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(71) Applicant: **Panasonic Electric Works Co., Ltd**
Kadoma-shi
Osaka 571-8686 (JP)

(72) Inventors:
- **OZAWA, Takahisa**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **OCHI, Kazuhiro**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **SHINOMIYA, Youichi**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **GOTOU, Takao**
  Kadoma-shi
  Osaka 571-8686 (JP)
- **MIHARA, Izumi**
  Kadoma-shi
  Osaka 571-8686 (JP)

(74) Representative: **Appelt, Christian W.**
Forrester & Boehmert
Pettenkoferstrasse 20-22
80336 München (DE)

(54) STANDING-POSITION TYPE PASSIVE EXERCISE MACHINE

(57) A passive exercise assisting device comprises a left foot support, a right foot support, and a driving unit. The left foot support and the right foot support are configured to bear a left foot and a right foot of a user respectively. The driving unit is configured to move the left foot support and the right foot support so as to give motions to the left foot support and the right foot support in relation with each other. The driving unit comprises at least one of a horizontal motion applying mechanism and a rotation motion applying mechanism. The horizontal motion applying mechanism is configured move the left foot support and the right foot support laterally to the left foot support and the right foot support. The rotation motion applying mechanism is configured rotate the left foot support and the right foot support about horizontal axes to the left foot support and the right foot support. The passive exercise assisting device further comprises a vertical motion applying mechanism being configured to move the left foot support and the right foot support vertically to the left foot support and the right foot support.

Fig.3a

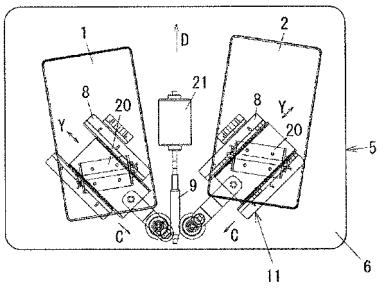


Fig.3b

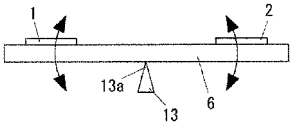
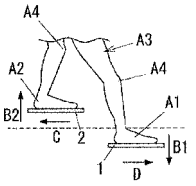


Fig.3c



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Description

TECHNICAL FIELD

[0001] This invention relates to a passive exercise assisting device for training muscles of lower legs.

BACKGROUND ART

[0002] Japanese registered utility model application publication No. 3112751 and Japanese patent application publication No. 2002-253700 discloses the prior exercise assisting device for training the muscles of the lower legs. The prior exercise device of stepping type is a device which is used for easily training the muscles of the user's lower leg in the home. The prior exercise assisting device of the stepping type comprises a left foot support, a right foot support, springs and air cylinders. The user places a user's left foot and a user's right foot feet on the left foot support and the right foot support respectively. Subsequently, the user alternately moves the user's left foot and the right foot up and down. In this manner, the user uses the exercise assisting device of the stepping type. By using the exercise assisting device of the stepping type, the user is able to perform exercise similar to the walking. Consequently, the user is able to promote the user's health.

[0003] However, the user is required to step the left foot support and the right foot support oneself when the user uses the prior exercise assisting device. When the user steps the left foot support and the right foot support of the prior exercise assisting device, the user bends and stretches the knee joint. Therefore, persons having knee pains or aged parsons have difficulty in using the prior exercise device of stepping type. In addition, the user of the prior exercise device of stepping type is required to move actively. That is, the user of the prior exercise device is needed to carry on the exercise with an effort. This effort is a burden to the user. Furthermore, the user does not amuse a simple up-down motion of the left foot and the right foot support. Therefore, the user gives up the exercise easily.

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] This invention is achieved to solve the above problem. An object of this invention is to produce the passive exercise assisting device of standing type. The passive exercise assisting device of standing type gives passive exercise of the up-down motion to the left leg and the right leg in order to train balance of the user's body and also train the muscle of the lower legs.

MEANS OF SOLVING THE PROBLEMS

[0005] In order to solve the above problem, the passive exercise assisting device in this invention comprises a left foot support, a right foot support, and a driving unit. The left foot support and the right foot support are shaped to bear a left foot and a right foot of the user respectively. The driving unit is configured to move the left foot support and the right foot support so as to give motions to respective the left foot support and the right foot support in relation with each other. The driving unit comprises at least one of a horizontal motion applying mechanism and a rotation motion applying mechanism. In addition, the driving unit comprises a vertical motion applying mechanism. The horizontal motion applying mechanism is configured to give horizontal motion to the left foot support and the right foot support in order to move the left foot support and the right foot support. The rotation motion applying mechanism is configured to give a rotation motion in order to rotate respective the left foot support and the right foot support about a horizontal axis along the horizontal direction. The vertical motion applying mechanism is configured to give vertical motions in synchronization with the horizontal motions or the rotation motions to the left foot support and the right foot support in order to move the left foot support and the right foot support in a vertical direction as the left foot support and the right foot support is moved by the horizontal motion applying mechanism or is rotated by the rotation motion applying mechanism.

[0006] In this case, the passive exercise assisting device of standing type is configured to slide the user's left foot and the right foot along a horizontal direction passively by means of the horizontal motion applying mechanism in a condition where the user stands on the left foot support and the right foot support. Alternatively, the passive exercise assisting device of standing type is configured to rotate the user's left foot and the right foot support about the respective horizontal axes in order to dorsiflex the ankle joints passively in a condition where the user stands on the left foot support and the right foot support. In addition, the horizontal slide motion or the rotation motion causes weight shift of the user. Therefore, the vertical motion applying mechanism is configured to give the vertical motions in synchronization with the horizontal slide motion or the rotation motions to the left foot support and the right foot support. Consequently, the user is able to enhance balance ability by putting the user's weight on the foot support, while the user moving the left femoral area and the right femoral area alternately. In addition, the balance ability, the capacity to support the user's weight by either one of the left leg or the right leg, and the capacity of the muscle of the lower leg are enhanced simultaneously by swinging the user's body leftward and rightward in order to break the user's balance, whereby the user is able to take exercise continuously with interest. Furthermore, the passive exercise assisting device gives the 3-dimensional exercise which includes a vertical motion in combination with the horizontal motion. Therefore, an exercise effect which is given to the lower leg is enhanced. Moreover, even the passive ex-

ercise assisting device gives the 3-dimensional exercise, the passive exercise assisting device hardly bend and stretch the knee joint. Therefore, the passive exercise assisting device allows the user to train the muscles of the legs of the user without risk of making an impact to the knee joint.

[0007] It is preferred that the driving unit is configured to move the left foot support and the right foot support such that the left foot support is interlocked with the right foot support.

[0008] It is preferred that the vertical motion applying mechanism comprises a vertical motion applying means. The vertical motion applying means is configured to move the left foot support and the right foot support in the vertical direction. The vertical motion applying means is configured to vary height of the left foot support in relation to the right foot support.

[0009] In this case, the vertical motion applying means is configured to give a seesaw motion to the left foot support and the right foot support such that the left foot support and the right foot support is passively and alternately moved in the vertical direction.

[0010] It is preferred that the left foot support and the right foot support are configured to be rotatable about a rotation axis. The rotation axis is perpendicular to a horizontal plane.

[0011] It is preferred that the passive exercise assisting device further comprises a rotation plate. The rotation plate has a rotation axis. The rotation axis is perpendicular to a horizontal plane. The rotation plate is rotated about the rotation axis. Both the left foot support and the right foot support are attached to the rotation plate. Consequently, the left foot support and the right foot support are rotated when the rotation plate is rotated. The rotation axis is located between the left foot support and the right foot support.

[0012] In this case, the passive exercise assisting device is configured to give the twist motion of twisting superior limb with respect to the lower leg. Consequently, the passive exercise assisting device is capable of stimulating the various muscles such as the lower back and the lower leg, especially the adducent muscles, whereby the passive exercise exercises the user in order to develop the user's muscle more effectively.

[0013] The vertical motion applying means is configured to give the vertical motion to the left foot support and the right foot support in order to move the left foot support and the right foot support downward as the horizontal motion applying mechanism gives the horizontal motion to the left foot support and the right foot support in order to move the left foot support and the right foot support forward from backward.

[0014] In this case, the user's weight acts on the left foot support and the right foot support which move forward and downward. Therefore, the user is able to exercise the user's balance ability more electively.

[0015] It is preferred that the vertical motion applying means is configured to give the vertical motion to the left foot support in order to move the left foot support downward as the rotation motion applying mechanism moves the left foot support from the frontward tilting posture to the backward tilting posture. The vertical motion applying means is configured to give the vertical motion to the right foot support in order to move the right foot support downward as the rotation motion applying mechanism moves the right foot support from the frontward tilting posture to the backward tilting posture.

[0016] In this case, the user is easily put the user's weight on the left foot support or the right foot support which has the backward tilting posture and which is moved downward. When the user's weight acts on the left foot support or the right foot support, the user's weight acts on the rear side of the knee, whereby the front side of the femoral area are is contracted when the user's weight acts on the left foot support or the right foot support. In this manner, the passive exercise assisting device gives the dosal flexion motion to the ankle joint effectively.

[0017] It is preferred that the vertical motion applying means is configured to give the vertical motion to the left foot support in order to move the left foot support downward as the rotation motion applying mechanism moves the left foot support from the backward tilting posture to the frontward tilting posture. The vertical motion applying means is configured to give the vertical motion to the right foot support in order to move the right foot support downward as the rotation motion applying mechanism moves the right foot support from the backward tilting posture to the frontward tilting posture.

[0018] In this case, the user is easily put the user's weight on the left foot support or the right foot support which has the forward tilting posture and which is moved downward. When the user's weight acts on the left foot support or the right foot support, the user's weight acts on the rear side of the knee, whereby the front side of the femoral area are is contracted when the user's weight acts on the left foot support or the right foot support. In this manner, the passive exercise assisting device gives the dosal flexion motion to the ankle joint effectivefy.

[0019] These and still other objects and advantages will become apparent from the following best mode for carrying out the invention referring to the attached drawings.

BRIEF EXPLANATION OF THE DRAWINGS

[0020]

Fig. 1 is a passive exercise assisting device of standing type in an embodiment of this invention. The passive exercise assisting device in Fig. 1 comprises a left foot support and a right foot support which are movable in a vertical direction.

Fig. 2 is an explanation illustration of the left foot support and the right foot support. The left foot support and the right foot support are moved in the ver-

tical direction by a vertical motion applying means.
Fig. 3a is a plane view of a horizontal slide motion applying mechanism in the embodiment.
Fig. 3b is an explanation illustration showing a base plate which is supported as a scale.
Fig. 3c is an explanation illustration showing the foot support which moves downward as the foot support moves toward a front direction.
Fig. 4a is a plane view for explanation of the horizontal slide applying mechanism and rotation motion applying mechanism of another embodiment.
Fig. 4b is an explanation illustration of the base plate which is supported as a scale.
Fig. 4c is an explanation illustration of a plantarflex exercise for plantarflexing the ankle joint.
Fig. 5a is an explanation illustration of the foot support. The foot support in Fig. 5a has a back tilting position, and is moved downward.
Fig. 5b is an explanation illustration of the foot support. The foot support in Fig. 5b has a front tilting position, and is moved downward.
Fig. 6a is an explanation illustration of the passive exercise assisting device which comprises a twist rotation means and vertical motion applying means.
Fig. 6b is an explanation illustration showing the base plate which is supported as the scale.
Fig. 6c is an explanation illustration showing a mechanism and a rotation plate. The rotation plate supports the foot supports. The mechanism comprises a motor which is configured to rotate the rotation plate.
Fig. 7 is a rotation mechanism of the above.
Fig. 8 is an explanation illustration of a horizontal slide motion applying mechanism of another embodiment.
Fig. 9a is an explanation illustration of the horizontal slide motion applying mechanism of the another embodiment.
Fig. 9b is an explanation illustration of the horizontal slide motion applying mechanism of the another embodiment.
Fig. 10a is an explanation illustration of the vertical motion applying means of the another embodiment.
Fig. 10b is an explanation illustration of the vertical motion applying means of the another embodiment.
Fig. 11 a is an explanation illustration of the vertical motion applying means of another modification.
Fig. 11b is an explanation illustration of the vertical motion applying means of another modification.
Fig. 11c is an explanation illustration of the vertical motion applying means comprising motors which are configured to move the left foot support and the right foot support respectively and individually.
Fig. 12a is an explanation illustration of the vertical motion applying means of the above.
Fig. 12b is an explanation illustration of the vertical motion applying means of the above.

BEST MODE FOR CARRYING OUT THE INVENTION

[0021] Hereinafter, an invention of the embodiment is explained on the basis of the attached drawings.

[0022] The passive exercise assisting device **5** in this invention comprises a left foot support **1,** a right foot support **2,** and a driving unit. The left foot support **1** is shaped to bear the left foot **A1** of the user. The right foot support **2** is shaped to bear the right foot **A2** of the user. The driving unit is configured to give motions to the left foot support **1** and the right foot support **2** such that the left foot support **1** and the right foot support **2** are related with each other. The driving unit comprises at least one of horizontal motion applying mechanism and a rotation motion applying mechanism. The rotation motion applying mechanism is configured to give rotation motions of rotating the left foot support **1** and the right foot support **2** to the left foot support **1** and the right foot support **2** respectively about horizontal axes **3.** The horizontal axes **3** extend along the horizontal plane. Furthermore, the driving unit comprises a vertical motion applying mechanism. The vertical motion applying mechanism is configured to give vertical motions of moving the left foot support and the right foot support in a vertical direction **B** to the left foot support **1** and the right foot support **2** respectively such that the vertical motion is in synchronization with the horizontal motion or the rotation motion.

[0023] Fig. 1 to Fig. 3 show one embodiment of the passive exercise assisting device of standing type. Fig. 1 shows a schematic view of the left foot support **1** and the right foot support **2** which are movable in the vertical direction individually. Fig. 2 is a schematic view of the left foot support **1,** the right foot support **2,** and the vertical motion applying means **13** of the vertical motion applying mechanism. The vertical motion applying means **13** is configured to move the left foot support **1** and the right foot support **2** individually in the vertical direction. Fig. 3 is a schematic view of the passive exercise assisting device of standing type which comprises the horizontal slide motion applying mechanism **11** and also the vertical motion applying means **13.**

[0024] The horizontal slide motion applying mechanism **11** shown in Fig. 3 is equivalent to the horizontal motion applying mechanism. The horizontal slide motion applying mechanism **11** is configured to move the left foot support **1** and the right foot support **2** in a front-back direction and also a lateral direction such that a combination of the trajectory of the left foot support and the trajectory of the right foot support traces out V-shape. Consequently, the horizontal slide motion applying mechanism **11** causes the user's muscle of the leg to expand and contract. The horizontal slide motion applying mechanism **11** comprises a base plate **6,** a left rail **8** and a right rail **8.** The left rail **8** and the right rail **8** are disposed on an upper surface of the base plate **6.** The left rail **8** has a lengthwise direction **Y1**. The right rail **8** has a lengthwise direction **Y2.** The left rail **8** and the right rail **8** extend toward a left direction and a right direction

respectively as the left rail **8** and the right rail extend toward a front direction. Therefore, the lengthwise direction **Y1** crosses the lengthwise direction **Y2** at a predetermined angle such that the left rail **8** and the right rail **8** extends away from each other as the left rail **8** and the right rail **8** extends toward a front direction. When a motor **21** is started, the motor rotates the worm wheel **9** so as to reciprocate the left truck **20** along the lengthwise direction **Y1** of the left rail **8** and also the right truck **20** along the lengthwise direction **Y2** of the right rail **8.** When the left truck **8** and the right truck **8** are reciprocated, the left foot support **1** and the right foot support **2** which respectively holds the left truck **20** and the right truck **20** are reciprocated along the lengthwise directions **Y1** and **Y2** of the left rail **8** and the right rail **8.**

[0025] In contrast, the vertical motion applying means **13** shown in Fig. 3b supports a center of a lower surface of the base plate **6** so as to support the base plate **6** as the scale while the center of the lower surface of the base plate **6** acts as a fulcrum **13a.** Consequently, the vertical motion applying means **13** is configured to hold the left foot support **1** and the right foot support **2** such that the vertical motion applying means **13** allows the left foot support **1** and the right foot support **2** to alternately move upward and downward like a seesaw motion

[0026] It is noted that the vertical motion applying means **13** is configured to support the left foot support **1** and the right foot support **2** as a scale to be movable as the seesaw when the user's weight is moved to the left foot support **1** or the right foot support **2.** However, the vertical motion applying mechanism **13** is not limited thereto. That is, it is also possible to employ the vertical motion applying means **13** which is realized by a ball or a roller. In a case where the ball or the roller acts as the fulcrum **13a,** the left foot support **1** and the right foot support **2** is swung about the fulcrum **13a** in **360** degrees. This configuration is also employed in the following embodiments.

[0027] As mentioned above, the passive exercise assisting device **5** of standing type being used by the user standing without bending the knee **A4** is produced. In this passive exercise assisting device **5,** when the user **A** starts the motor while the user stands on the left foot support **1** and the right foot support **2,** the left foot support **1** and the right foot support **2** are driven to move such that the trajectories of the left foot support **1** and the right foot support **2** traces V-shape. Further, the left foot support **1** and the right foot support **2** are driven to move such that the left foot support **1** has **180** degrees out of phase with the right foot support **2.** With this configuration, the passive exercise assisting device gives pseudo-walking exercise to the user. In addition, when the user trains the walking ability by the passive exercise assisting device, the passive exercise assisting device causes the weight shift of the user in the front-back direction. As a result, the base plate **6** which holds the left foot support **1** and the right foot support **2** is moved as the seesaw. Therefore, the user's weight is applied to either one of the left foot support **1** or the right foot support **2** which is located lower than the other foot support. That is, when the user stands on the left foot support **1** and the right foot support **2,** the user has very precarious balance position. Then, the user tries to recover from the precarious balanced position in order to maintain balance by using the muscles of the entire body. That is, even the user's weight is slightly shifted by the passive exercise assisting device, the user's leg muscles are initiated to maintain balance by command from the brain. In this manner, the user's brain, motorius, and the balance ability is trained. In addition, agings of the brain, the motorius, and the balance ability are also trained. In addition, when the left foot support **1** or the right foot support **2** is moved downward, the load which acts on the lower leg **A3** is increased. Therefore, the user is able to train the **3**-dimensional balance ability by putting the user's weight on the left foot support **1** and the right foot support **2** certainly while the left femoral area and the right femoral area are alternately moved in the vertical direction. In this manner, the user using the passive exercise assisting device is able to train (a) the balance ability while performing the pseudo walking exercise, (b) the capacity of supporting the user's weight by only the left leg **A1** or the right leg **A2,** and (c) the muscle of the lower leg **A3** at one time. Therefore, it is possible to obtain a training assisting effect of assisting the training. In addition, the passive exercise assisting device is able to give not **2**-dimensional exercise but **3**-dimensional multiple exercise including planar motion in combination with a motion for maintaining the balance in the vertical direction. Therefore, the load applied to the lower leg **A3** is increased. Furthermore, while the passive exercise assisting device is used by the user having a standing posture, the user has no need to bend the knee **A4.** Therefore, there is no possibility of applying the large load to the knee joint. Consequently, it is possible to train the muscles of the lower leg **A3** while the user hurts the user's knee joint. As a result, elderly persons having a difficulty of shifting the user's weight in the front-back direction are also able to use the passive exercise assisting device easily. Therefore, the elderly persons are also able to train the walking ability by the passive exercise assisting device.

[0028] Fig. 4 and Fig. 5 shows another embodiment. In this embodiment, the driving unit comprises the rotation motion applying mechanism **12** in addition to the horizontal slide motion applying mechanism **11** and the verticai motion applying means **13.** The rotation motion applying mechanism **12** is configured to rotate each the left foot support **1** and the right foot support **2** about horizontal axles **3.** The horizontal **axle 3** extends along the horizontal direction. The horizontal slide motion applying mechanism **11** and the vertical motion applying means **13** are same as the horizontal slide motion applying mechanism **11** and the vertical motion applying means **13** in Fig. 3, respectively. The rotation motion applying mechanism **12** is configured to rotate the left foot support **1** and the right foot support **2** about the respective horizontal axles.

With this configuration, the rotation motion applying mechanism **12** gives the rotation motion of inclining the left foot support and the right foot support with the horizontal plane to the left foot support **1** and the right foot support **2** such that each the left foot support **1** and the right foot support **2** is movable between a frontward tilting posture and a backward tilting posture. As the foot **A1 (A2)** is plantarflexed to have a frontward tilting posture of having toe being located lower than the heel, the weight of the user acts on the front side of the knee, whereby the rear side of the femoral area is contracted. In contrast, as the foot **A1 (A2)** is dosalflexed to have a backward tilting posture (shown in Fig. 5a) of having the heel being located lower than the toe, the weight of the user acts on the rear side of the knee, whereby the front side of the femoral area is contracted. In order to give the planarflex motion and the dorsiflex motion, as shown in Fig. 4a, the rotation motion applying mechanism **12** comprises motors **30** for the left foot support 1 and the right foot support **2** respectively and integrally. Each the motor **30** is configured to rotate forward and backward. Each the motor **30** is configured to give rotation motion of moving the left foot support **1** (the right foot support **2)** between the frontward tilting posture and the backward tilting posture. The rotation motion of the left foot support **1** (the right foot support **2)** is interlocked with the V-shape motion of the left foot support **1** (the right foot support **2).** For example, the motor **30** moves the left foot support **1** (the right foot support **2)** to the frontward tilting posture or the backward tilting posture as the left foot support **1** (the right foot support **2)** moves toward the front direction **D.** Consequently, the user is able to perform the planarflex motion and the dorsiflex motion in addition to the v-shape motion and the seesaw motion.

[0029] When, as shown in Fig. 5a, the left foot support **1** bearing the dorsiflexed foot **A1** is moved downward **B1**, the power is put into shin of the user such that the shin of the user withstands the motion of the foot being dorsiflexed. Consequently, the muscles of the shin are strengthened. In contrast, when, as shown in Fig. 5b, the left foot support **1** bearing the plantarflexed foot **A1** is moved downward **B1**, the power is put into sura of the user such that the sura of the user withstands the motion of the foot being plantarflexed. Consequently, the muscles of the sura are strengthened. Furthermore, it is possible to reduce the shear force applied to the knee **A4** in a case where the foot is dorsiflexed or plantarflexed. Therefore, there is no possibility of injury of the knee, whereby the user is able to perform the dorsifilexion exercise and the plantar flexion exercise without risk of the knee pain. In addition, when the inclination angle of the left foot support **1** (the right foot support **2)** with respect to the horizontal plane is varied by the motor **30,** it is possible to vary the inclination angles of the left foot support **1** and the right foot support **2** with respect to the horizontal plane.

[0030] Furthermore, in this embodiment, when the ankle joints is moved to have a dorsiflexion condition or a plantar flexion condition, the ankle joint is dorsiflexed or plantarflexed in a direction so as not to be twisted. That is, as shown in Fig. 4c, each the horizontal axles **3** are located below each one of the heels of the feet **A1, A2.** Therefore, the feet **A1, A2** receives no force other than the force in the direction for dorsiflexing and plantarflexing. Consequently, there is no possibility of twisting the ankles, whereby the user is able to perform the dorsiflexion exercise and the plantarflexion exercise without risk of twisting the ankles. This advantage is also obtained in the embodiments other than this embodiment.

[0031] Fig. 6 and Fig. 7 show yet another embodiment. The passive exercise assisting device in Fig. 6 and Fig. 7 comprises the rotation motion applying mechanism **12,** the vertical motion applying means **13,** and a twist rotation means **15.** The twist rotation means **15** is configured to rotate left foot support **1** and the right foot support about a vertical axis perpendicular to the horizontal plane. It should be noted that the vertical motion applying means **13** in Fig. 6 and Fig. 7 is equal to the vertical motion applying means **13** in Fig. 3. In contrast, the passive exercise assisting device in this embodiment does not comprise the horizontal slide motion applying mechanism **11**. The rotation motion applying mechanism **12** in this embodiment, shown in Fig. 7, comprises a worm **36** and a pair of worm wheels **37.** The worm **36** is connected with an output shaft of a motor **35** which is configured to rotate forward and backward. The worm wheel **37** is meshed with a pair of the worm wheels **37.** Each one of the worm wheel **37** is connected to each one of the left foot support **1** and the right foot support **2.** The motor **35** is configured to generate the rotation for rotating the left foot support **1** and the right foot support **2** about the horizontal axles **3,** respectively. The twist rotation means **15,** shown in Fig. 6a, is configured to rotate a rotation plate **7** in a direction indicated by an arrow F relative to the base plate **6**. The twist rotation means **15** is configured to be rotated by the user on the left foot support **1** and the right foot support **2** attached to the rotation plate **7** actively may employed. In addition, it is also possible to employ the twist rotation means **15** which is configured to passively rotate the rotation plate **7** by the motor **40.** The rotation plate **7** is provided with driving shaft **41** which holds the worm wheel **42.** The worm wheel **42** is meshed with the worm **43** fixed to the output shaft of the motor **40** which is configured to rotate forward and backward. With this configuration, the twist rotation means is configured to rotate the rotation plate **7** about the driving shaft by the motor **40** which rotates forward and backward.

[0032] In this manner, it is possible to give the twist exercise F of twisting the superior limb **A5** with respect to the lose leg **A3** in addition to the dorsflextion and plantarflextion exercise by the rotation motion applying mechanism **12** (shown in Fig. 7), and the seesaw exercise **B1 B2** by the vertical motion applying means **13** (shown in Fig. 6b). Therefore, it is possible to stimulate the muscles of the lower back A**6** and the lower leg **A3,**

especially adducent muscles, whereby it is possible to strengthen the muscles more effectively. In addition, the passive twist rotation generated by the rotation plate **7** with using the motor **40** makes it possible to strengthen the muscles of the lower legs **A3.** Furthermore, the passive exercise assisting device in this embodiment comprises no horizontal slide motion applying mechanism **11**. However, the passive exercise assisting device in this embodiment may further comprises the horizontal slide motion applying mechanism.

[0033] Above embodiments shows the horizontal slide motion applying mechanism **1** being configured to move the left foot support **1** and the right foot support **2** such that the left foot support **1** and the right foot support **2** moves along the trajectory of V-shape in order to generate V-shape motion. However, the motion of the horizontal slide motion applying mechanism **11** is not limited thereto. That is, it is only required for the horizontal slide motion applying mechanism **11** to give the horizontal motion to the left foot support **1** and the right foot support **2** in order to move the left foot support **1** and the right foot support **2** in the horizontal direction. Fig. 8 and Fig. 9 show the respective embodiment.

[0034] Fig. 8 shows the left foot support **1** and the right foot support **2** which is moved in directions parallel to each other. The left foot support **1** and the right foot support **2** are moved toward the front direction **D** and the back direction **C** alternately. The left foot support **1** and the right foot support **2** are moved along a guide **60** and a guide **61,** respectively. In this embodiment, a motor **50** is provided with an output shaft **51** which is rotated forward and backward. The output shaft **51** is provided with a main gear **52.** The main gear **52** is meshed to a sub gear **53** and a sub gear **54.** The sub gear **53** and the sub gear **54** are located in both sides of the main gear **52.** The left foot support **1** is provided at its end face with a rack **55** which meshes with the sub gear **53.** The right foot support **2** is provided at its end face with a rack **56** which meshes with the sub gear **54**. When the motor **50** is started to generate frontward and backward rotation, the left foot support **1** and the right foot support **2** are moved in the front-back direction alternately. Therefore, the passive exercise assisting device is suitable for using the pseudo ski training.

[0035] Fig. 9 shows the left foot support **1** and the right foot support **2** which are driven to move horizontally in the lateral direction E such that the left foot support **1** and the right foot support **2** moves toward and away from each other. The left foot support **1** and the right foot support **2** are moved along a guide **62** and a guide **63** respectively The guide **62** and the guide **63** are configured to guide the left foot support **1** and the right foot support **2** in the lateral direction E such that the left foot support **1** and the right foot support 2 moves toward and away from each other. Each the left foot support **1** and the right foot support **2** is connected to a first end of a link **60.** The link **60** is shaped to have a rhomboid, and is configured to expand and contract in the lateral direction. The link **60** has a second end which is connected to a piston rod **62** of an oil hydraulic cylinder **61.** When the piston rod is extended as shown in Fig. 9b, the link **60** extends in the lateral direction. Consequently, the left foot support **1** and the right foot support **2** are moved away from each other. In contrast, when the piston rod **62** is returned, the link **60** extends in the front-back direction. Consequently, the left foot support **1** and the right foot support **2** are moved toward each other. In this manner, the left foot support **1** and the right foot support **2** are moved toward and away from each other in the lateral direction E. Therefore, it is suitable for the opening exercise of opening the both legs.

[0036] Each one of Fig. 10 to Fig. 12 shows yet another embodiment. These embodiments show examples of the vertical motion applying means **14** of the vertical motion applying mechanism. Each the left foot support **1** and the right foot support **2** has a representative point in the vertical direction **B**. The vertical motion applying mechanism is configured to move the representative point of the left foot support **1** relative to the representative point of the right foot support **2.** That is, the vertical motion applying means is configured to move the left foot support **1** and the right foot support **2** in the vertical direction. The vertical motion applying means is configured to move the left foot support **1** and the right foot support **2** in such a manner that the height of the left foot support **1** is moved relative to the height of the right foot support **2.**

[0037] The vertical motion applying means **14** in Fig. 10 comprises the oil hydraulic cylinder **70** and the piston rod **71.** The base plate **6** is configured to swing about the fulcrum **13**a in such a manner that the base plate **6** moves as a seesaw. The base plate **6** is provided at is one end with a piston rod **71.** When the piston rod **71** is extended, the base plate **6** is swung about the fulcrum **13**a**.** An arrow **B1** and an arrow **B2** of Fig. 10 show the motions of the right foot support **2** when the piston rod **71** of the vertical motion applying means **14** is moved. In this manner, the left foot support **1** and the right foot support **2** are passively moved as the seesaw in such a manner that the left foot support **1** and the right foot support **2** are moved in the directions of **B2** and **B1**, respectively.

[0038] The vertical motion applying means **14** of Fig. 11 comprises a motor **80** and a pair of eccentric cams **81, 82.** In this embodiment, the two eccentric cams **81** and **82** are fixed to the output shaft **80a** of the motor, and are spaced from each other. When the upwardly projected dimension **L1** of the eccentric cam **81** is maximized, the upwardly projected dimension **L2** of the eccentric cam **82** is minimized. The eccentric cam **81** is disposed under the left foot support **1**. The eccentric cam **82** is disposed under the right foot support **2.** When the motor **80** rotates the output shaft **80a**, rotation motion of each the eccentric cam **81** and the eccentric cam **82** is translated into the vertical motion of each the left foot support **1** and the right foot support **2.** Consequently, the left foot support **1** and the right foot support **2** are passively moved in the vertical directions **B1**, **B2** in such a manner that the left foot support **1** and the right foot support **2** are

moved as the seesaw. It should be noted that it is possible to employ two motors **80A**, **80B** shown in Fig. 11c in order to rotate the eccentric cams **81** and **82** individually. Consequently, the left foot support **1** and the right foot support **2** are moved individually, or are moved randomly instead of being alternately moved in the vertical direction as the seesaw. In this case, it is possible to adjust the speed, the distance, and the timing of the left foot support **1** and the right foot support **2** in the vertical direction. Therefore, the left foot support **1** and the right foot support **2** are randomly moved in the vertical direction. As a result, the left foot support **1** and the right foot support **2** are moved unpredictably and passively. Consequently, it is possible to enhance the effect of the balance exercise.

[0039] The vertical motion applying means **14** of Fig. 12 comprises links **90, 91,** and a connection rod **92.** Each the link **90** and the link **91** is shaped to have the rhomboid. The link **90** and the link **91** are arranged in the lateral direction. The links **90, 91** are configured to expand and contract toward a vertical direction **B**, and are disposed under the left foot support **1** and the right foot support **2,** respectively. The link **90** is pivotally connected to the link **91** by means of the connection rod **92.** An upper end of the link **90** is connected to the piston rod **96** of the oil hydraulic cylinder **95.** When the piston rod **96** is expanded in the vertical direction, the link **90** is extended in the vertical direction while the link **91** is shortened in the vertical direction. In contrast, when the piston rod **96** is contracted in the vertical direction, the link **90** is shortened in the vertical direction while the link **91** is extended in the vertical direction. Consequently, the left foot support **1** and the right foot support **2** are alternately moved in the vertical direction in such a manner that the left foot support **1** and the right foot support **2** are moved as a seesaw. It should be noted that it is possible to employ individual oil hydraulic cylinders **95,** and two links **90, 91** separated from each other. One of the oil hydraulic cylinders **95** is connected to the link **90,** and the other of the oil hydraulic cylinders is connected to the link **91** in order to move the links **90 91**, individually. Consequently, the left foot support **1** and the right foot support **2** are individually and randomly moved in the vertical direction.

[0040] These explanations are made on the basis of the vertical motion applying means **14** of Fig. 10 to Fig. 12. When the horizontal slide motion applying mechanism **11** shown in Fig. 3a gives the horizontal motion to the left foot support **1** in order to move the left foot support **1** forward **D** from backward **C,** the vertical motion applying means **14** gives the vertical motion in synchronization with the horizontal motion to the left foot support **1** in order to move left foot support **1** downward **B1**. Therefore, the user is able to easily apply the user's weight to the left foot support **1.** Similarly, when the horizontal slide motion applying mechanism **11** shown in Fig. 3a gives the horizontal motion to the right foot support **2** in order to move the right foot support **2** forward **D** from backward **C,** the vertical motion applying means **14** gives the vertical motion in synchronization with the horizontal motion to the right foot support **2** in order to move the right foot support **2** downward **B1**. Therefore, the user is able to easily apply the user's weight to the right foot support **2.** Consequently, it is possible for the user to perform the balance exercise effectively.

[0041] In addition, the explanation of the embodiment is made on the basis of the vertical motion applying means **14.** When the rotation motion applying mechanism **12** gives the rotation motion to the left foot support **1** (the right foot support **2)** in order to move the left foot support **1** (the right foot support **2)** from the frontward tilting posture to the backward tilting posture shown in Fig. 4a, the vertical motion applying means **14** moves the left foot support **1** (the right foot support **2)** toward a lower direction **B1** as the left foot support **1** (the right foot support **2)** moves to the backward tilting posture shown in Fig. 5a. According to this motion, it is possible for the user to apply the user's weight to the left foot support **1** (the right foot support **2)** easily. Furthermore, in this case, the user's weight is applied to the rear side of the knee **A4.** Consequently, the front side of the femoral area is also contracted, whereby it is possible to give the dorsal flexion of the ankle joint effectively.

[0042] Further explanation of the embodiment is made on the basis of the vertical motion applying means **14.** When the rotation motion applying mechanism **12** gives the rotation motion to the left foot support **1** (the right foot support **2)** in order to move the left foot support **1** (the right foot support **2)** from the backward tilting posture to the frontward tilting posture shown in Fig. 4a, the vertical motion applying means **14** moves the left foot support **1** (the right foot support **2)** toward a lower direction **B1** as the left foot support **1** (the right foot support **2)** moves to the frontward tilting posture tilting posture. Therefore, it is possible for the user to apply the user's weight to the left foot support **1**. Furthermore, the user's weight is applied to the front side of the knee **A4.** Therefore, it is possible to contract the rear side of the femoral area. As a result, it is possible for the user to plantarflex the ankle joint effectively.

[0043] Although the present invention is described with particular reference to the above illustrated embodiments, the present invention should not be limited thereto, and should be interpreted to encompass any combinations of the individual features of the embodiments.

Claims

1. A passive exercise assisting device of standing type comprising:

   a left foot support and a right foot support being configured to bear a left foot and a right foot of a user respectively;

   a driving unit being configured to move said left foot support and said right foot support so as to give motions to said left foot support and said

right foot support in relation with each other;
said driving unit comprising at least one of a horizontal motion applying mechanism and a rotation motion applying mechanism, said horizontal motion applying mechanism being configured to give horizontal motions to said left foot support and said right foot support such that said horizontal motion applying mechanism moves said left foot support and said right foot support in a horizontal direction, said rotation motion applying mechanism being configured to give rotation motions to said left foot support and said right foot support such that said rotation motion applying mechanism rotates said left foot support and said right foot support about horizontal axes along the horizontal direction,
wherein
said driving unit comprises a vertical motion applying mechanism being configured to give vertical motions to said left foot support and said right foot support such that said vertical motion applying mechanism moves said left foot support and said right foot support in a verticai direction, and
said verticai motion applying mechanism being configured to give the vertical motions to said left foot support and said right foot support in synchronization with the horizontal motions or the rotation motion.

2. The passive exercise assisting device as set forth in claim 1, wherein
said driving unit being configured to move said left foot support and said right foot support such that said left foot support is interlocked with said right foot support.

3. The passive exercise assisting device as set forth in claim 1, wherein
said vertical motion applying mechanism comprises a vertical motion applying means which is configured to move said left foot support and said right foot support in the vertical direction, and
said vertical motion applying means being configured to move said left foot support and said right foot support in order to vary height of said left foot support relative to said right foot support.

4. The passive exercise assisting device as set forth in claim 1, wherein
said left foot support and said right foot support are configured to be rotatable about a rotation axis which is perpendicular to a horizontal plane.

5. The passive exercise assisting device as set forth in claim 1 further comprises a rotation plate,
said rotation plate having a rotation axis which is perpendicular to a horizontal plane,
said rotation plate being rotated about said rotation axis,
both said left foot support and said right foot support are attached to said rotation plate, whereby said left foot support and said right foot support are rotated when said rotation plate is rotated,
said rotation axis being located between said left foot support and said right foot support.

6. The passive exercise assisting device as set forth in claim 3, wherein
said vertical motion applying means being configured to give the vertical motion to said left foot support and said right foot support in order to move said left foot support and said right foot support downward as said horizontal motion applying mechanism gives the horizontal motion to said left foot support and said right foot support in order to move said left foot support and said right foot support frontward from backward.

7. The passive exercise assisting device as set forth in claim 3, wherein
said vertical motion applying means is configured to give the vertical motion to said left foot support in order to move said left foot support downward as said rotation motion applying mechanism gives the rotation motion to said left foot support in order to move said left foot support from a frontward tilting posture to a backward tilting posture, and
said vertical motion applying means is configured to give the vertical motion to said right foot support in order to move said right foot support downward as said rotation motion applying mechanism gives the rotation motion to said right foot support in order to move said right foot support from a frontward tilting posture to a backward tilting posture.

8. The passive exercise assisting device as set forth in claim 3, wherein
said vertical motion applying means is configured to give the vertical motion to said left foot support in order to move said left foot support downward as said rotation motion applying mechanism gives the rotation motion to said left foot support in order to move said left foot support from a backward tilting posture to a frontward tilting posture, and
said vertical motion applying means is configured to give the vertical motion to said right foot support in order to move said right foot support downward as said rotation motion applying mechanism gives the rotation motion to said right foot support in order to move said right foot support from a backward tilting posture to a frontward tilting posture.

Fig.1

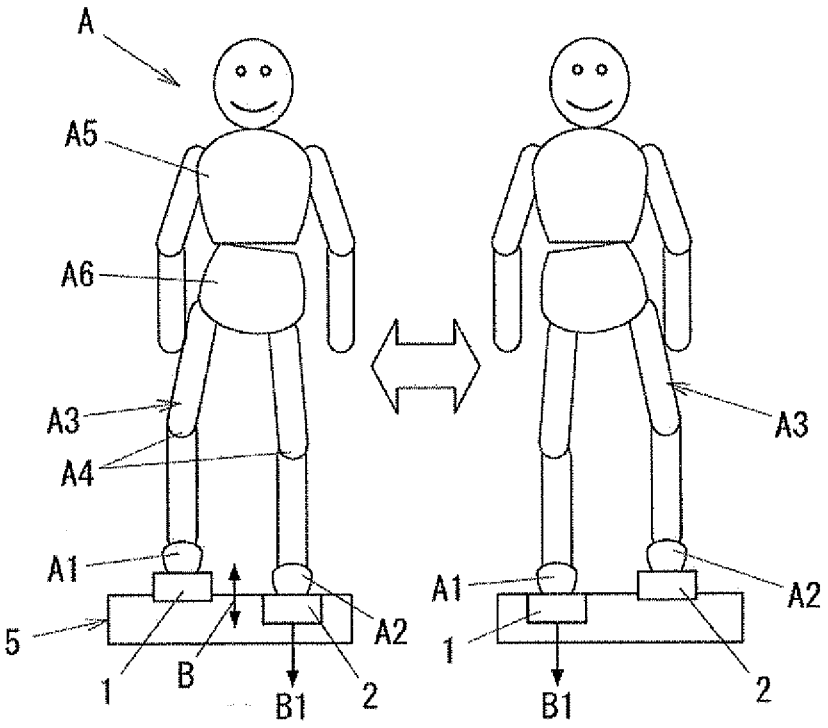


Fig.2

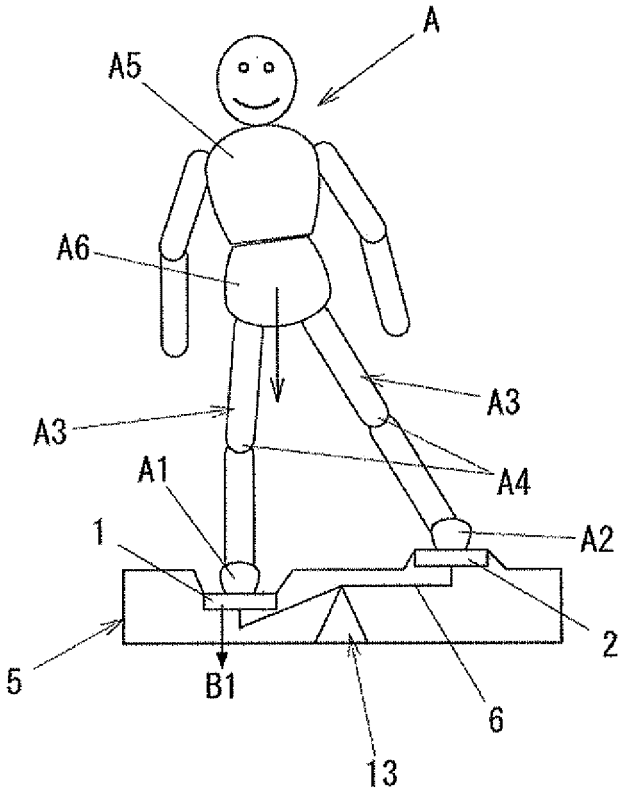


Fig.3a

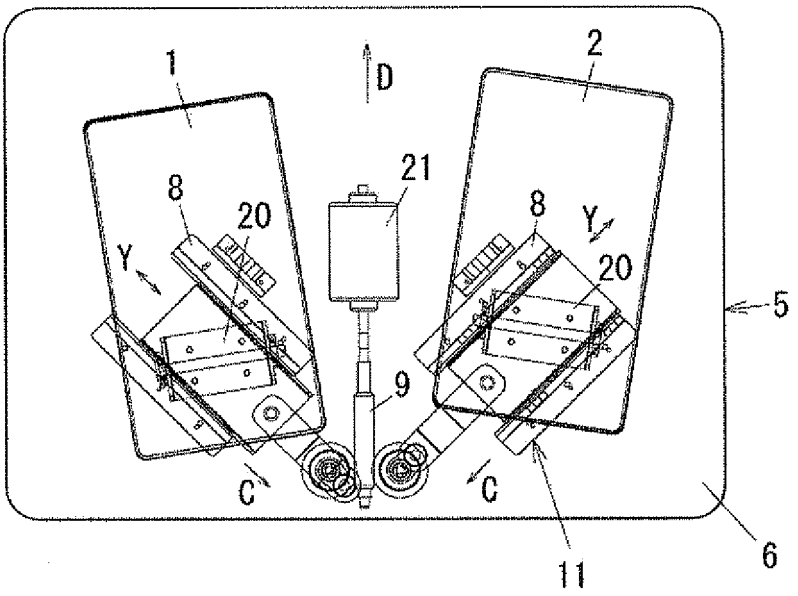


Fig.3b

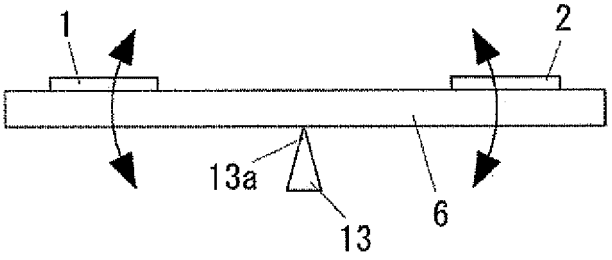


Fig.3c

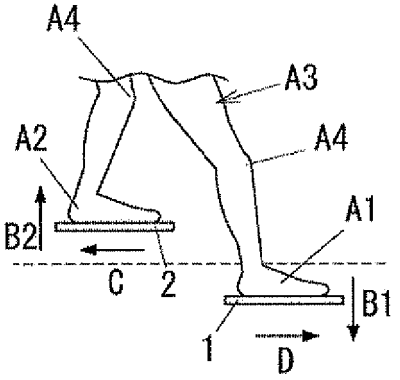


Fig.4a

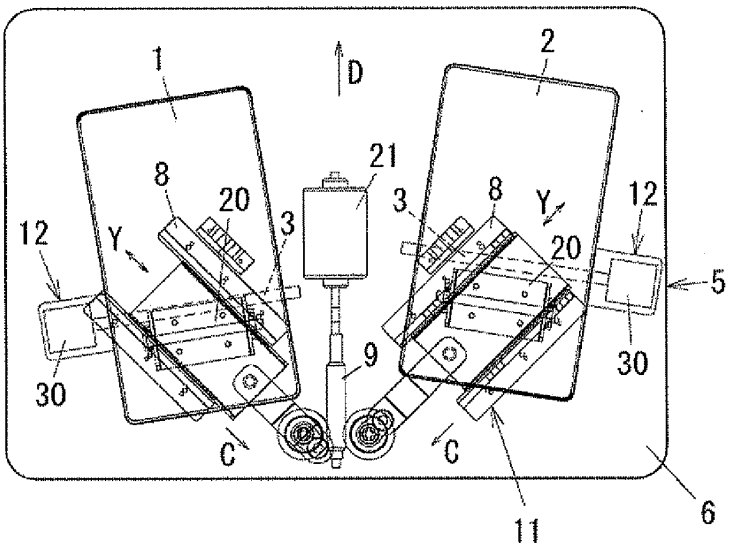


Fig.4b

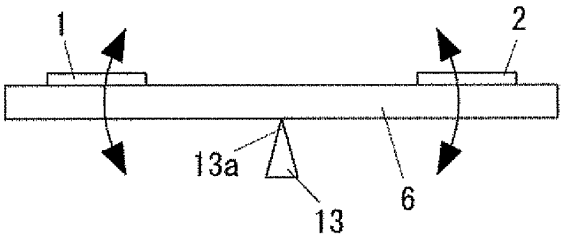


Fig.4c

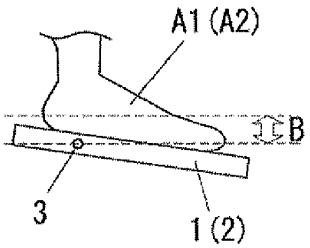


Fig.5a

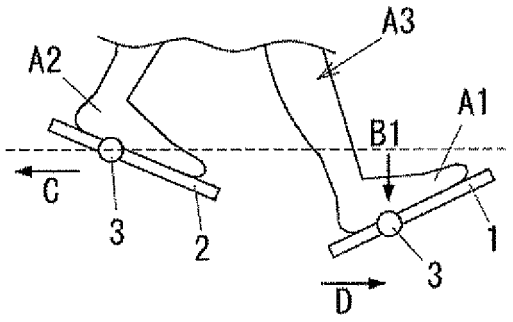


Fig.5b

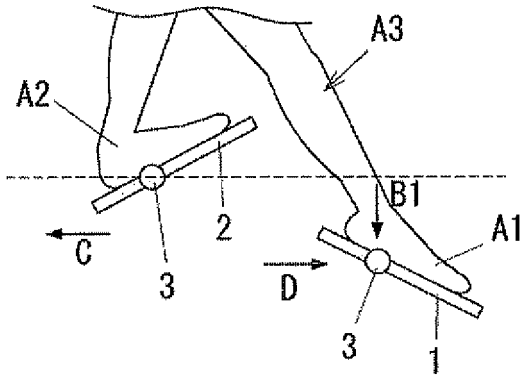


Fig.6a

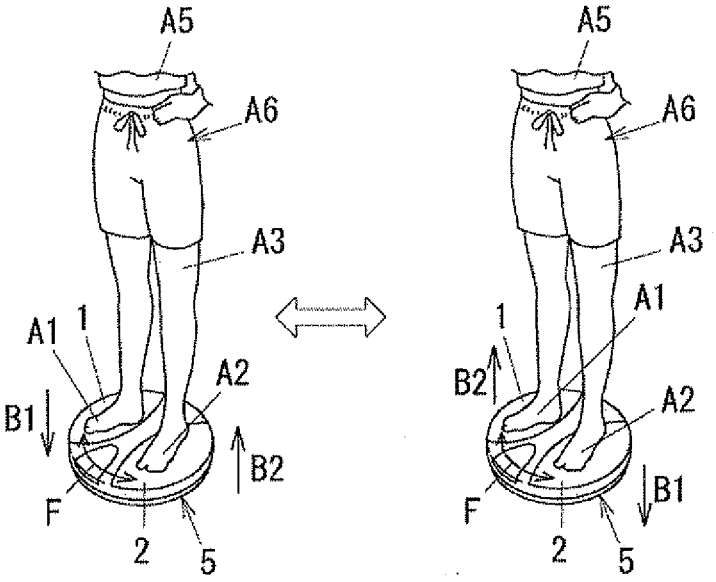


Fig.6b

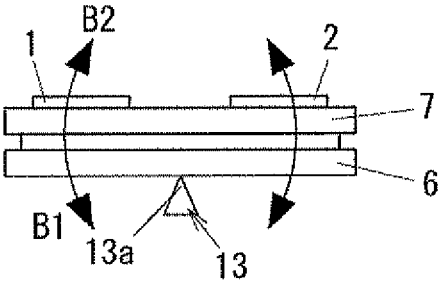


Fig.6c

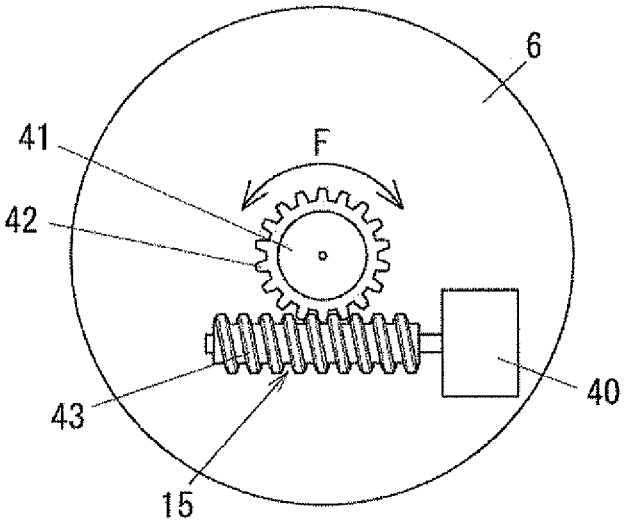


Fig.7

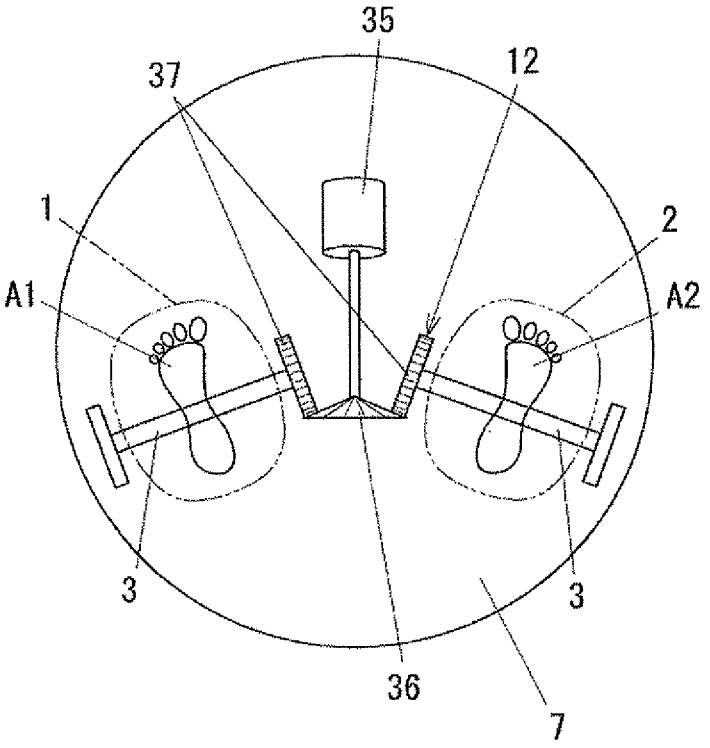


Fig.8

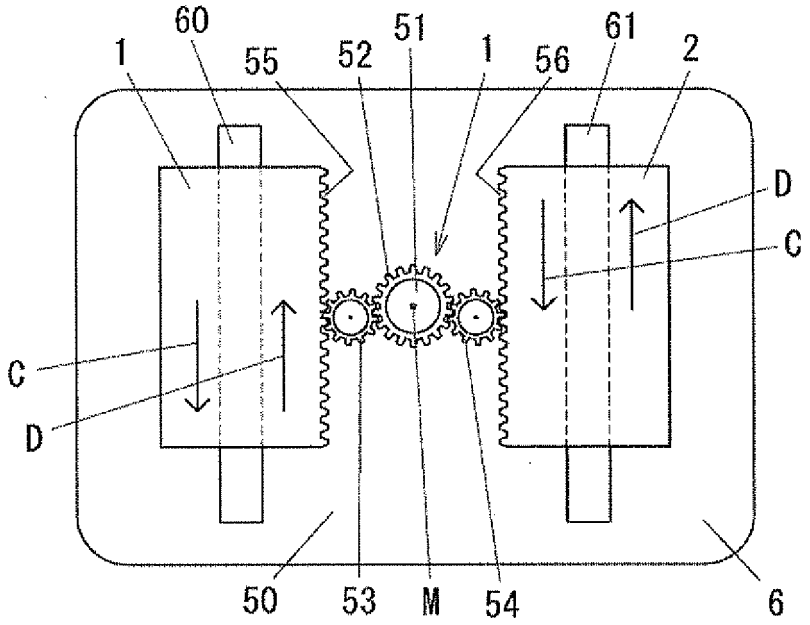


Fig.9a

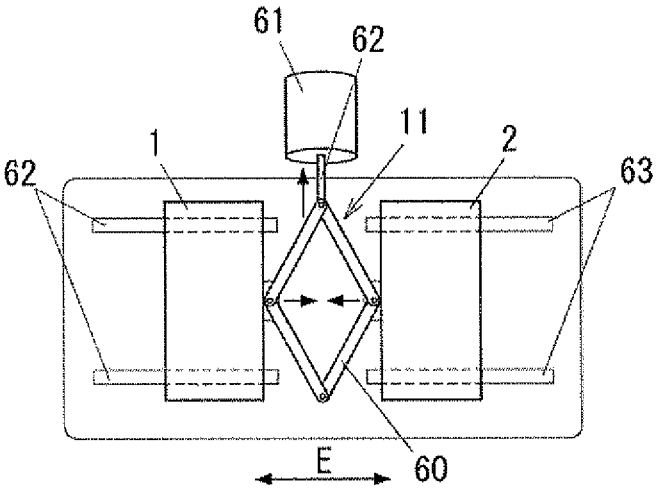


Fig.9b

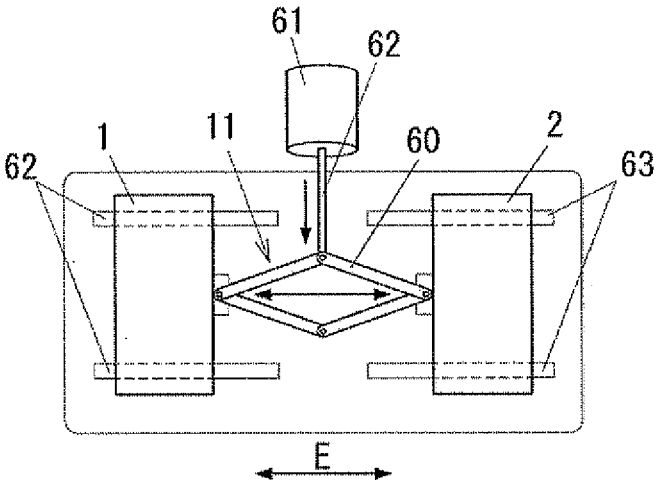


Fig.10a

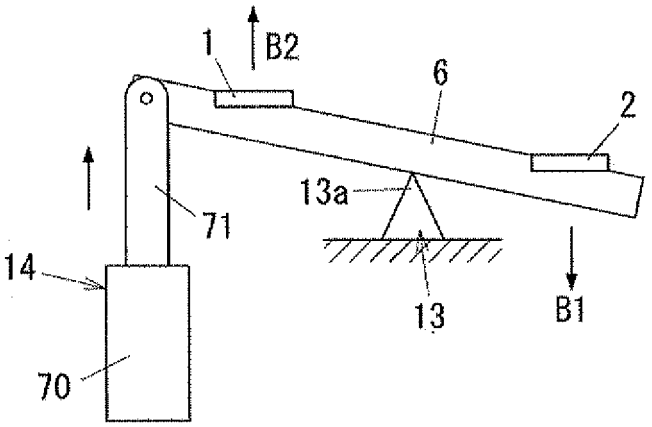


Fig.10b

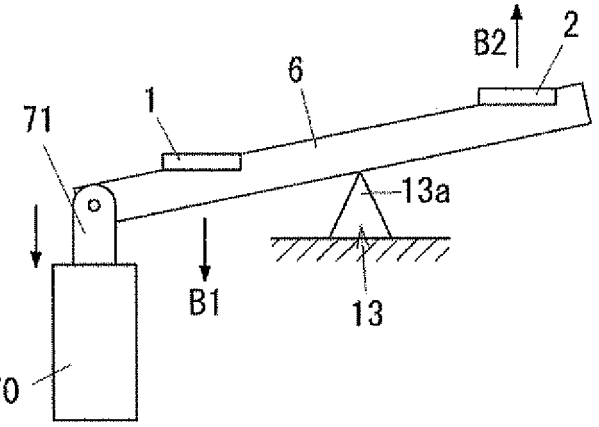


Fig.11a

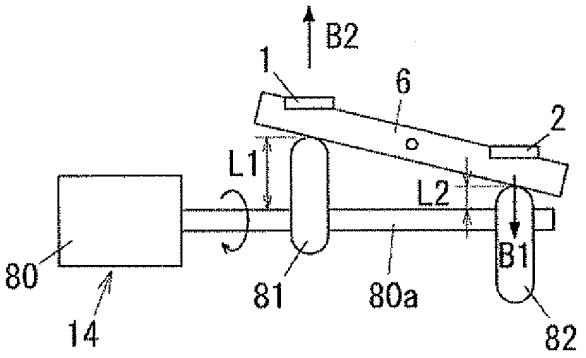


Fig.11b

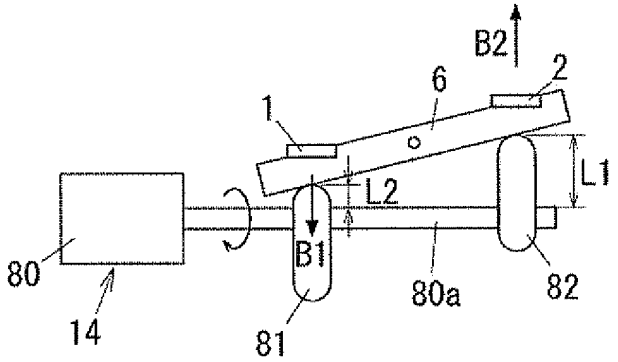


Fig.11c

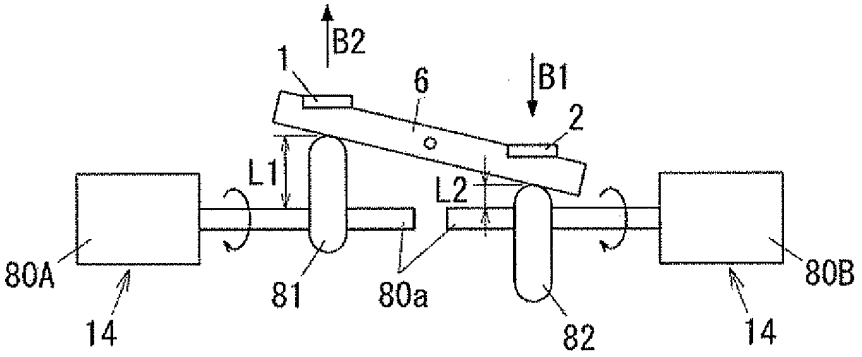


Fig.12a

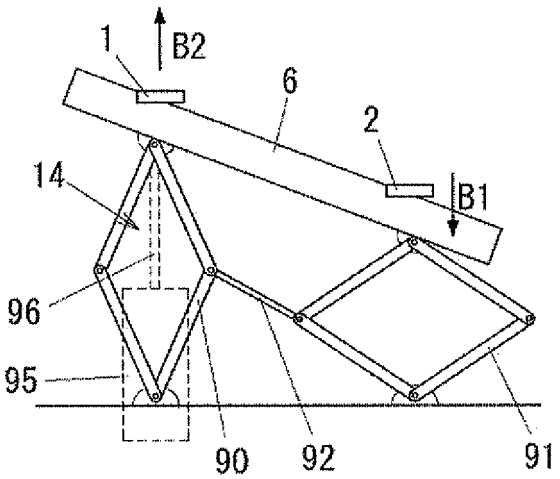
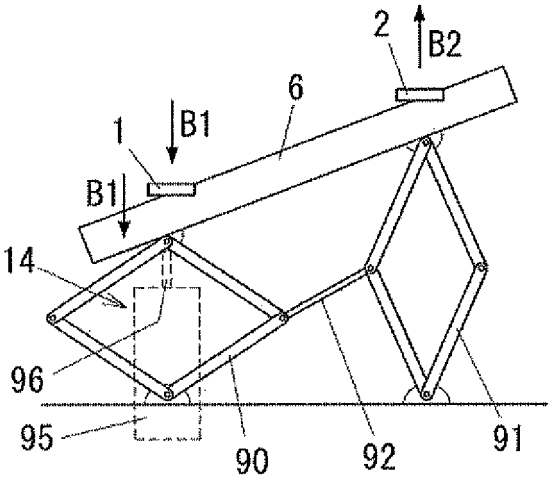


Fig.12b



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/073564

A. CLASSIFICATION OF SUBJECT MATTER
A63B23/04(2006.01)i, *A61H1/02*(2006.01)i, *A63B22/16*(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)
A63B23/04, A61H1/02, A63B22/16, 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.
Y	JP 3111917 U (Koko Jitsugyo Kofun Yugen Koshi), 28 July, 2005 (28.07.05), Full text; all drawings (Family: none)	1-8
Y	JP 2007-167625 A (Daito Electric Machine Industry Co., Ltd.), 05 July, 2007 (05.07.07), Full text; all drawings & WO 2008/044352 A1 & CN 101161222 A	1-8
Y	JP 2002-306629 A (Omron Corp.), 22 October, 2002 (22.10.02), Full text; all drawings (Family: none)	7

☒ 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
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"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)
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"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 March, 2009 (30.03.09)	07 April, 2009 (07.04.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/073564

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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REFERENCES CITED IN THE DESCRIPTION

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