exercise assisting device with the single driving source is capable of stimulating each of the leg muscles by the exercise. In addition, the right foot support and the left foot support are respectively reciprocated by the different route. Therefore, the single driving source that driving force generates is capable of applying the different motion to the right foot support and the left foot support.

**[0012]** The invention in claim 2 discloses the exercise assisting device according to claim 1, wherein the driving source is a rotary motor. The router includes a first gear and a pair of second gears. The rotary motor has an output shaft. The first gear is fixed to the output shaft of the rotary motor. A pair of the second gears is meshed with the first gear. The reciprocator includes a translation mechanism of translating rotary motions of the second gears into reciprocatory motion of the left foot support and the right foot support respectively.

**[0013]** According to the invention of claim 2, the first gear is fixed to the output shaft of the rotary motor. The first gear meshes with a pair of the second gears. A pair of the respective second gears is translated into reciprocatory motion of the left foot support and the right foot support by the translation mechanism. Therefore, it is possible to cause the phase difference between the left foot support and the right foot support by only varying the mesh position between the first gear and the second gears. In addition, the first gear meshes with the second gears. Therefore, an amount of displacement that is caused by the mesh between the first gear and the second gears is smaller than an amount of slip displacement caused by a belt which is provided for dividing the driving force into two routes. That is, this configuration makes it possible to move the right foot support and the left foot support as planned. In addition, this configuration also makes it possible to prevent the displacement between the first gear and the second gears due to temporal change.

**[0014]** The invention in claim 3 discloses the exercise assisting device according to claim 1, wherein the first gear is a worm gear. The second gears are worm wheels which mesh with the worm gear. The translation mechanism includes a crank rode for translation of rotary motion of the worm wheel to the reciprocatory motions of the left foot support and the right foot support.

**[0015]** With this configuration, the worm gear meshes with the worm wheels. Therefore, the worm gear generates the rotary force which is divided by the worm wheels. These worm wheels generate rotations which are translated into reciprocatory motion of the left foot support and the right foot support. Therefore, it is possible to dispose the output shaft along a plane that the left foot support and the right foot support reciprocate. Consequently, this configuration makes it possible to reduce a thickness size along a direction which intersects with top faces of the right foot support and the left foot support. That is, this configuration makes it possible to reduce size of the exercise assisting device.

**[0016]** The invention in claim 4 discloses the exercise assisting device as set forth in any one of claim 1 to 3, wherein the router is configured to give a phase difference between the movements of the left foot support and the right foot support.

**[0017]** With this configuration, the router gives the phase difference between the reciprocatory motion of the left foot support and the reciprocatory motion of the right foot support. Therefore, this configuration makes it possible to give the phase difference to the left foot support and the right foot support which are reciprocated by the single driving source. Further, in the case where the gears are employed as the router, it is possible to give the phase difference by only adjusting position that the first gear meshes with the second gears.

**[0018]** The invention in claim 5 discloses the exercise assisting device as set forth in any one of claim 1 to 3, further includes an inclination provider which is configured to vary a top surface angle of each of the left foot support and the right foot support with respect to a reference plane in an interlocked manner with the reciprocatory movement of the left foot support and the right foot support. The inclination provider comprises a guide face and a follower projection. The guide face is formed on one of the foot support and the frame to have at least an inclination surface inclined with respect to the direction of the movement of the left foot support and the right foot support, and the follower projection is formed on the other of the foot support and the frame to come into sliding contact with the guide face while the left foot support and the right foot support are driven to move in order to vary the top surface angle of each of the left foot support and the right foot support with respect to the reference plane.

**[0019]** With this configuration, the guide face is formed on one of the frame and the foot support, and the following projection is formed on the other of the frame and the foot support. Therefore, this configuration makes it possible to move the left foot support and the right foot support while inclining the left foot support and the right foot support according to the reciprocatory motion of the left foot support and the right foot support. That is, this configuration makes it possible to not only move the left foot support and the right foot support forward/rearward and lateral direction but also incline the left foot support and the right foot support with respect to the frame by the single driving source. Therefore, the exercise assisting device is configured to stimulate the user's various leg muscles by operating the left foot support and the right foot support to give complex movement as above mentioned. In addition, the exercise assisting device has the single driving source. Therefore, it is possible to provide inexpensive exercise assisting device.

**[0020]** The invention in claim 6 discloses the exercise assisting device as set forth in claim 5, wherein the inclination provider includes an axle and a bearing. The axle is provided on a side of one of the foot support and the frame, and the bearing is provided on the other of the foot support and the frame in order to support the axle.

The axle defines a pivot axis around which each of the left foot support and the right foot support swings in response to the top surface of the left foot support and the right foot support which are inclined along the inclination surface.

**[0021]** With this configuration, positional relation between the pivot axis and the both foot supports is kept constantly. Therefore, it is possible to exercise desired muscles and desired joints in a concentrated manner.

**[0022]** The invention in claim 7 discloses the exercise assisting device of claim 5, wherein the follower projection is provided at its top with a roller which comes into a rolling contact with the guide face.

**[0023]** With this configuration, the follower projection has its tip with the roller which comes into the rolling contact with the guide face. Therefore, this configuration makes it possible to smoothly move the following projection while the left foot support and the right foot support receives user's load.

#### BRIEF DESCRIPTION OF THE DRAWINGS

##### **[0024]**

Fig. 1 is a planer view of the embodiment in this invention.

Fig. 2 is an exploded perspective view of the above.

Fig. 3 is a cross sectional view of a main part seen from rear.

Fig. 4 is a cross sectional view of the main part of the above.

Fig. 5 (a) is a block diagram explaining function of the driving unit of the above.

Fig. 5 (b) is a block diagram explaining function of the driving unit of the above,

Fig. 6 is a cross sectional view of the main part of the above seen from right.

Fig. 7 is a perspective view of the main part of the above.

Fig. 8 (a) is a side view of the main part of the above.

Fig. 8 (b) is a side view of the main part of the above.

Fig. 9 (a) is a side view of the main part of another embodiment.

Fig. 9 (b) is a side view of the main part of another embodiment.

Fig. 10 is a schematic view of the above showing the position of the foot in using the device.

#### BEST MODE FOR CARRYING OUT THE INVENTION

**[0025]** In this embodiment, configurations of this invention are explained by using an exercise assisting device disposed on a floor. However, it is also possible to apply the configurations of this invention to the device which is provided in the floor. In addition, the exercise assisting device is capable of employing configurations fixed at a predetermined position, and also employing configurations being movable. Fig. 1 and Fig. 2 shows the exercise

assisting device which comprise a base plate 1a which defines a frame for disposing on the floor. Fig. 1 and 2 shows the base plate 1a which is formed to have rectangular. However, the circumference shape is not limited to the rectangular. Hereinafter, the base plate 1 has a top face parallel to the floor in a condition where the base plate 1 a is disposed on the floor. Therefore, an upper direction and a lower direction in Fig. 1 and 2 are defined as an upper direction and a lower direction when the exercise assisting devices is used.

**[0026]** An upper plate 1b is disposed above the base plate 1a, and is coupled thereto to constitute a housing 1. The base plate 1a is provided with a left foot support 2a and a right foot support 2b adapted respectively for bearing left and right feet of a user. Also, a drive unit 3 is disposed on the base plate 1 a for moving the left and right foot supports 2a and 2b. It is noted that an arrow X in FIGS. 1 and 2 denotes a forward direction of the device. This applies to any other figure which includes the arrow X. In addition, an arrow X in the other figures similarly denotes a forward direction of the device.

**[0027]** The upper plate 1 b is formed with two openings 11 a and 11 b extending in a thickness direction of the plate to expose the left and right foot supports 2a and 2b, respectively. The openings 11a and 11 b are each formed into a rectangular shape. The openings 11 a and 11 b have their longitudinal center lines extending in a crossing relation with respect to the forward/rearward direction of the housing 1 such that the distance between the center lines is greater at the front ends of the openings than at the rear ends thereof.

**[0028]** As shown in FIG. 3, slide grooves 12 are provided on opposite width ends of each of the openings 11 a and 11 b in communication therewith for receiving a flange 22b formed on each of footrest covers 22. Each of the footrest covers 22 is cooperative with a foot plate 21 to define each of the left and right foot supports 2a and 2b, and is composed of a main section 22a in the shape of a rectangular barrel and is formed with the flange 22b extending around an open face (upper face) over the entire periphery of the main section 22a. The footrest cover 22 has an integrally formed attachment plate 22c at a lower end within the main section 22a.

**[0029]** The main section 22a has its lengthwise as well as the width dimensions respectively less than those of the openings 11 a and 11 b, while the flange 22b has such dimensions larger than those of the openings 11 a and 11 b. Further, the slide groove 12 has its opposed bottom spaced by a distance greater than a corresponding distance between the opposite edges of the flange 22b. Thus, the footrest cover 22 is allowed to move within the confines of the slide groove 12 with respect to the width as well as lengthwise direction thereof.

**[0030]** The foot plate 21 is formed into a rectangular plate slightly smaller than the inner periphery of the main section 22a of the footrest cover 22 to have such dimensions as to bear the entire foot of the user. The foot plate 21 is made of a material or shaped to have a large coef-

ficient of friction. The foot plate 21 is integrally formed around its lower periphery with generally U-shaped cover members 21 a and 21 b. The foot plate 21 is integrally formed on its bottom at a portion surrounded by the cover members 21 a and 21 b with a pair of bearings 21 c spaced in the width direction of the foot plate 21.

**[0031]** A bearing plate 23 of U-shaped cross section is fixed to the top of the attachment plate 22c of the footrest cover 22 to have its open end oriented upwardly, and has its opposed legs 23a in contact respectively with the outer faces of the bearing 21 c of the foot plate 21. An axle 24 penetrates through the legs 23a of the bearing plate 23 and the bearings 21 c to extend in the width direction of the foot plate 21. The foot plate 21 is allowed to swing about the axle 24 in such a manner that the foot plate 21 moves up and down at its lengthwise forward and rearward ends. The cover members 21 a and 21 b are provided to conceal a gap formed between the foot plate 21 and the footrest cover 22 while the foot plate 21 swings relative to the footrest cover 22.

**[0032]** A truck 41 of U-shaped cross section is fixed to the bottom of the attachment plate 22c of the footrest cover 22 to have its open end oriented downwardly, and is provided on each exterior face of its legs 41 a with two wheels 42. The base plate 1 a is formed with two fixed rails 43 for each of the left and right foot supports 2a and 2b such that the truck 41 is placed on the rails 43 with the wheels 42 roll in the rail grooves 43a in the upper end of the rails 43. A derailment prevention plate 18 is provided on top of the rail 43 for preventing the wheels 42 from running off the rail grooves 43a (see FIG. 4).

**[0033]** The rails 43 extend in a direction different from the lengthwise direction of the openings 11a and 11b in the housing 1. As described in the above, the openings 11a and 11b have their individual longitudinal center lines inclined with respect to each other so as to be spaced by a larger distance at the forward ends than at the rearward ends. Also, the rails 43 have their individual longitudinal directions crossed with each other in the like manner.

**[0034]** However, the rails 43 are inclined in relation to the forward/rearward direction of the housing 1 at a large angle than the openings 11a and 11b. For example, when the openings 11a and 11b have their lengths inclined relative to the forward/rearward direction of the housing 1 at an angle of 30 degrees, the rails 43 have its length inclined at an angle of 45 degrees. In short, the rails 43 are oriented to such a direction as to prevent an increase of shearing force acting on the knee joints while the left and right foot supports 2a and 2b are moved along the rails 43 in a condition that the user's feet are placed thereon with each center line of the feet aligned with each of the length of the openings 11a and 11b. Although the present embodiment illustrates a preferred mode that the left and right foot supports 2a and 2b are moved along the individual travel paths of shifting their positions both in the forward/rearward direction and the lateral direction, it is possible to determine the orientation of the rails 43

such that the left and right foot supports 2a and 2b are moved either in the forward/rearward direction or the lateral direction.

**[0035]** With the above arrangement, the left and right foot supports 2a and 2b are allowed to move respectively along the lengths of the rails 43. Because of that the rails 43 have their lengths inclined respectively with respect to the lengthwise center lines of the openings 11a and 11b, the foot plate 21 and the footrest cover 22 are allowed to move within the openings 11a and 11b along the directions crossing with the lengthwise direction of the openings 11 a and 11 b. That is, the truck 41 cooperates with the wheels 42, the rail 43, and the derailment prevention plate 44 to act as a guide 4 which restrict the travel path of the left foot support 2a and the right foot support 2b.

**[0036]** As shown in FIG. 5, the drive unit 3 which shifts the positions of the left and right foot supports 2a and 2b includes a driving source 31 of generating a driving force, a router 32 for transmitting the driving force of the driving source 31 to the left and right foot supports 2a and 2b, and reciprocators 33 for using the driving force to reciprocate the trucks 15 respectively along the rails 43. Although the present embodiment is configured to divide the driving force at the router 32 and transmit the divided driving force to the reciprocators 33, as shown in FIG. 5 (a), it is equally possible to generate the reciprocating driving force at the reciprocator 33 and divide the same at the router 32, as shown in FIG. 5(b).

**[0037]** Details of the drive unit 3 are now explained. The driving source 31 is a rotary motor 31. The motor 31 has an output shaft 31 a which is coupled to the router 32.

**[0038]** The router 32 includes a worm gear 32a coupled to an output shaft 31 a of the motor 31, and a pair of worm wheels 32b. The worm gear 32a is composed of a first gear 32a. The worm wheels 32b are composed of second gears 32b. The worm gear 32a and the two worm wheels 32b are held within a gearbox 34 fixed to the base plate 1 a. The gearbox 34 is composed of a gear case 34a with a top opening, and a lid 34b fitted in the opening of the gear case 34a. A pair of bearings 32c is mounted between the gear case 34a and the lid 34b to bear the opposite longitudinal ends of the worm gear 32a.

**[0039]** Extending through the worm wheel 32b is a rotary shaft 35 which is held by the gear case 34a and the lid 34b and is coupled to the worm wheel 32b to be driven thereby to rotate. The rotary shaft 35 is formed at its upper end with a coupling section 35a with non-circular cross-section (rectangular one in the illustrated instance).

**[0040]** The motor 31 is mounted on a holder member 34c of the gear case 34a and on a holder plate 13a secured to the base plate 1a, and is fixed to the base plate 1a by means of the lid 34b fitted over the gear case 34a and a retainer plate 13b coupled to the holder plate 13a.

**[0041]** As shown in FIG. 6, the reciprocator 33 includes a crank plate 36 coupled at its one end to the coupling section 35a of the rotary shaft 35, and a crank rod 38

coupled to the crank plate 36 by means of a crank shaft 37. The crank shaft 37 has its one end fixed to the crank plate 36 and has the other end received in the bearing 38a carried on one end of the crank rod 38. That is, the crank rod 38 has its one end rotatively coupled to the crank plate 36, while the other end of the crank rod 38 is coupled to the truck 41 by means of an axle 38b so as to be rotatively coupled thereto.

**[0042]** As is apparent from the above, the crank rod 38 functions as a translation mechanism to translate the rotary motion of the worm wheel 32b into a reciprocatory motion of the truck 41. Since the crank rod 38 is provided for each of the worm wheels 32b and the trucks 15 are provided respectively to the left and right foot supports 2a and 2b, the crank rods 38 function as the individual translation mechanism for translating the rotary motion of the worm wheels 32b into the reciprocating motions of the left and right foot supports 2a and 2b.

**[0043]** As described in the above, the truck 41 has its travel path restricted by the wheels 16 and the rails 43 so that the truck 41 reciprocate along the length of the rails 43 as the worm wheel 32b rotates. That is, the rotation of the motor 31 is transmitted to the crank plate 36 by way of the worm 32a and the worm wheel 32b, so that the crank rod 38 coupled to the crank plate 36 causes the truck 41 to reciprocate linearly along the rails 43. Whereby, the left and right foot supports 2a and 2b are driven to reciprocate respectively along the length of the rails 43.

**[0044]** In the present embodiment, the worm gear 32a and the two worm wheels 32b are responsible for routing the driving force into two channels respectively for driving the left and right foot supports 2a and 2b so that the drive unit 3 drives the left and right foot supports 2a and 2b in a manner linked to each other. The worm wheels 32b are meshed with the worm gear 32a at different portions spaced apart by 180 degrees such that the right foot support 2b comes to the forward end of its movable range when the left foot support 2a comes to the rear end of its movable range. As the left foot support 2a comes to the right end of its movable range when it comes to the rear end of the movable range, and the right foot support 2b comes to the right end of its movable range when it comes to the forward end of the movable range, the left and right foot supports 2a and 2b shift in the same direction along the lateral direction.

**[0045]** As apparent from the above, it is possible to give a desired phase difference of the movement between the left and right foot supports 2a and 2b by varying positions of meshing the worm gear 32a with the worm wheels 32b. When the device is used by the user at the standing posture with one's feet placed on the left and right foot supports 2a and 2b, the phase difference of 180 degrees is effective to minimize the shifting of the user's weight in the forward/rearward direction, enabling the exercise even by the user suffering from lowered balancing capability. Alternatively, when no phase difference is given, the device necessitates the shifting movement of the

user's weight in the forward/rearward direction, thereby developing an exercise not only for the leg muscles but also for lower back muscles of the user maintaining the balancing capability.

**[0046]** In the present embodiment, the foot plate 21 provided on each of the left and right foot supports 2a and 2b is allowed to swing about the pivot axis of the axles 24 relative to the footrest cover 22, enabling to vary the height positions of the forward end as well as the rearward end of the foot plate 21 shown in Fig. 7. Thus, the height positions of the toe and the heel of the foot placed on the foot plate 21 can be varied for enabling the plantarflexion and dorsiflexion of the ankle joint.

**[0047]** Now, in order to link the swinging movement of the foot plate 21 about the axle 24 with the reciprocating movement thereof along the rail 43, the base plate 1a is provided at a portion along the travel path of the foot plate 21 with a guide surface 14 including an inclination 14a. In this connection, the foot plate 21 is provided on its bottom with a follower projection 25 which comes into contact with the guide surface 14. In the illustrated embodiment, the inclination 14a extends the full length of the guide surface 14 at a constant angle relative to the upper face of the base plate 1a. The guide surface 14 is not particularly delimited to the illustrated embodiment and may be shaped to have the inclination partially along its length. Although it is suffice that the follower projection 25 is formed from a material and/or shaped into a configuration to have a tip of small coefficient of friction, the follower projection 25 is preferred to have at its top a roller 25 which comes into rolling contact with the guide surface 14, as illustrated in the figure.

**[0048]** The follower projection 25, which is arranged to come into rolling contact with the guide surface 14, rides up and down the inclination 14a while each of the left and right foot supports 24a is driven by the motor 31 to reciprocates, thereby swinging the foot plate 21 about the axle 24 to vary its tilt angle relative to the base plate 1a, and therefore enabling the plantarflexion and dorsiflexion at the ankle joint.

**[0049]** Although the illustrated embodiment has the base plate 1a formed with the guide surface 14a and the foot plate 21 formed with the follower projection 25, the same operation can be achieved with a configuration of FIG. 9 in which the foot plate 21 is provided with the guide surface 14 and the base plate 1a is provided with the follower projection 25.

**[0050]** In the above embodiment, the router 32 of the drive unit 3 is configured to have the worm gear 32a and the worm wheels 32b for realizing the power transmission from the output shaft 31a of the motor 31 to the rotary shaft 35 of the worm wheel 32b with speed reduction. However, a belt can be utilized to transmit the power from the output shaft 31a of the motor 31 to the rotary shaft 35 perpendicular to the output shaft 31a. In this instance, instead of the worm wheel 32b, a pulley is utilized to receive the belt while dispensing with the worm 32a.

**[0051]** In the above embodiment, the motor 31 has its

output shaft 31a extending along the upper surface of the base plate 1 a. However, when the output shaft 31a is required to extend perpendicular to the upper surface of the base plate 1 a, spur gearing is adopted to achieve the transmission and routing of the rotary power, instead the combination of the worm 32a and the worm wheels 32b. In this instance, pulleys and a belt may be used in place of the spur gearing for transmission of the rotary power between the pulleys.

**[0052]** Instead of using the crank plate 36 and the crank rod 38, the reciprocator 33 may be composed of a grooved cam driven to rotate by the motor 31 and a cam follower engaged in a groove of the cam. In this instance, the grooved cam can be used instead of the worm wheel 32b and be arranged to have its rotation axis parallel to the output shaft 31 a of the motor for power transmission from the output shaft 31 a to the grooved cam through a pinion.

**[0053]** Further, when using only one grooved cam for power transmission from the output shaft 31 a of the motor 31 to the groove cam, two cam followers can be used for engagement respectively with the cam grooves of the cams such that the grooved cam and the cam followers are cooperative to function as the router 32 as well as the reciprocators 33.

**[0054]** When the user uses the exercise assisting device in stand posture, the user stands on the left foot support and the right foot support with the user's left foot and right foot are respectively on the left foot support and the right foot support in an initial position that the left foot support and the right foot support are respectively at a stop, and subsequently starts operation of the drive unit 3. As shown in Fig. 10, the left foot support 2a and the right foot support 2b respectively has longitudinal directions Dx arranged along a direction inclined with a forward/rearward direction defined by the arrow X to make an angle of 9 degrees. Consequently, there is no possibility of twisting the user's legs when the user stands on the left foot support and the right foot support, thereby the exercise assisting device permitting the user to stand posture naturally.

**[0055]** At the initial positions, the left and right foot supports 2a and 2b are located at the same level along the forward/rearward direction. That is, the representative points of the left and right foot supports 2a and 2b lie on a line extending along the lateral direction when they are at the initial positions. Accordingly, when the user stands on the left and right foot supports 2a and 2b of the initial positions, a vertical line depending from the weight center of the user passes through a center between the left and right foot supports 2a and 2b.

**[0056]** As apparent from the above, the drive unit 3 can drive the left and right foot supports 2a and 2b to move in the forward/rearward direction and at the same time to move in the lateral direction in the linked manner to each other. The left and right foot supports 2a and 2b are driven to reciprocate linearly along the rails 43, respectively, so as to move in directions different from the

lengthwise directions of the feet. For example, the left and right foot supports 2a and 2b move in the directions inclined at an angle of 45 degrees relative to the forward/rearward direction of the housing 1, over the travel distance of 20 mm, for example.

**[0057]** Also as discussed in the above, the foot plate 21 is driven to swing about the axle 24 as each of the left and right foot supports 2a and 2b reciprocates along the rail 43. While the foot plate 21 is moving, the follower projection 25 rides up and down the inclination 14a of the guide surface 14 to cause the dorsiflexion of the ankle joint when each of the left and right foot supports 2a and 2b comes to its forward end position, and the plantarflexion when it comes to its rearward end position. The axle 24 is positioned nearer to the heel within the length of the foot bottom. Each of the dorsiflexion and plantarflexion is realized at the tilt angle of about 10 degrees relative to a reference plane defined by the upper surface of the base plate 1 a.

**[0058]** The dorsiflexion and the plantarflexion can be made respectively at the rearward end position and the forward end position of each of the left and right foot supports 2a and 2b in opposite relation to the above. Also, the tilt angle relative to the reference plane can be selected differently from the above mentioned angle. Such modified operation can be easily realized by an appropriate shaped guide surface 14.

## Claims

### 1. An exercise assisting device comprising:

a left foot support and a right foot support respectively configured to bear a user's left foot and right foot;  
a guide configured to restrict travel paths respectively of said left foot support and said right foot support,  
a drive unit configured to move said left and right foot supports in a mutually linked manner, and  
a frame mounting said left foot support, said right foot support, said guide, and said drive unit,

wherein

said drive unit comprises a drive source of generating a driving force,  
a router configured to provide two routes for distributing said driving force respectively to said left foot support and said right foot support, and  
a reciprocator configured to reciprocate said left and right foot supports in at least one of a forward/rearward direction and a lateral direction by said driving force.

### 2. An exercise assisting device as set forth in claim 1, wherein said drive source is a rotary motor,

said router includes a first gear fixed to an output shaft of said rotary motor, and a pair of second gears meshing with said first gear, and said reciprocator includes a translation mechanism of translating rotary motions of the second gears into reciprocatory motion of said left and right foot supports, respectively. 5

3. An exercise assisting device as set forth in claim 2, wherein 10  
 said first gear is a worm gear,  
 said second gear is a worm wheel meshing with said worm gear,  
 said translation mechanism includes a crank rod for translation of rotary motion of said worm wheels to the reciprocatory motions of said left and right foot supports. 15
4. An exercise assisting device as set forth in any one of claims 1 to 3, wherein 20  
 said router is configured to give a phase difference between the movements of said left and right foot supports.
5. An exercise assisting device as set forth in any one of claims 1 to 3, further including: 25  
 an inclination provider configured to vary a top surface angle of each of said left and right foot supports with respect to a reference plane in an interlocked manner with the reciprocatory movement thereof, 30  
 said inclination provider comprises a guide face formed on one of said foot support and said frame to have at least an inclination surface inclined with respect to the direction of the movement of said left and right foot supports, and a follower projection formed on the other of said foot support and said frame to come into sliding contact with said guide face while said left and right foot supports are driven to move. 35 40
6. An exercise assisting device as set forth in claim 5, wherein 45  
 said inclination provider includes an axle on a side of one of said foot support and said frame, and a bearing on a side of the other of said foot support and said frame for supporting said axle, said axle defining a pivot axis around which each of said left and right foot supports swings in response to the top surface thereof being inclined along said inclination surface. 50
7. An exercise assisting device as set forth in claim 5, wherein 55  
 said follower projection is provided at its top with a roller which comes into a rolling contact with said guide face.



Fig.1

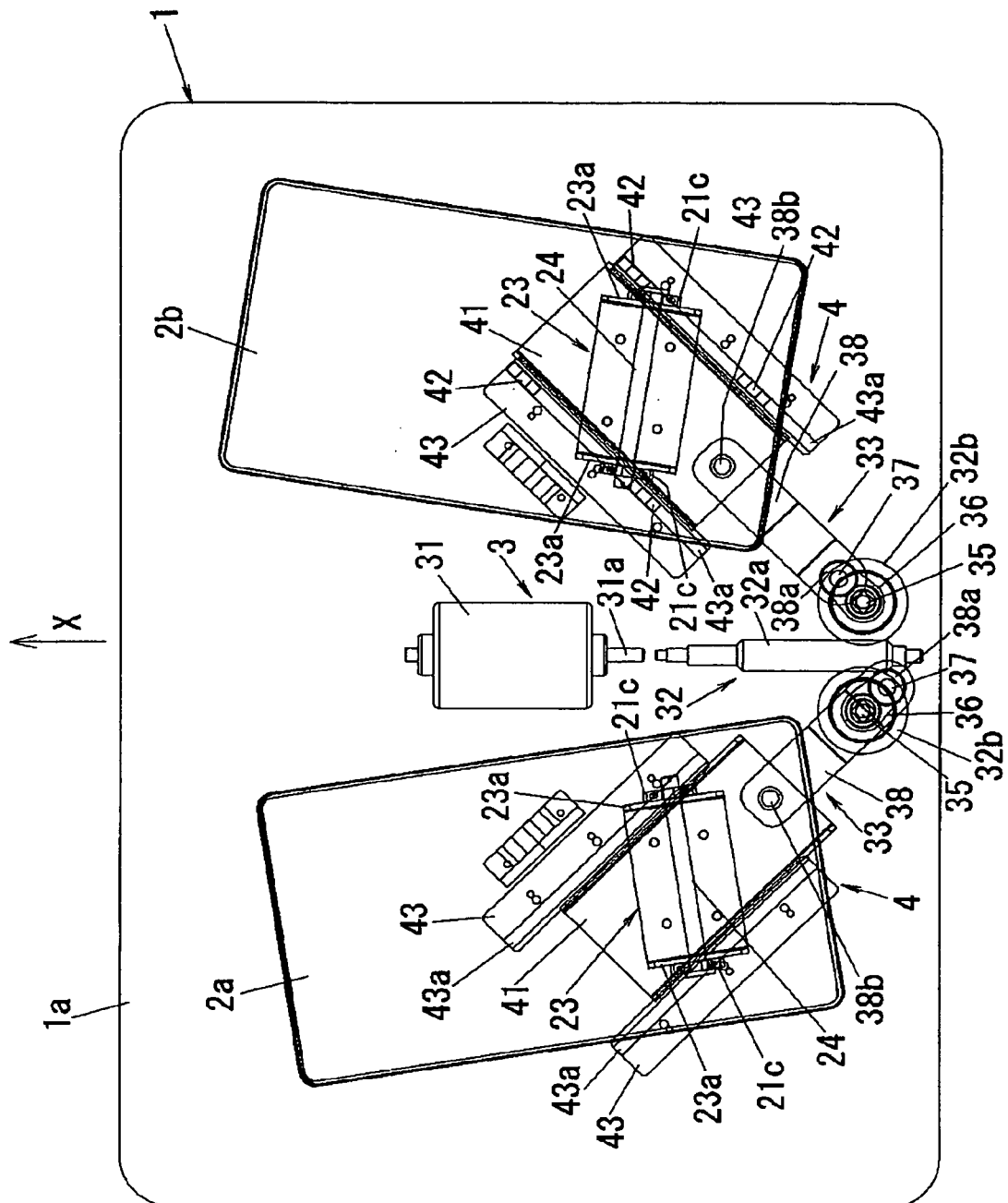


Fig. 2

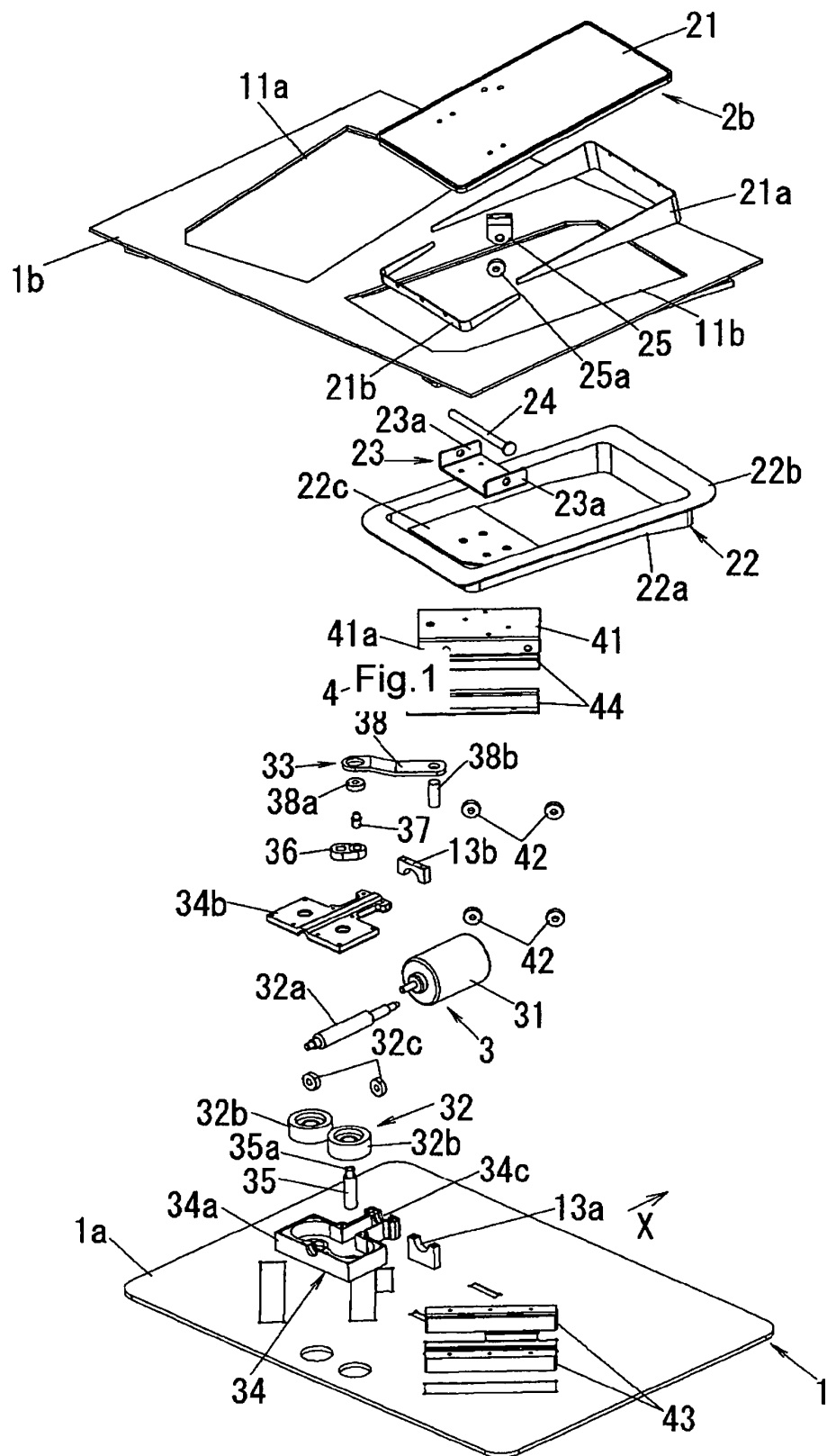


Fig. 3

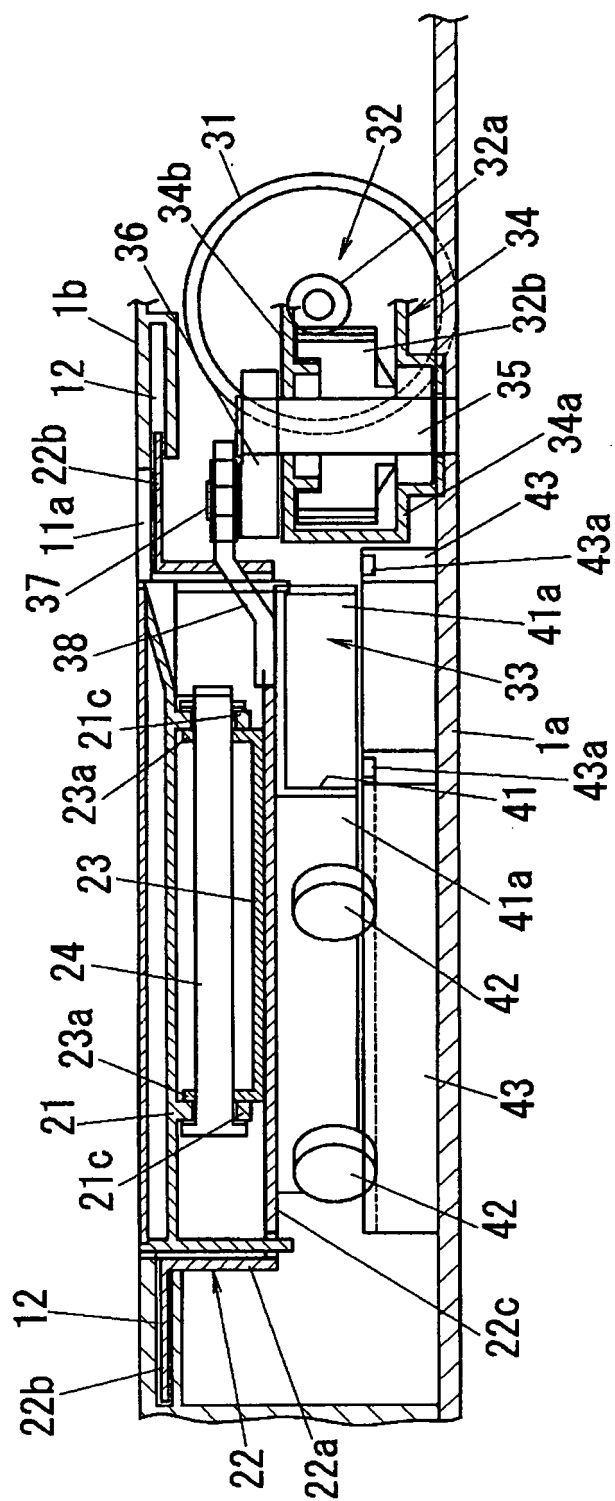


Fig. 4

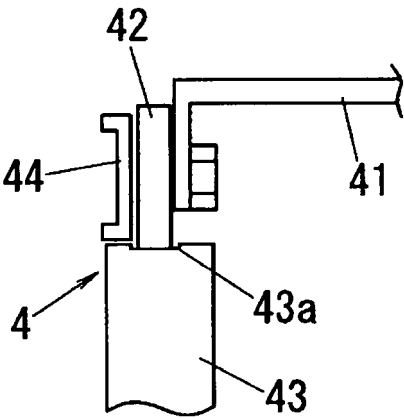


Fig. 5

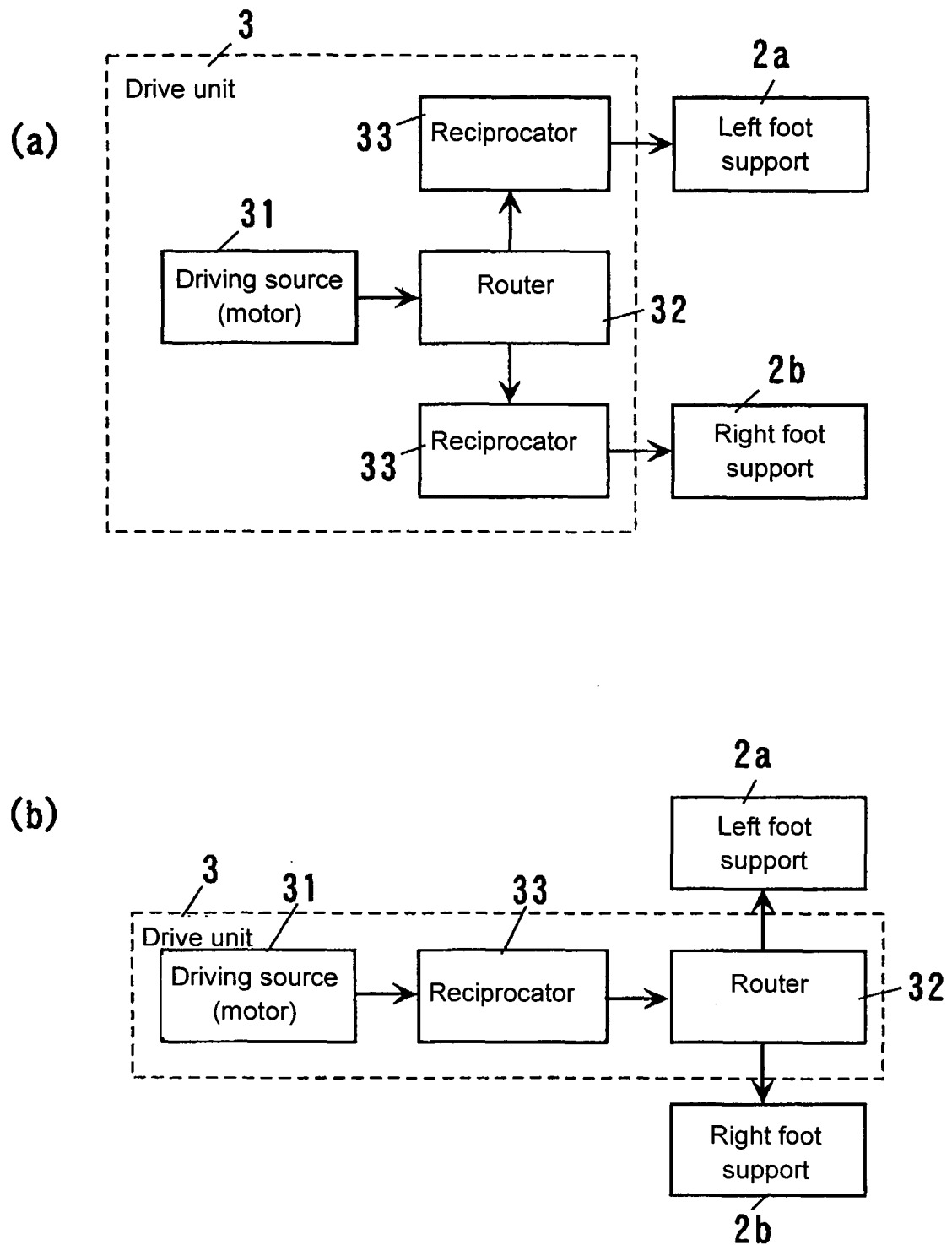


Fig. 6

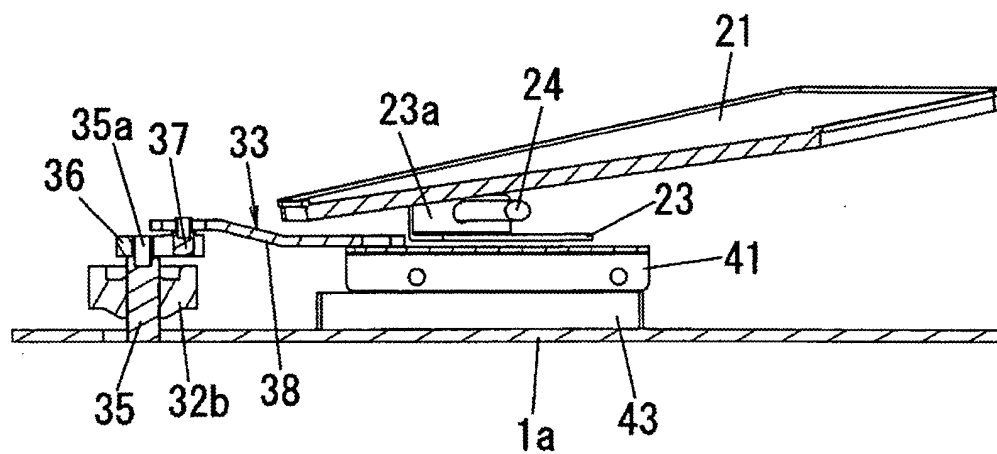


Fig. 7

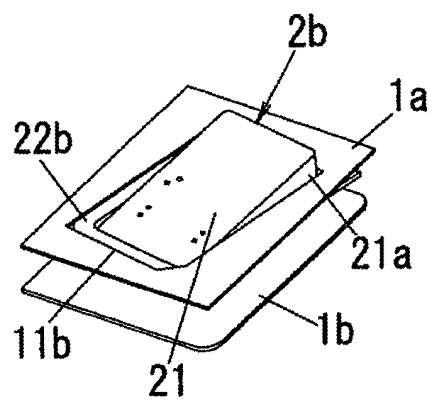


Fig. 8

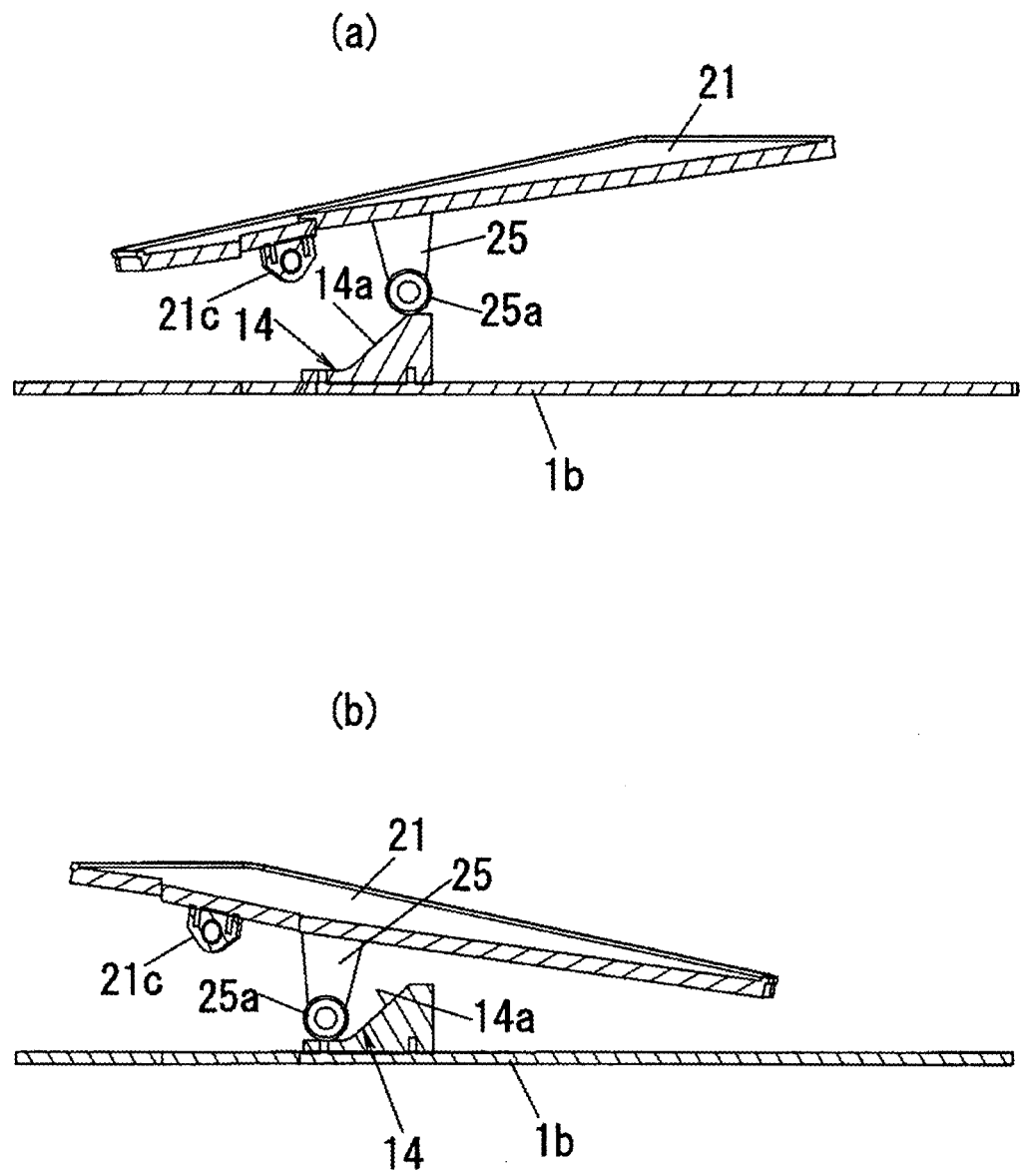


Fig. 9

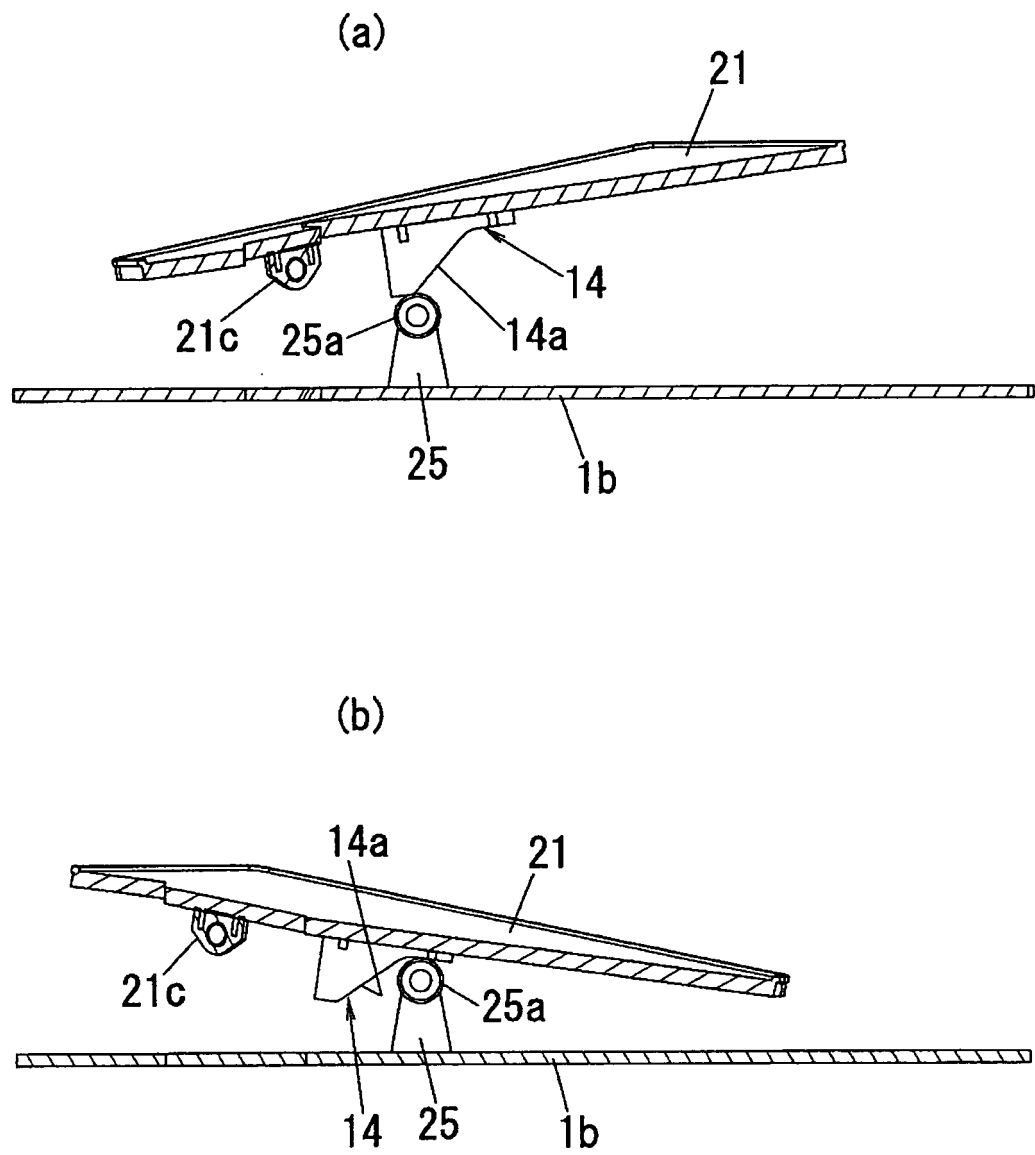
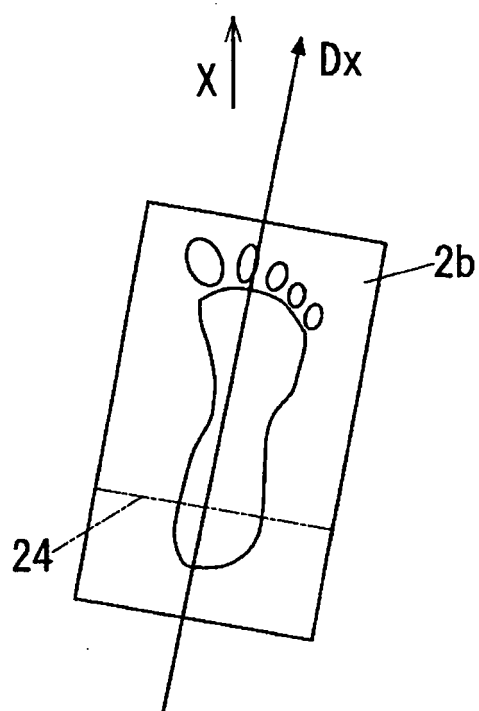




Fig. 10



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/074847

A. CLASSIFICATION OF SUBJECT MATTER A61H1/02 (2006.01) i, A63B23/04 (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, A63B23/04		
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 1996-2008 Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008		
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.
Y A	JP 2003-290386 A (Matsushita Electric Works, Ltd.), 14 October, 2003 (14.10.03), Fig. 1 (Family: none)	1-4 5-7
Y A	JP 10-055131 A (Shiraito TANI), 24 February, 1998 (24.02.98), Fig. 8 & US 5902214 A	1-4 5-7
Y A	JP 2002-325860 A (Taito Corp.), 12 November, 2002 (12.11.02), Par. No. [0024] (Family: none)	1-4 5-7
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> 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 31 March, 2008 (31.03.08)		Date of mailing of the international search report 08 April, 2008 (08.04.08)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/074847

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2003-190235 A (Shun'ichi IIJIMA), 08 July, 2003 (08.07.03), Par. Nos. [0012] to [0014] (Family: none)	1-4 5-7

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**REFERENCES CITED IN THE DESCRIPTION**

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- JP 10055131 A [0003] [0003]