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Aoki et al.

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(54) **LOWER LIMB EXERCISE DEVICE AND LOWER LIMB EXERCISE SYSTEM**

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A63B 22/06 (2006.01)

(52) **U.S. Cl.**
CPC .. ***A63B 22/0694*** (2013.01); *A63B 2208/0233* (2013.01); *A63B 2225/09* (2013.01)

(58) **Field of Classification Search**
CPC A63B 22/0694; A63B 2208/0233; A63B 2225/09; A63B 21/1609; A63B 21/4034; A63B 22/0605
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,735,422	A *	2/1956	Jones	A63B 22/0694 601/36
4,390,177	A *	6/1983	Biran	A63B 22/0605 188/83
5,314,392	A *	5/1994	Hawkins	A63B 22/0056 482/52
5,647,822	A *	7/1997	Avganim	A63B 22/0007 482/57
7,621,852	B2 *	11/2009	Bowser	A63B 23/12 482/121
8,795,141	B2 *	8/2014	Huang	A63B 22/0605 482/142
10,220,246	B2 *	3/2019	Lernihan	A63B 22/0664
D906,445	S *	12/2020	Colburn	A63B 21/00069 D21/663
11,305,153	B2 *	4/2022	Dalmia	A63B 22/06

(Continued)

FOREIGN PATENT DOCUMENTS

JP	2000-116818 A	4/2000
JP	2022-163744 A	10/2022

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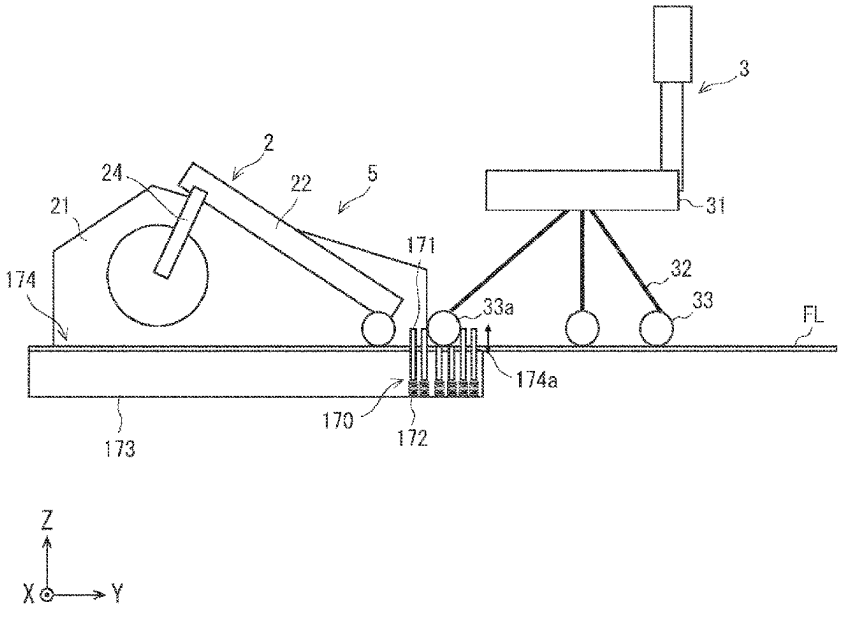
(74) *Attorney, Agent, or Firm* — Dinsmore & Shohl LLP

(57) **ABSTRACT**

A lower limb exercise device that enables a user to perform a lower limb exercise effectively is achieved. A lower limb exercise device according to one embodiment of the present disclosure enables a user to perform a lower limb exercise while the user is seated on a chair. The lower limb exercise device includes exercise equipment for the user to perform the lower limb exercise, and a restriction mechanism configured to restrict movement of at least one caster of the chair from a reference arrangement range of the caster during the lower limb exercise.

10 Claims, 22 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2014/0274622	A1*	9/2014	Leonhard	A47C 9/002 403/345
2016/0107026	A1*	4/2016	Hsu	A63B 22/0058 482/80
2017/0216660	A1*	8/2017	Lernihan	A63B 22/0694
2018/0339190	A1*	11/2018	Bailar	A63B 22/0046
2020/0289882	A1*	9/2020	Pena	A63B 21/1609
2020/0298052	A1*	9/2020	Dalmia	A63B 22/0694
2022/0331652	A1	10/2022	Aoki et al.	

* cited by examiner

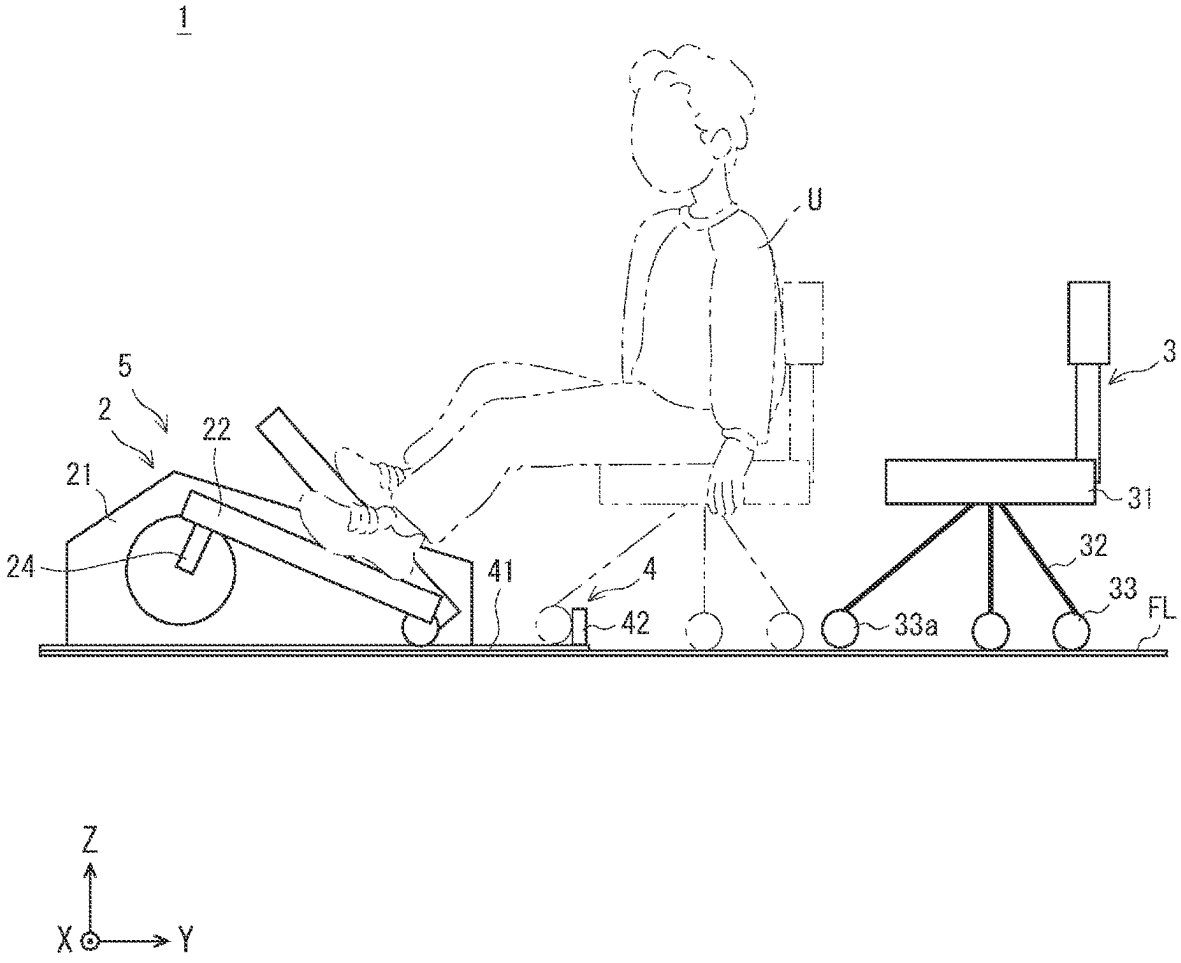


Fig. 1

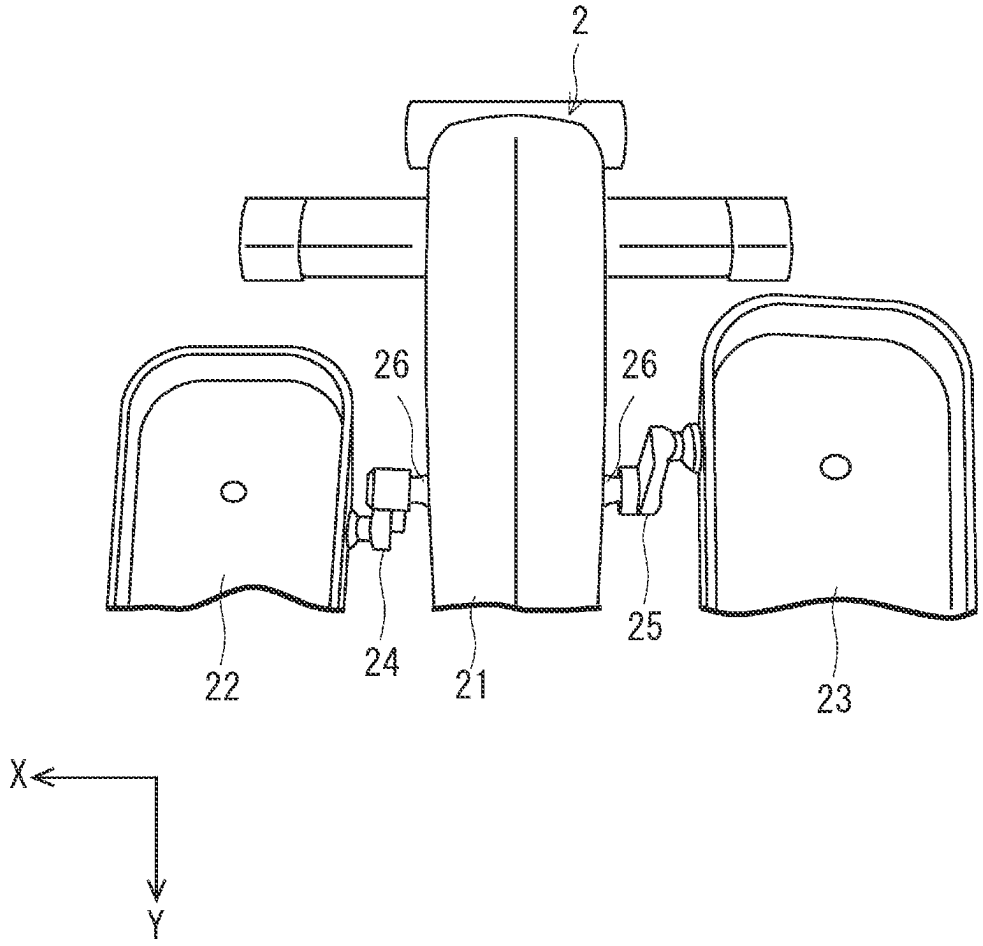


Fig. 2

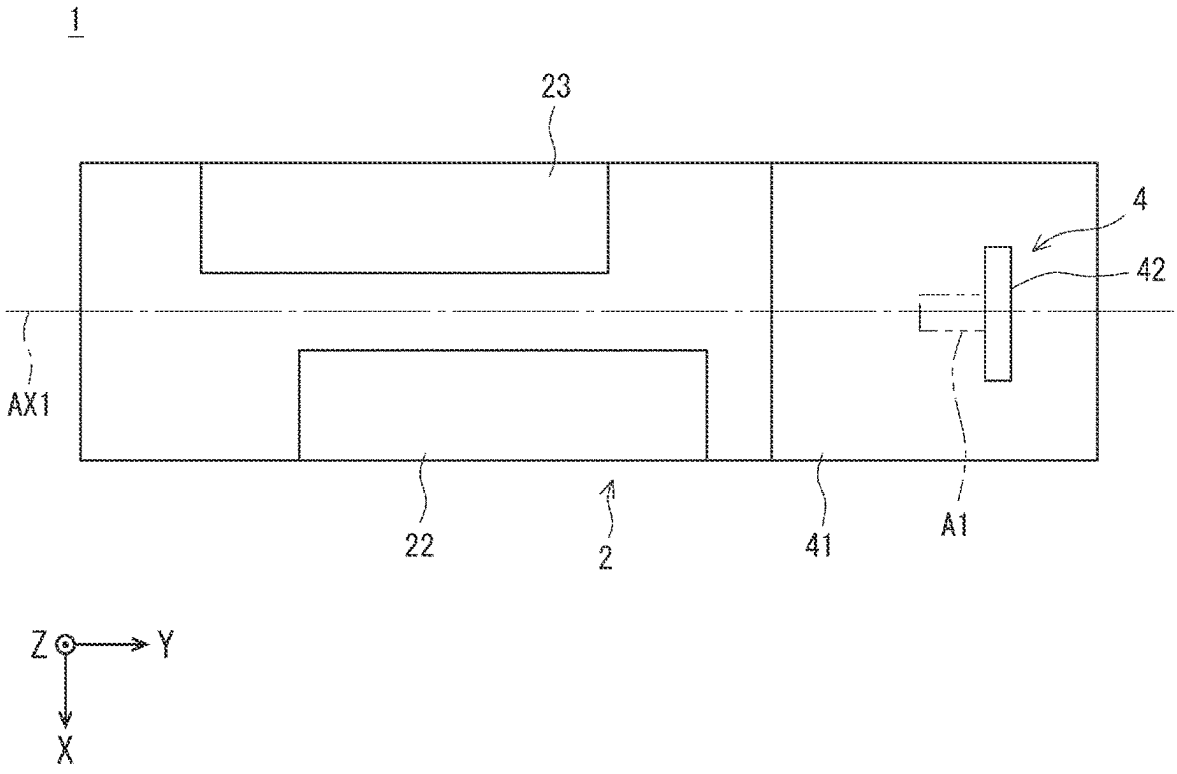


Fig. 3

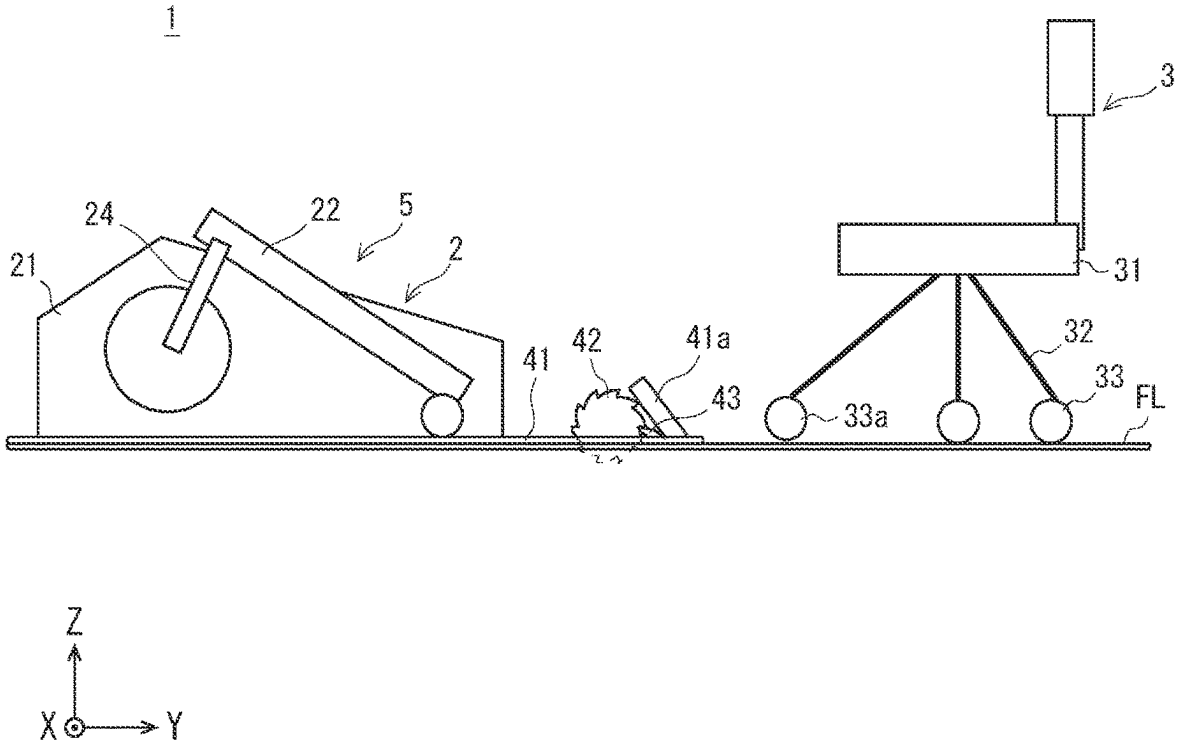


Fig. 4

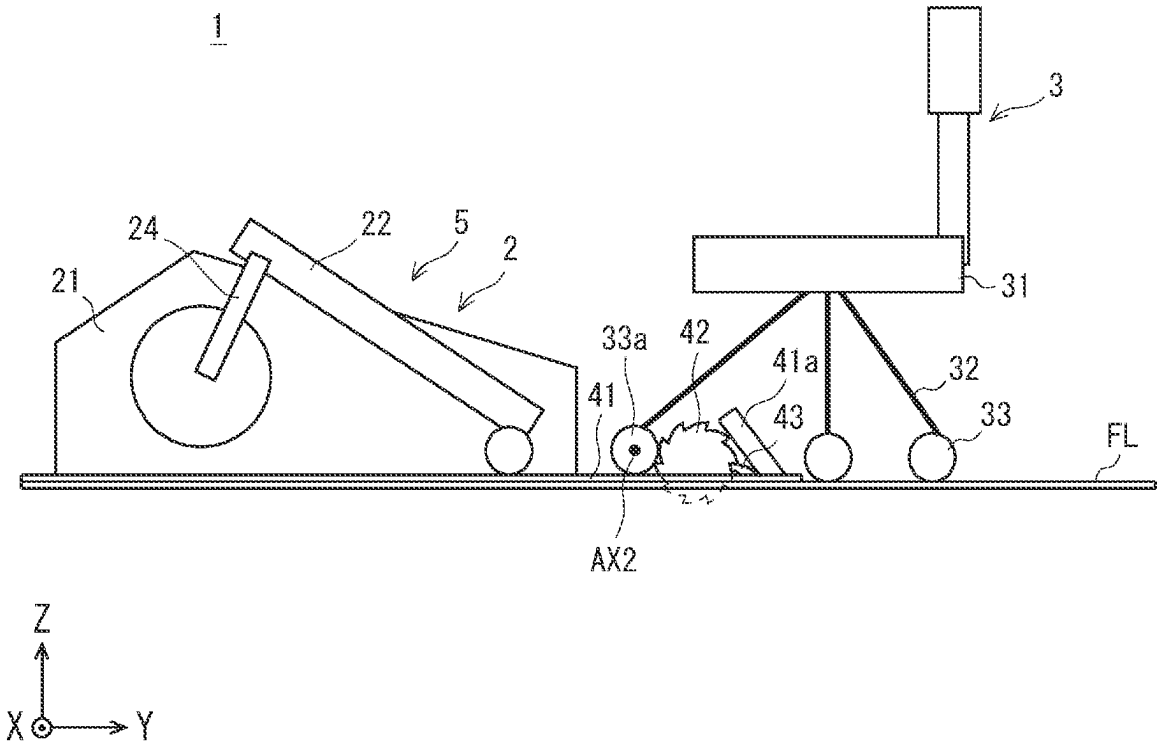


Fig. 5

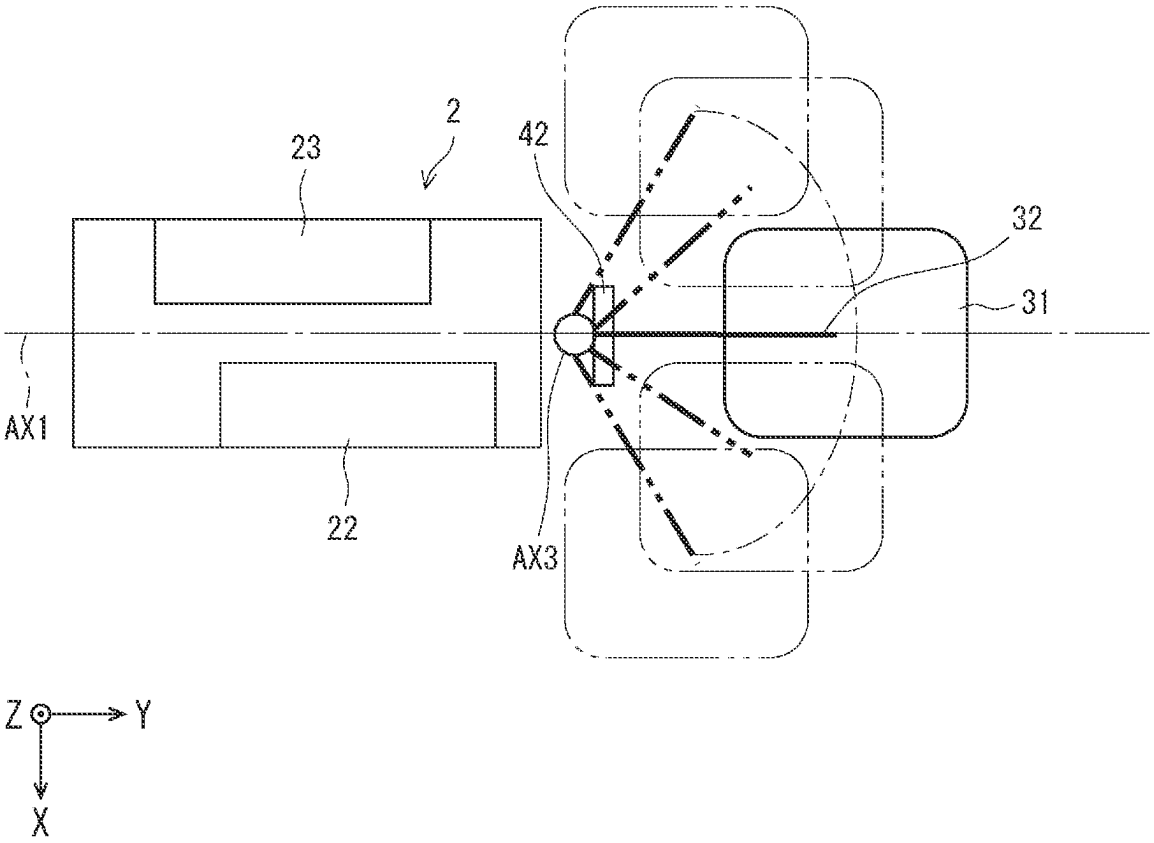


Fig. 6

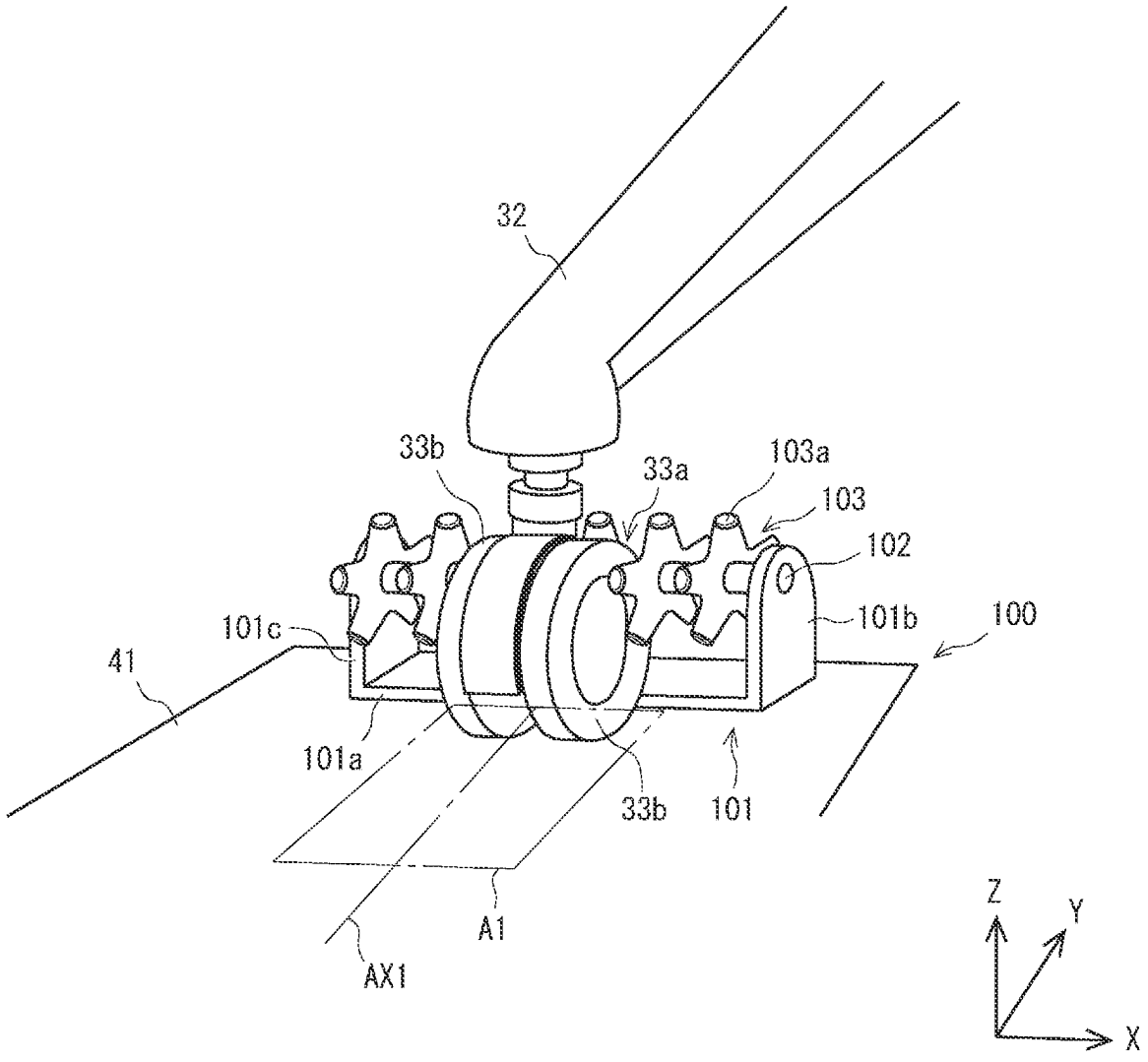
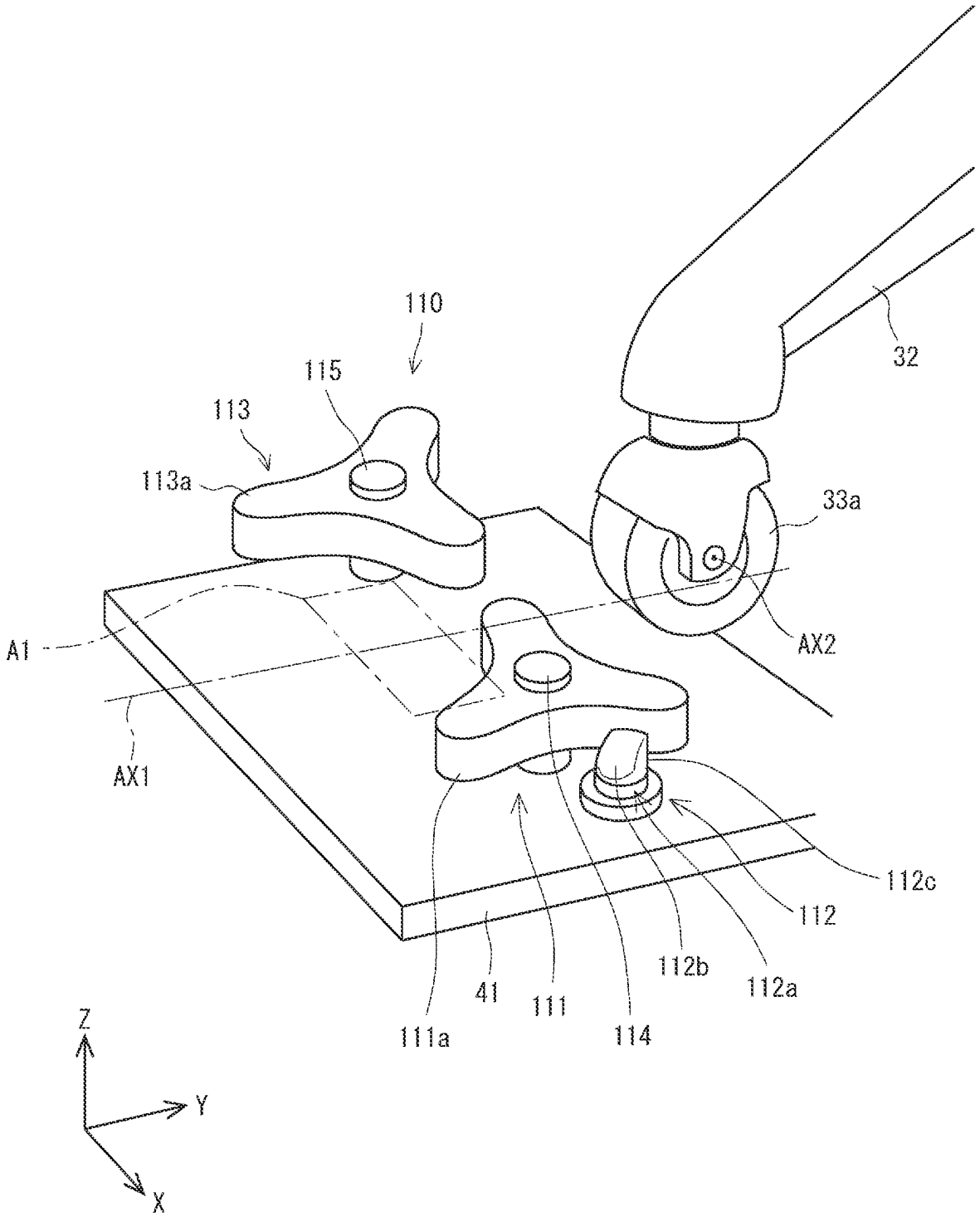


Fig. 7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113
113a
32
33a
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A1
AX1
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112
112b
112a
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111a
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Z
Y
X

Fig. 8

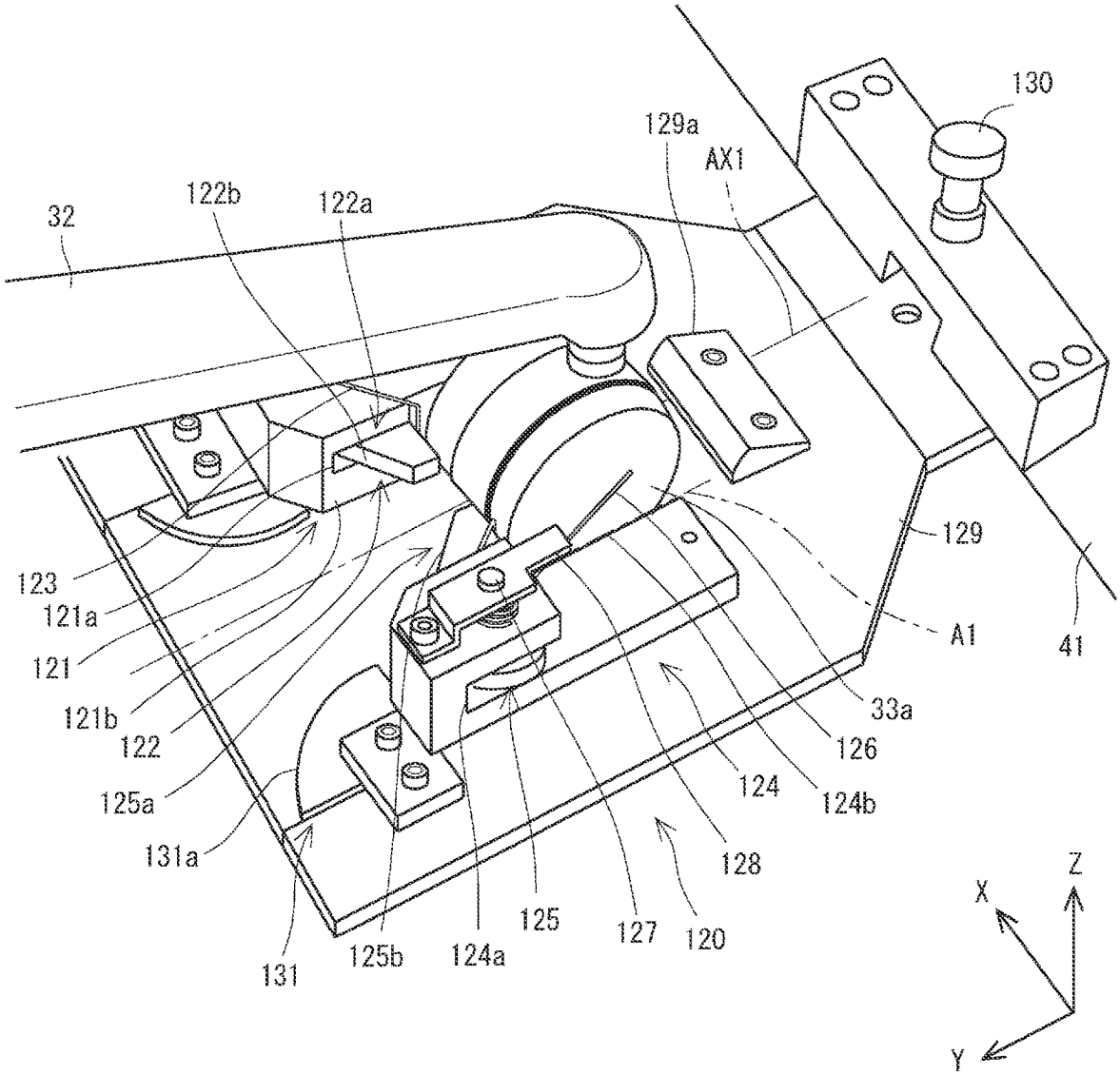
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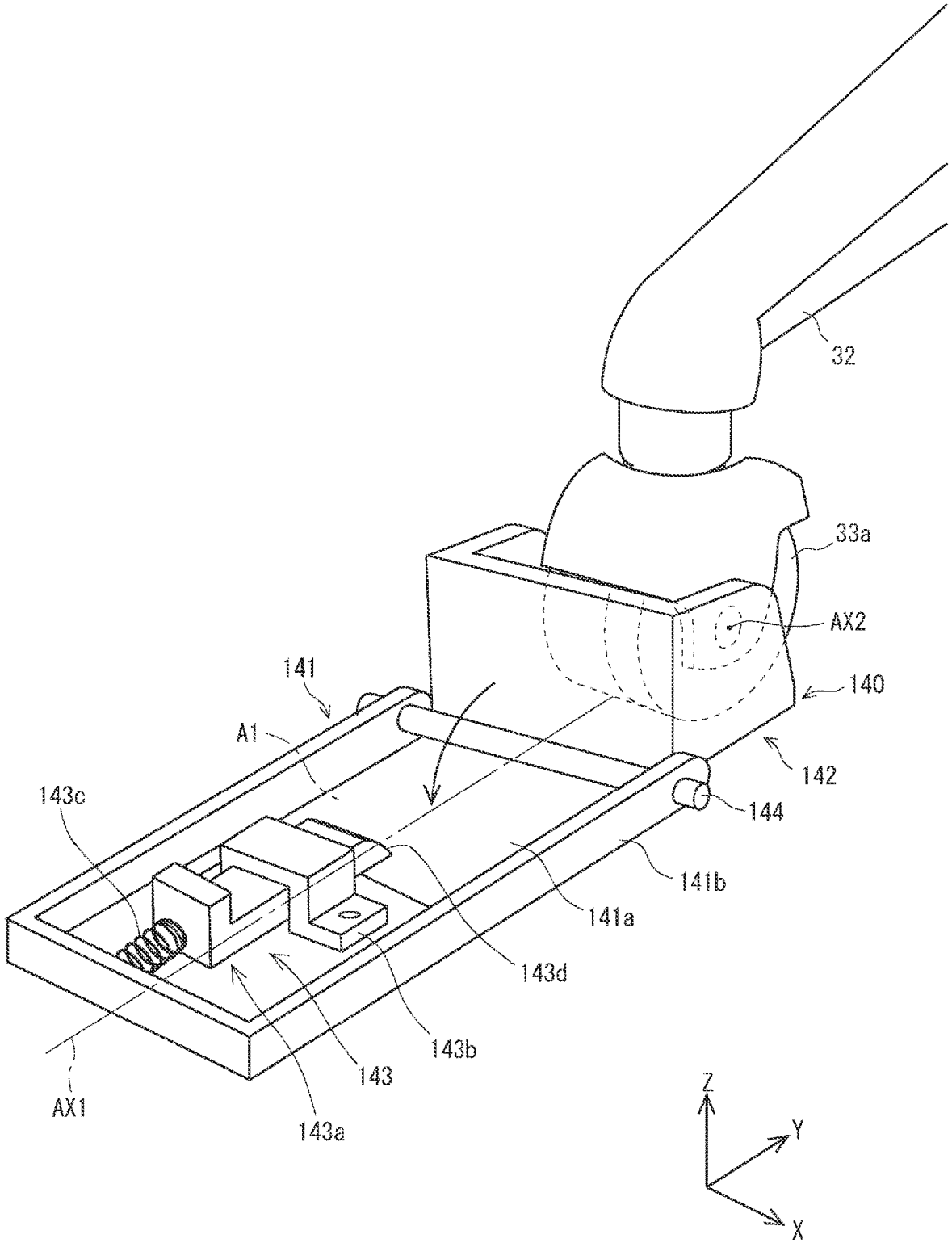
Fig. 9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AX2
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AX1
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Fig. 10

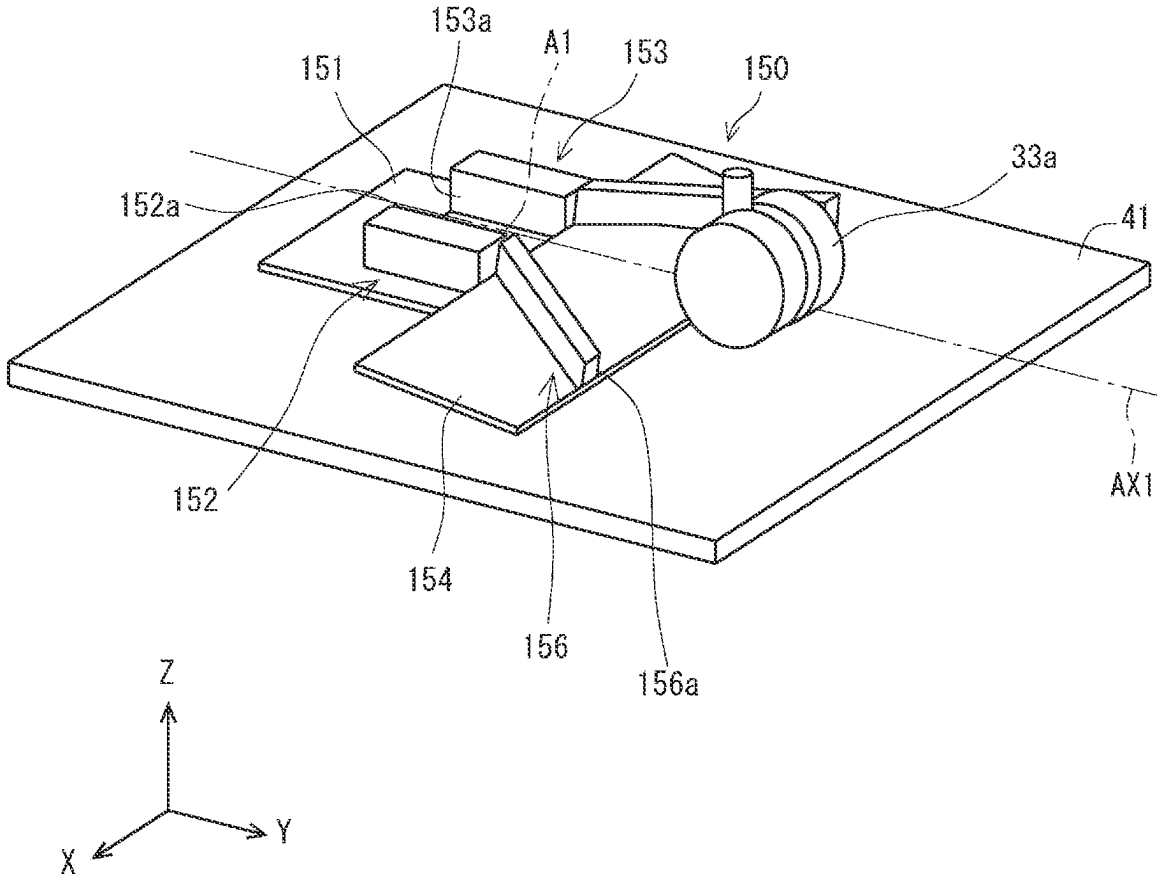

Fig. 11

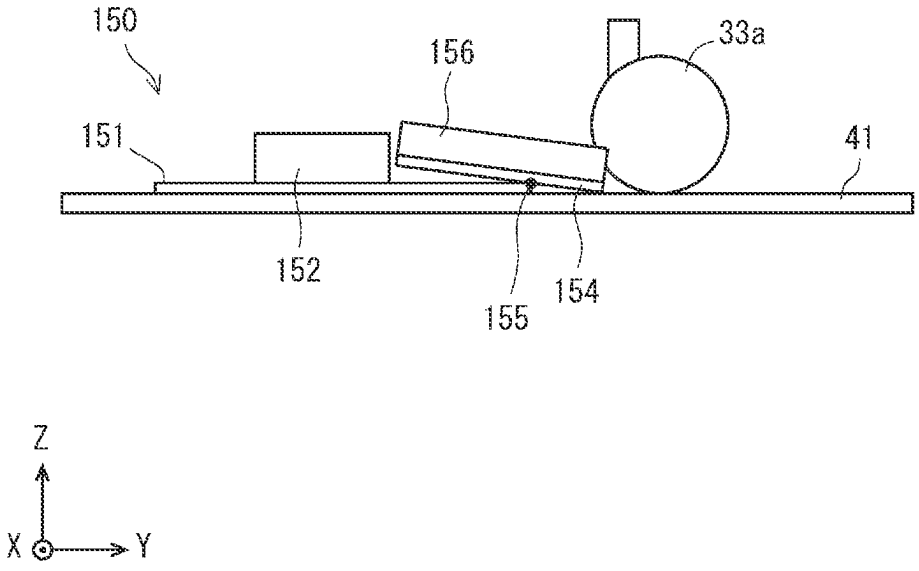

Fig. 12

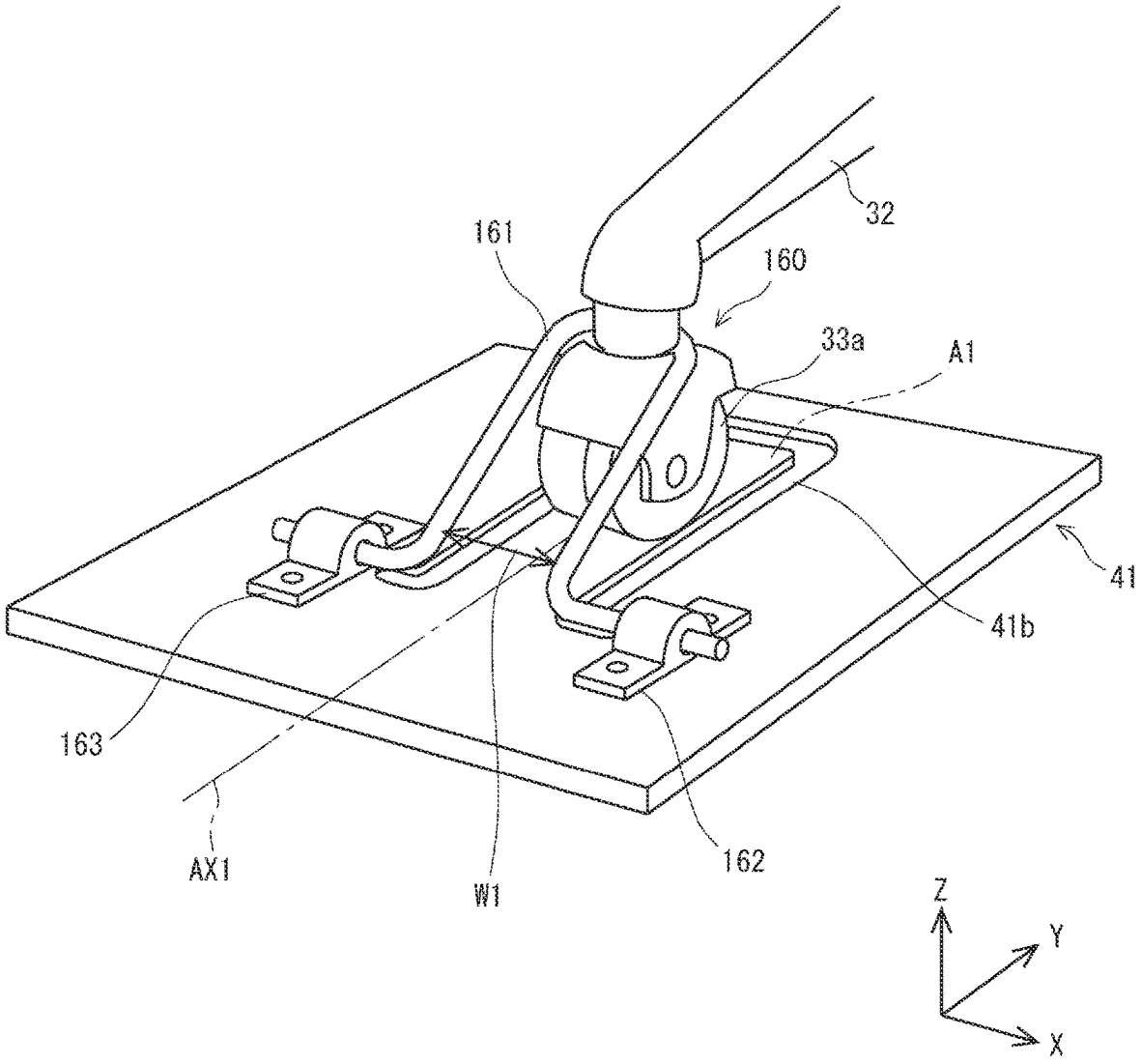

Fig. 13

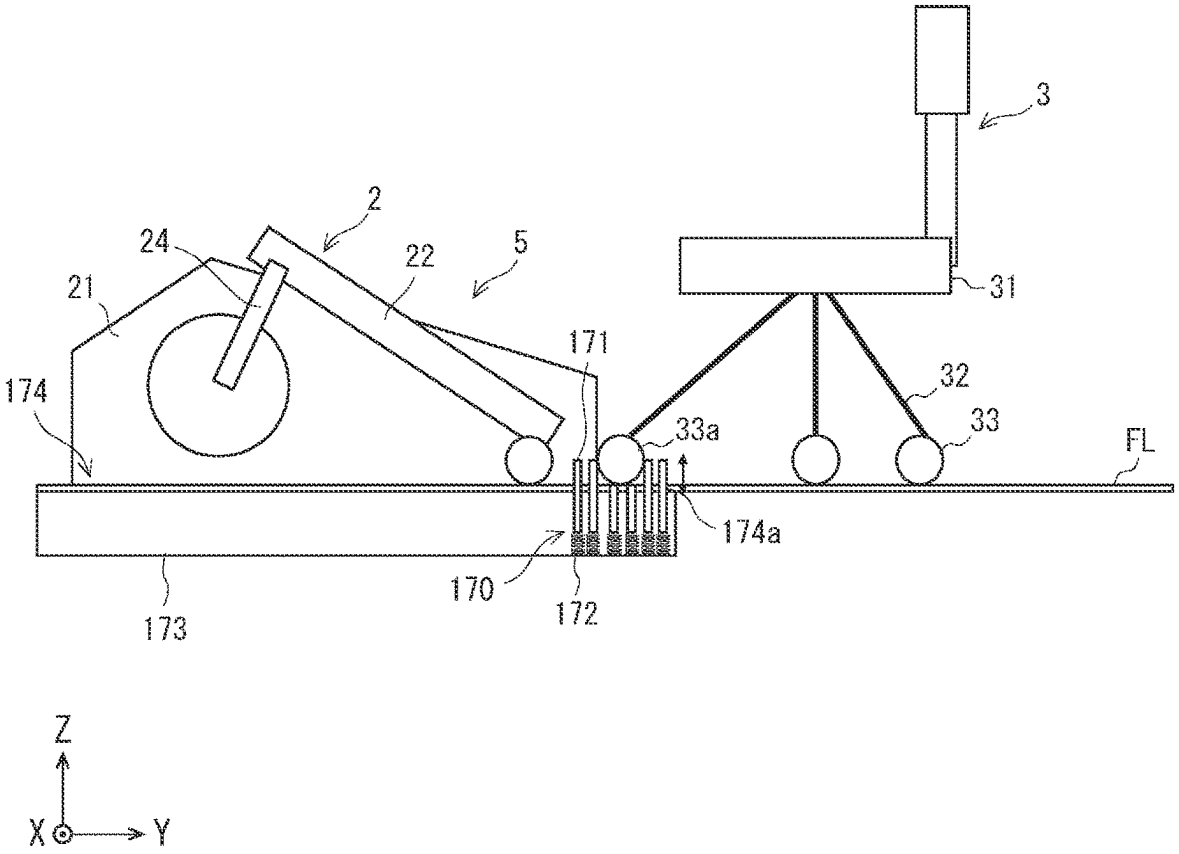

Fig. 14

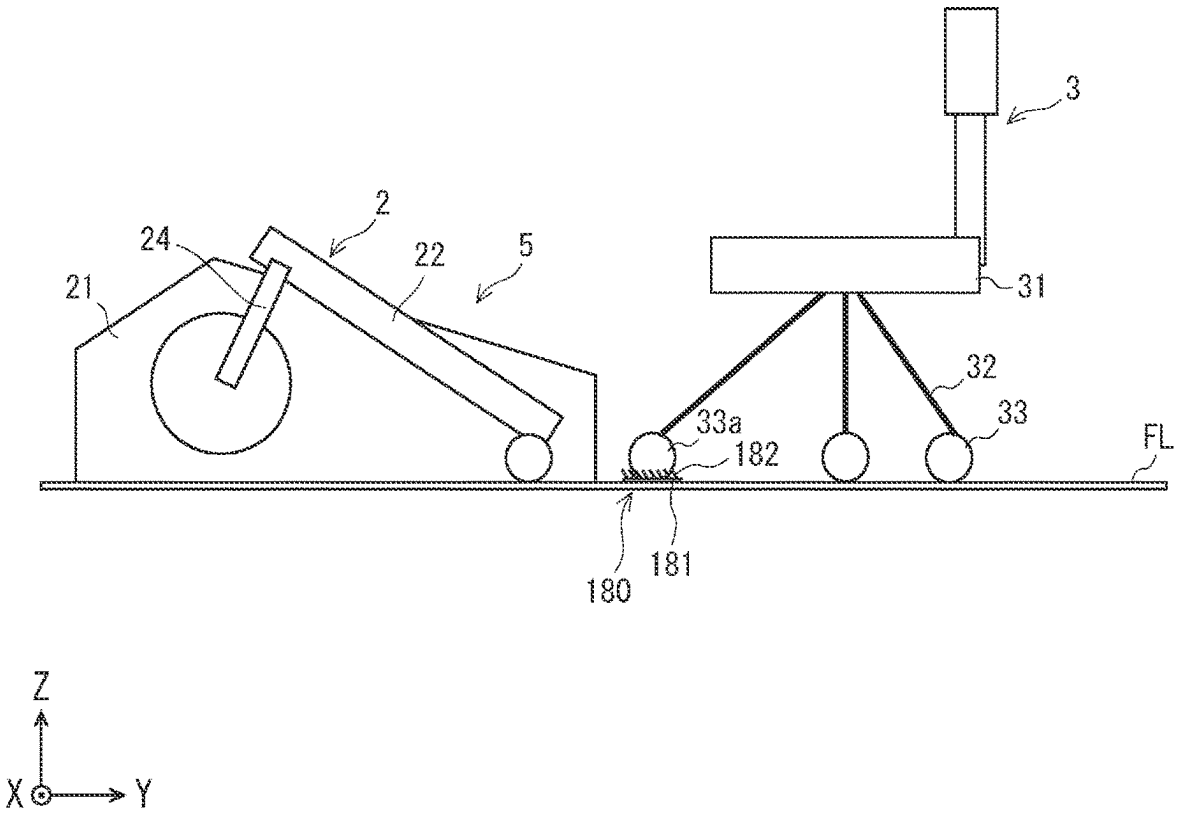

Fig. 15

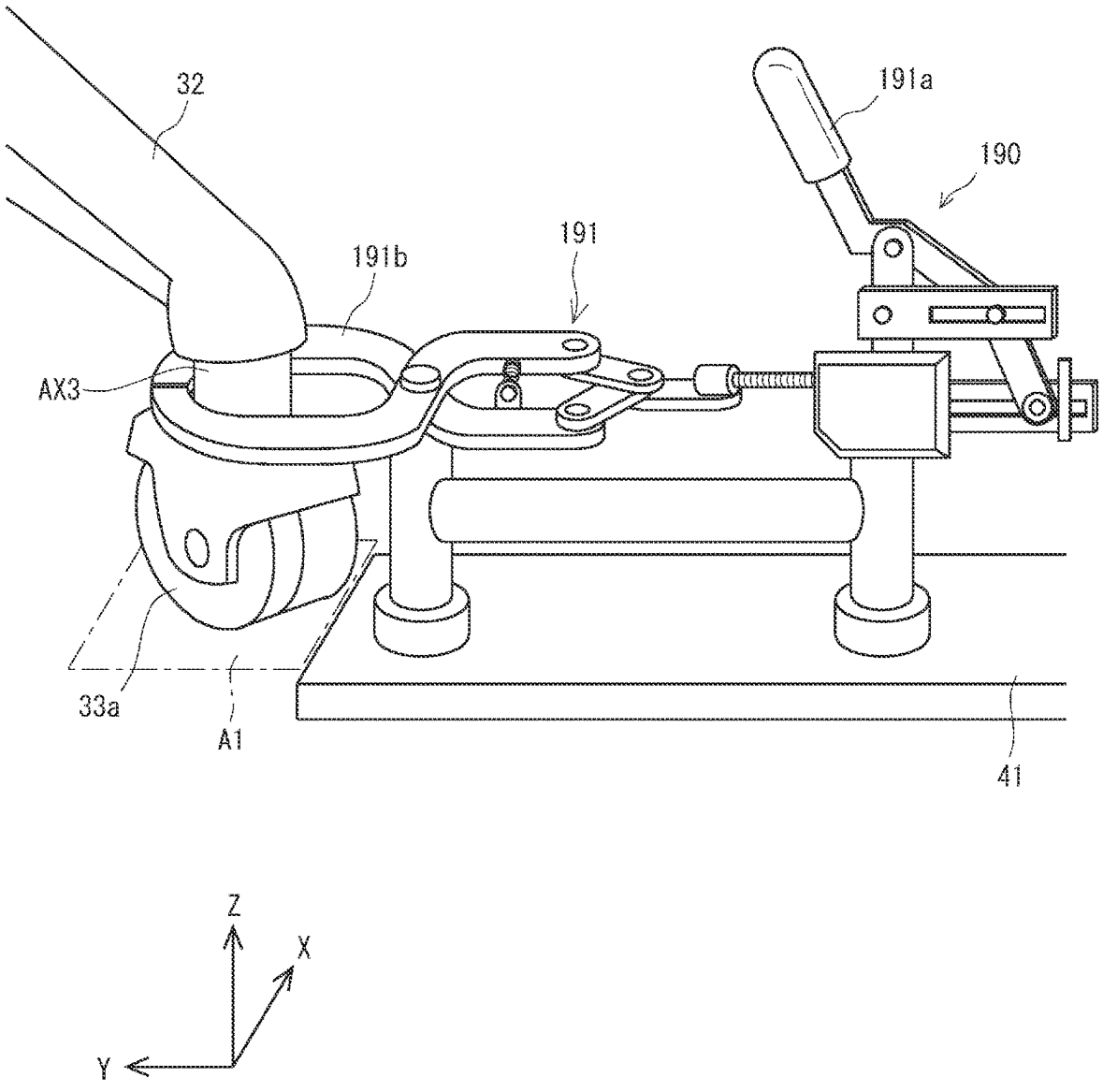

Fig. 16

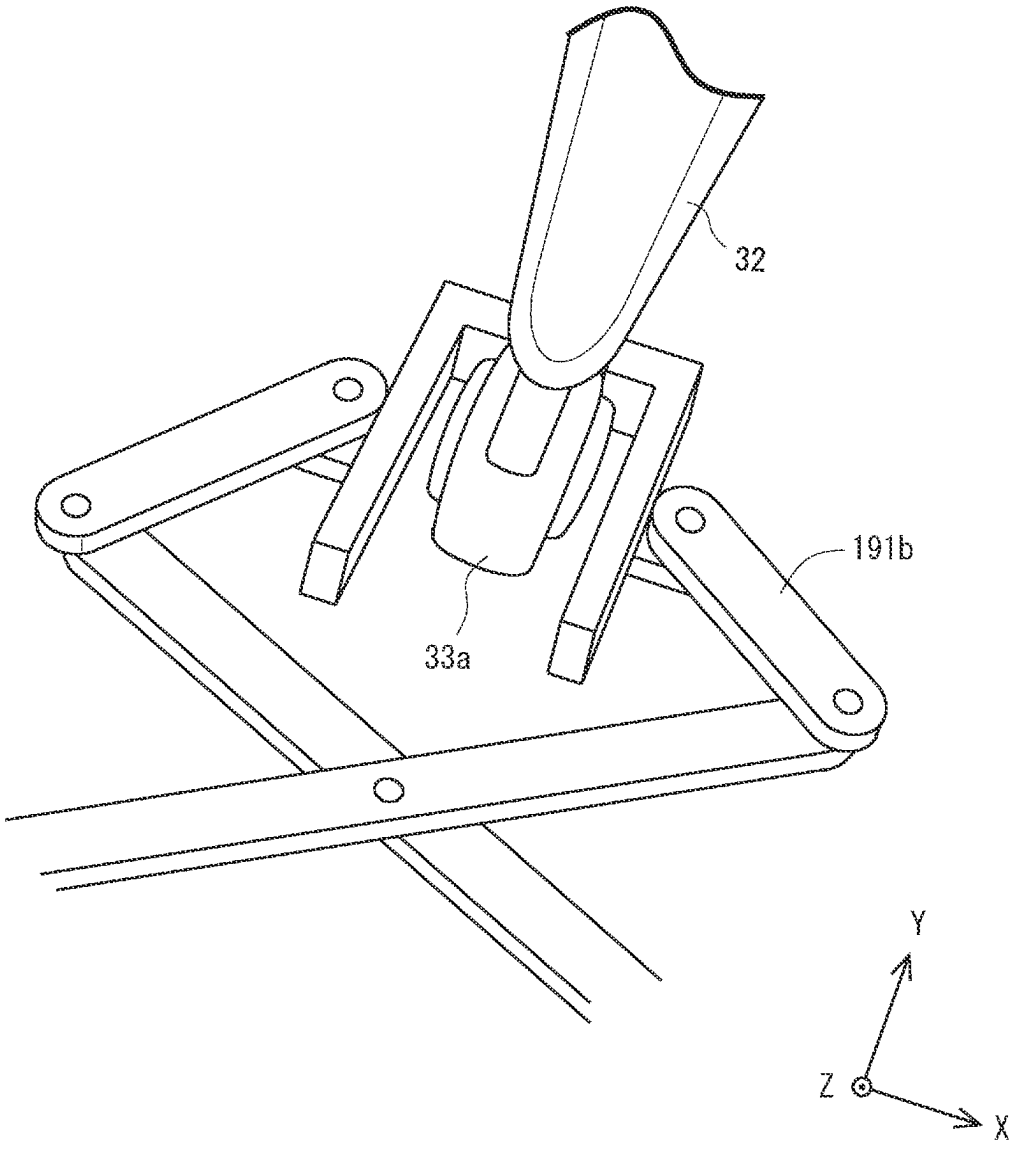

Fig. 17

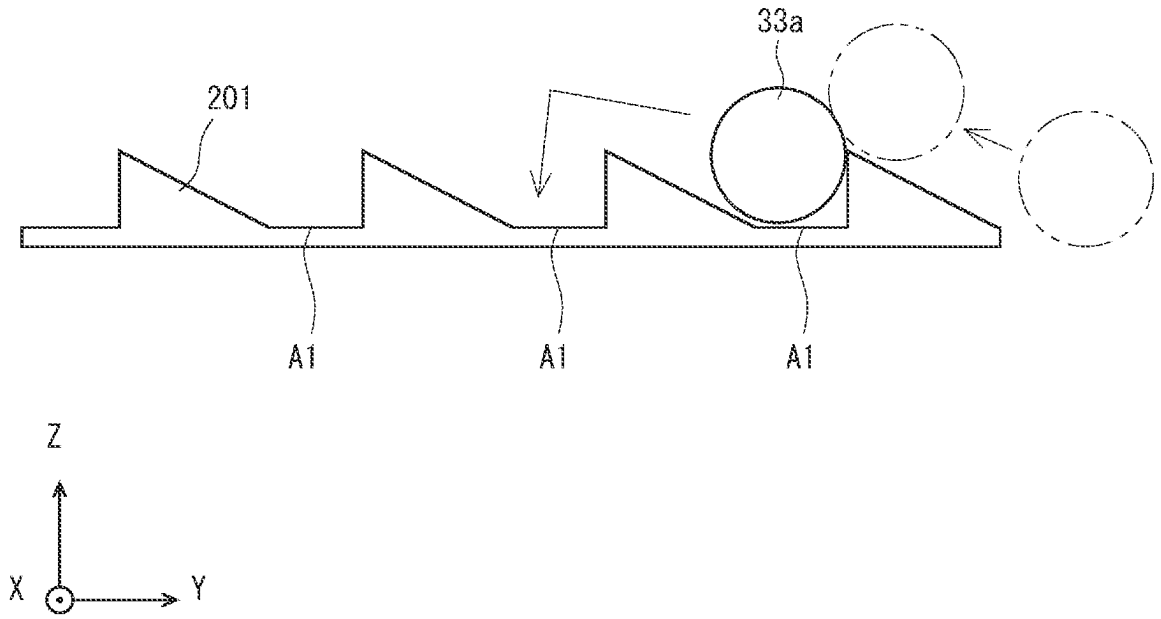

Fig. 18

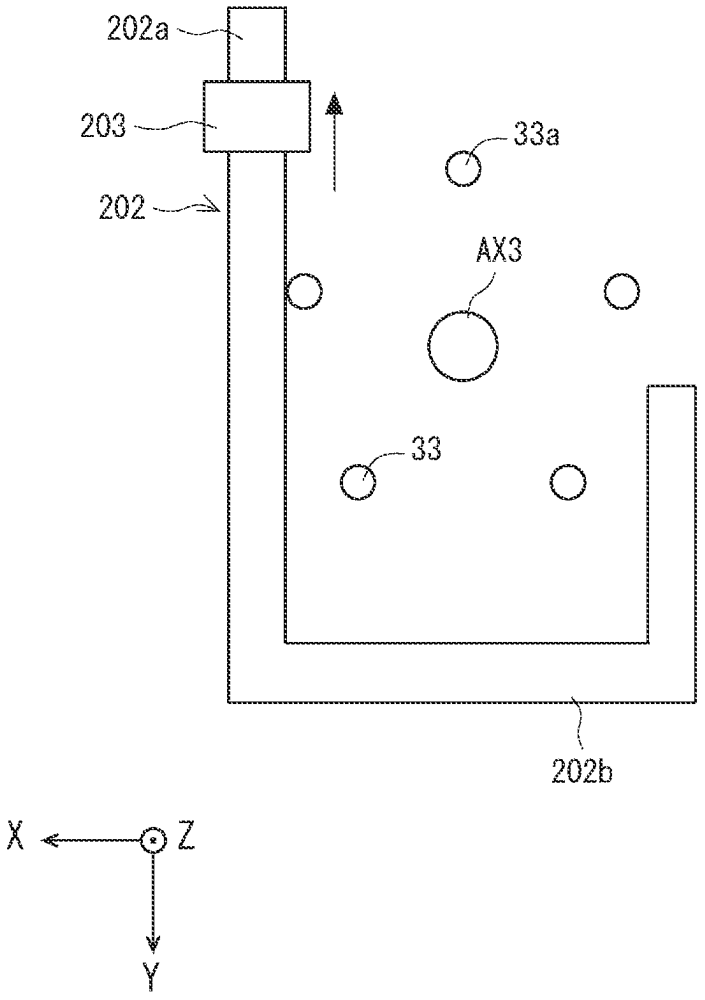

Fig. 19

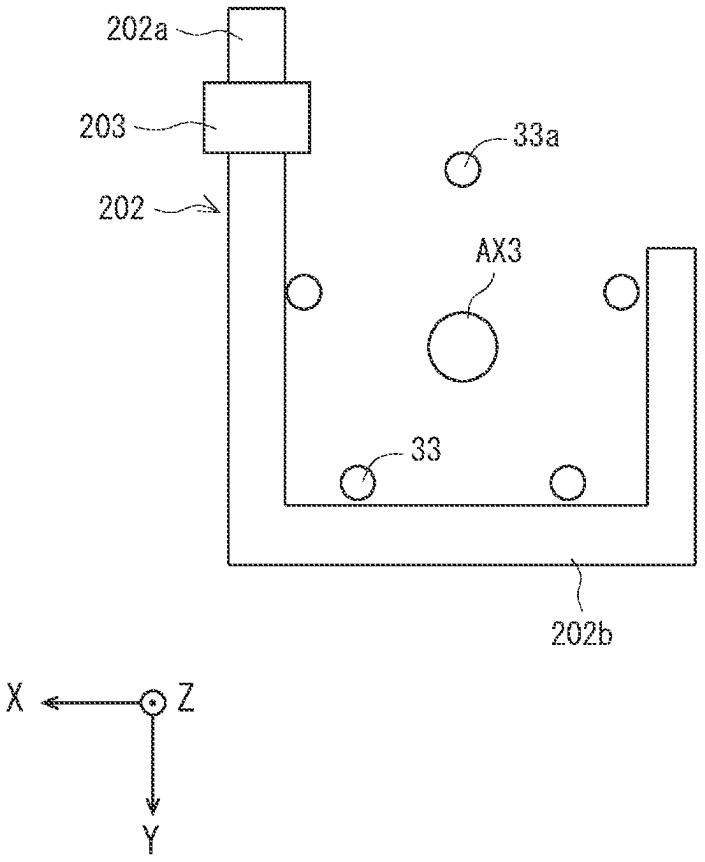

Fig. 20

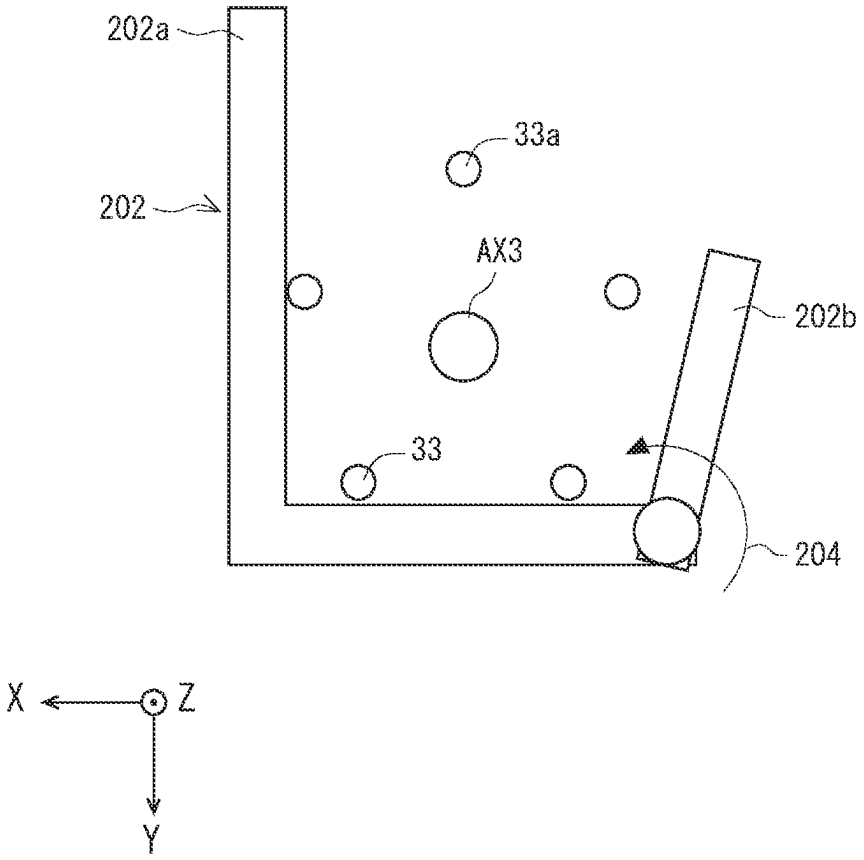

Fig. 21

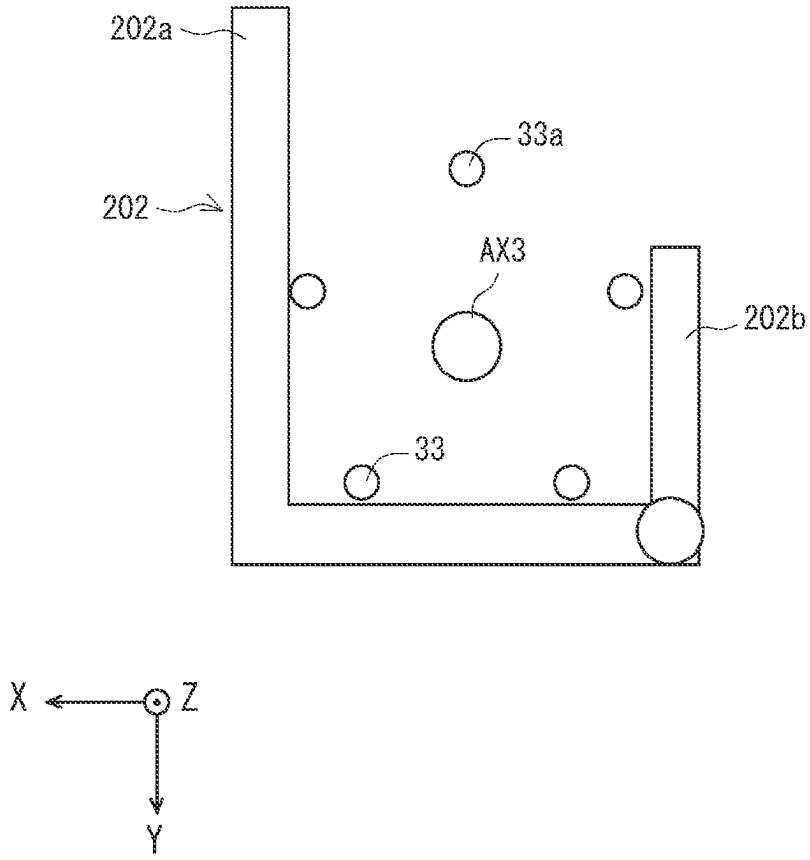

Fig. 22

LOWER LIMB EXERCISE DEVICE AND LOWER LIMB EXERCISE SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from Japanese patent application No. 2022-175359, filed on Nov. 1, 2022, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

The present disclosure relates to a lower limb exercise device and a lower limb exercise system.

For example, Japanese Unexamined Patent Application Publication No. 2000-116818 discloses a lower limb exercise device based on pedaling exercises. The lower limb exercise device of Japanese Unexamined Patent Application Publication No. 2000-116818 includes a seat surface, a pair of left and right pedals, a crank, and a load apparatus. A trainee (user) sits on the seat surface and rotates the pair of left and right pedals. The seat surface is fixed to a frame.

SUMMARY

The applicant has found the following problem. In such a lower limb exercise device, the user usually performs a lower limb exercise while sitting on a chair. At this time, a problem occurs in that a relative position of the chair to the lower limb exercise device is shifted due to a reaction force of the foot pedaling. Therefore, the user may not be able to perform a pedaling exercise effectively.

The present disclosure has been made in view of the above problem, and achieves a lower limb exercise device and a lower limb exercise system that enable a user to perform a lower limb exercise effectively.

A lower limb exercise device according to one aspect of the present disclosure for enabling a user to perform a lower limb exercise while the user is seated on a chair includes:

- exercise equipment for the user to perform the lower limb exercise; and
- a restriction mechanism configured to restrict movement of at least one caster of the chair from a reference arrangement range of the caster during the lower limb exercise.

In some embodiments of the above lower limb exercise device, an upper part of the restriction mechanism is open.

In some embodiments of the above lower limb exercise device, the restriction mechanism is capable of adjusting a position of the reference arrangement range of the caster in a front-rear direction.

In some embodiments of the above lower limb exercise device, the position of the reference arrangement range of the caster is made adjustable in the front-rear direction by providing a plurality of the restriction mechanisms in the front-rear direction of the lower limb exercise device.

In some embodiments of the above lower limb exercise device, the position of the reference arrangement range of the caster is made adjustable in the front-rear direction by moving the restriction mechanism in the front-rear direction of the lower limb exercise device.

In some embodiments of the above lower limb exercise device, the restriction mechanism includes a contact part where the caster that moves away from the exercise equipment is brought into contact,

- a position of the contact part relative to the exercise device is constrained in a region on a side moving away from the exercise equipment in the front-rear direction of the lower limb exercise equipment, and
- an upper end of the contact part is arranged higher than a center of the caster with the caster arranged inside the reference arrangement range and the contact part arranged at an uppermost position.

In some embodiments of the above lower limb exercise device, the contact part is a movable plate that can move in an up-down direction of the lower limb exercise device and is energized upward of the lower limb exercise device.

In some embodiments of the above lower limb exercise device, the contact part is a rotating member that is rotatable around a rotation axis extending in an up-down direction or a left-right direction of the lower limb exercise device and whose rotation is restricted so as to restrict movement of the caster to a side moving away from the exercise equipment when the caster moving away from the exercise equipment is brought into contact.

In some embodiments of the above lower limb exercise device, a plurality of the contact parts are arranged in the front-rear direction of the lower limb exercise device.

In some embodiments of the above lower limb exercise device, the restriction mechanism includes a grounding part of the caster, a position of the grounding part relative to the exercise equipment is constrained in a region on a side moving away from the exercise equipment in the front-rear direction of the lower limb exercise device, and a frictional force on the side moving away from the exercise equipment is greater than a frictional force on the side of the exercise equipment.

In some embodiments of the above lower limb exercise device,

- the grounding part includes a projection that is inclined upward of the lower limb exercise device toward the exercise equipment, and
- the projection is made of an elastic body and a plurality of the projections are arranged in the front-rear direction of the lower limb exercise device.

In some embodiments of the above lower limb exercise device, the restriction mechanism is a constraint mechanism that constrains a position of the caster or the chair relative to the exercise equipment so as to maintain the caster arranged inside the reference arrangement range.

In some embodiments of the above lower limb exercise device, the restriction mechanism is detachable from the exercise equipment.

A lower limb exercise system according to one aspect of the present disclosure includes:

- the above lower limb exercise device; and
- the chair.

In some embodiments of the above lower limb exercise system, the exercise equipment includes:

- a pair of left and right pedals on which the user's feet are placed; and
- a rotation mechanism configured to rotate the pedals by the user's feet pushing down the pedals.

According to the present disclosure, a user can perform a lower limb exercise effectively.

The above and other objects, features and advantages of the present disclosure will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not to be considered as limiting the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a side view showing a user performing a lower limb exercise using a lower limb exercise system according to a first embodiment;

FIG. **2** is a plan view showing exercise equipment of the lower limb exercise system according to the first embodiment;

FIG. **3** is a plan view for describing an arrangement relationship between first and second pedals of the exercise equipment and a contact part of a restriction mechanism in the lower limb exercise system according to the first embodiment;

FIG. **4** is a side view showing a specific configuration of the contact part of the restriction mechanism in the lower limb exercise system according to the first embodiment;

FIG. **5** is a side view for describing an arrangement relationship between elements when a user performs a lower limb exercise using the lower limb exercise system according to the first embodiment;

FIG. **6** is a plan view for describing a movement of a seat surface of a chair when the user performs a lower limb exercise by pedaling the first and second pedals of the exercise equipment;

FIG. **7** is a perspective view showing a specific configuration of a restriction mechanism according to a second embodiment;

FIG. **8** is a perspective view showing a specific configuration of a restriction mechanism according to a third embodiment;

FIG. **9** is a perspective view showing a specific configuration of a restriction mechanism according to a fourth embodiment;

FIG. **10** is a perspective view showing a specific configuration of a restriction mechanism according to a fifth embodiment;

FIG. **11** is a perspective view showing a specific configuration of a restriction mechanism according to a sixth embodiment;

FIG. **12** is a side view showing the specific configuration of the restriction mechanism according to the sixth embodiment;

FIG. **13** is a perspective view showing a specific configuration of the restriction mechanism according to a seventh embodiment;

FIG. **14** is a side view showing a specific configuration of a restriction mechanism according to an eighth embodiment;

FIG. **15** is a side view showing a specific configuration of the restriction mechanism according to a ninth embodiment;

FIG. **16** is a perspective view showing a specific configuration of a restriction mechanism according to a tenth embodiment;

FIG. **17** is a plan view showing a specific configuration of different contact parts of the restriction mechanism according to the tenth embodiment;

FIG. **18** is a side view showing a specific configuration of a restriction mechanism according to another embodiment;

FIG. **19** is a plan view showing a state of a caster before constraint in the restriction mechanism according to the other embodiment;

FIG. **20** is a plan view showing a state of the caster after constraint in the restriction mechanism according to the other embodiment;

FIG. **21** is a plan view showing a state of the caster before constraint in the restriction mechanism according to the other embodiment; and

FIG. **22** is a plan view showing a state of the caster after constraint in the restriction mechanism according to the other embodiment.

DESCRIPTION OF EMBODIMENTS

Specific embodiments to which the present disclosure is applied are described in detail below with reference to the drawings. However, the present disclosure is not limited to the following embodiments. In addition, in order to clarify the descriptions, the following descriptions and drawings have been simplified as appropriate.

First Embodiment

A basic configuration of a lower limb exercise system according to this embodiment is described. FIG. **1** is a side view showing a user performing a lower limb exercise using the lower limb exercise system according to this embodiment. FIG. **2** is a plan view showing exercise equipment of the lower limb exercise system according to the first embodiment. FIG. **1** simply shows a contact part of a restriction mechanism.

In the following description, a three-dimensional (XYZ) coordinate system is used for clarification. Here, an X-axis positive side is the left side of the lower limb exercise system, an X-axis negative side is the right side of the lower limb exercise system, a Y-axis positive side is the rear side of the lower limb exercise system, a Y-axis positive side is the front side of the lower limb exercise system, a Z-axis positive side is the upper side of the lower limb exercise system, and a Z-axis negative side is the lower side of the lower limb exercise system.

The lower limb exercise system **1**, as shown in FIG. **1**, is suitable for performing lower limb exercises using exercise equipment **2** with a user U seated on a chair **3**. The lower limb exercise system **1** is arranged and used on a floor surface FL of a facility. The lower limb exercise system **1** includes the exercise equipment **2**, the chair **3**, and a restriction mechanism **4**. The exercise equipment **2** is composed of, for example, a pedaling exercise apparatus as shown in FIG. **2**, and includes a body part **21**, a first pedal **22** on the X-axis positive side, and a second pedal **23** on the X-axis negative side.

When the user U's foot pushes down the first pedal **22** or the second pedal **23**, the body part **21** serves as a rotation mechanism for rotating the first pedal **22** and the second pedal **23** in a circular or elliptical trajectory. Specifically, as shown in FIG. **2**, one end of a first crank **24** on the X-axis positive side and one end of a second crank **25** on the X-axis negative side are coupled to the body part **21**.

The first crank **24** and the second crank **25** are rotatably attached to the body part **21**, as shown in FIG. **2**. For example, the one end of the first crank **24** and the one end of the second crank **25** are coupled to a rotation axis **26** of the body part **21**. The first crank **24** and the second crank **25** rotate around the rotation axis **26**. The body part **21** may have a load resistor that imparts a load to the rotational motion of the first crank **24** and the second crank **25**. The body part **21** may have a gear or the like for making the load variable.

The first pedal **22** is attached to the other end of the first crank **24**. The second pedal **23** is attached to the other end of the second crank **25**. The user U places his/her left foot on the first pedal **22** and his/her right foot on the second pedal **23**. When the user U performs a pedaling exercise by

moving his/her knee joint or hip joint by pushing down with his/her feet, the first crank **24** and the second crank **25** rotate around the rotation axis **26**.

Furthermore, an angle between the first pedal **22** and the first crank **24** and an angle between the second pedal **23** and the second crank **25** changes according to the rotation of the first crank **24** and the second crank **25**. The first crank **24** and the second crank **25** rotate according to the pedaling exercise of the user U so that the first pedal **22** and the second pedal **23** follow an elliptical or circular trajectory. In some embodiments, such exercise equipment **2** is portable.

The chair **3** is used by the user U to sit on, for example, at work or at home. As shown in FIG. **1**, the chair **3** has a configuration in which casters **33** are fixed to leading edges of legs **32** projecting from the seat surface **31** on which the user U sits to the Z-axis negative side. In some embodiments, the casters **33** are, for example, universal casters. The chair **3** is not limited to a chair of the general form described above, and may be, for example, a wheelchair.

The restriction mechanism **4** includes the exercise equipment **2** and the restriction mechanism **4** to constitute a lower limb exercise device **5**. The restriction mechanism **4** restricts movement of at least one caster **33** of the chair **3** from a reference arrangement range A**1** (see FIG. **3**) of the casters **33** during a lower limb exercise. Here, FIG. **3** is a plan view for describing an arrangement relationship between the first and second pedals of the exercise equipment and the contact part of the restriction mechanism in the lower limb exercise system according to this embodiment. In FIG. **3**, the contact part of the restriction mechanism is shown briefly.

The restriction mechanism **4** has a base part **41** and a contact part **42** as shown in FIGS. **1** and **3**. The base part **41** is a plate member approximately parallel to the XY plane and extends in, for example, the Y-axis direction. The exercise equipment **2** is fixed to a part of the base part **41** on the Y-axis negative side. At this time, when viewed from the Z-axis direction, a part of the base part **41** on the Y-axis positive side includes the preset reference arrangement range A**1** of the casters **33** of the chair **3**.

As shown in FIG. **1**, when the chair **3** is about to be moved to the Y-axis positive side and the caster **33** on the Y-axis negative side of the chair **3** (hereafter, the caster on the Y-axis negative side of the chair **3** may be given a symbol **33***a* to distinguish it from other casters) is moved from the reference arrangement range A**1** to the Y-axis positive side, the caster **33***a* is brought into contact with the contact part **42**. As shown in FIGS. **1** and **3**, the contact part **42** is arranged near the end of the reference arrangement range A**1** of the caster **33***a* on the Y-axis positive side.

At this time, as shown in FIG. **3**, the contact part **42** is arranged to pass through the center between the first pedal **22** and the second pedal **23** of the exercise equipment **2** and to cross, in the X-axis direction, a central axis AX**1**, which extends in the Y-axis direction. Therefore, the reference arrangement range A**1** of the caster **33***a* is set to cross the central axis AX**1** of the exercise equipment **2**.

FIG. **4** is a side view showing a specific configuration of the contact part and the like of the restriction mechanism in the lower limb exercise system according to this embodiment. The contact part **42** is, for example, a rotating member composed of a gear as shown in FIG. **4**. The contact part **42** is supported by the base part **41** rotatable around a rotation axis extending in the X-axis direction.

That is, the position of the contact part **42** in the Y-axis direction of the exercise equipment **2** is constrained in a region on the Y-axis positive side of the exercise equipment **2**. A width dimension of the contact part **42** in the X-axis direction is larger than a width dimension of the caster **33**.

Such a contact part **42** and a claw part **43** constitute a ratchet mechanism in which counterclockwise rotation of the contact part **42** is allowed and clockwise rotation of the contact part **42** is restricted when viewed from the X-axis positive side. The claw part **43** is supported by the base part **41** rotatable around the rotation axis extending in the X-axis direction and is energized toward the contact part **42** by an elastic body.

In some embodiments, an inclined part **41***a* covering the contact part **42** from the Y-axis positive side is formed at a part of the base part **41** on the Y-axis positive side of the contact part **42**. The inclined part **41***a* inclines to the Z-axis positive side toward the Y-axis negative side.

Next, a flow in which the user U performs a lower limb exercise using the lower limb exercise system **1** according to this embodiment will be described. FIG. **5** is a side view for describing an arrangement relationship between elements when a user performs a lower limb exercise using the lower limb exercise system according to this embodiment.

First, the user U moves the chair **3** to the Y-axis negative side so that one caster **33***a* on the Y-axis negative side of the chair **3** goes over the contact part **42** of the restriction mechanism **4** to the Y-axis negative side, and as shown in FIG. **5**, the caster **33***a* is arranged on the Y-axis negative side of the contact part **42** of the restriction mechanism **4**.

At this time, since the contact part **42** is allowed to rotate counterclockwise as viewed from the X-axis positive side, when the caster **33***a* of the chair **3** goes over the contact part **42**, the contact part **42** is rotated counterclockwise and does not prevent the caster **33***a* from going over the contact part **42** to the Y-axis negative side. In addition, when the inclined part **41***a* is formed in the base part **41**, the caster **33***a* can easily go over the contact part **42** to the Y-axis negative side.

Next, the user U moves the chair **3** to the Y-axis positive side to bring the caster **33***a* of the chair **3** into contact with the contact part **42** of the restriction mechanism **4**, and arranges the caster **33***a* inside the reference arrangement range A**1**. At this time, the end of the contact part **42** on the Z-axis positive side is arranged on the Z-axis positive side of the center (i.e., rotation axis AX**2**) of the caster **33***a*.

In some embodiments, a rotation axis AX**2** of the caster **33***a* may be arranged inside the reference arrangement range A**1** be arranged in the approximately X-axis direction and that the approximately center of the width dimension of the caster **33***a* in the X-axis direction be arranged on the central axis AX**1** of the exercise equipment **2**.

In this state, the user U sits on the seat surface **31** of the chair **3** and performs a lower limb exercise by pedaling the first pedal **22** and the second pedal **23** of the exercise equipment **2**. At this time, the chair **3** is about to be moved to the Y-axis positive side, but the clockwise rotation of the contact part **42** as viewed from the X-axis positive side is restricted. Therefore, the movement of the caster **33***a* of the chair **3** to the Y-axis positive side is restricted.

This restricts the movement of the caster **33***a* of the chair **3** from the reference arrangement range A**1** to the Y-axis positive side by the contact part **42**. Therefore, the user U can favorably pedal the first pedal **22** and the second pedal **23** of the exercise equipment **2** by a reaction force of the base part **41**, and as a result, the user U can effectively perform lower limb exercises.

Moreover, with the caster **33***a* of the chair **3** arranged inside the reference arrangement range A**1**, the end of the contact part **42** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a*. There-

fore, it is possible to suppress the caster **33***a* from going over the contact part **42** to the Y-axis positive side, and it is possible to surely restrict the movement of the chair **3** on the Y-axis positive side.

At this time, if the rotation axis of the contact part **42** is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**, it is possible to more surely suppress the caster **33***a* from going over the contact part **42** to the Y-axis positive side.

Here, FIG. **6** is a plan view for describing the movement of the seat surface of the chair when the user performs a lower limb exercise by pedaling the first and second pedals of the exercise equipment. When the casters **33** of the chair **3** are composed of free casters, if the user U performs a lower limb exercise by pedaling the first pedal **22** and the second pedal **23** of the exercise equipment **2** with one caster **33***a* on the Y-axis negative side of the chair **3** in contact with the contact part **42** as described above, the seat surface **31** is moved in an arc around a pivot axis AX**3** extending in the Z-axis direction of the caster **33***a*, as shown in FIG. **6**.

This enables continuous exercises even if the relative positional relationship between the exercise equipment **2** and the chair **3** changes. Further, since the distance between the seat surface **31** and the first pedal **22** and the second pedal **23** changes, the load on the trunk is large and the exercise effect can be improved.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the user U moves the chair **3** to the Y-axis positive side so that the caster **33***a* of the chair **3** goes over the contact part **42** to the Y-axis positive side, because a space on the Z-axis positive side of the restriction mechanism **4** is opened, so that the exercise equipment **2** and the chair **3** can be easily separated.

Although the restriction mechanism **4** according to this embodiment is fixed to the exercise equipment **2** through the base part **41**, it may be detachably coupled to the exercise equipment **2**. In addition, the restriction mechanism **4** according to this embodiment includes the contact part **42** and the claw part **43** constituting a ratchet mechanism. Alternatively, the contact part may be configured as a one-way clutch. In some embodiments, in this case, the surface of the contact part is covered with a friction material such as rubber or silicon.

Second Embodiment

FIG. **7** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **7**, a restriction mechanism **100** according to this embodiment includes a fixed part **101**, a shaft **102**, and contact parts **103** in addition to the base part **41**. The position of the restriction mechanism **100** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

When viewed from the Y-axis direction, the fixed part **101** is approximately C-shaped with the Z-axis positive side open and includes a base part **101***a*, a first sidewall part **101***b* projecting from the end of the base part **101***a* on the X-axis positive side to the Z-axis positive side, and a second sidewall part **101***c* projecting from the end of the base part **101***a* on the X-axis negative side to the Z-axis positive side. The fixed part **101** is fixed to the base part **41**.

The shaft **102** extends in the X-axis direction. The end of the shaft **102** on the X-axis positive side is fixed to the first sidewall part **101***b*, and the end of the shaft **102** on the X-axis negative side is fixed to the second sidewall part **101***c*. The contact parts **103** are passed through the shaft **102** and fixed to the shaft **102**. A plurality of the contact part **103** are arranged in the X-axis direction.

At this time, the contact parts **103** are arranged near the end of the reference arrangement range A**1** of the caster **33***a* of the chair **3** on the Y-axis positive side. When viewed from the Y-axis direction, the contact parts **103** are arranged in a range wider than the width dimension of the caster **33***a* of the chair **3** in the X-axis direction. In some embodiments, the caster **33** includes two wheels **33***b* arranged in the direction in which the rotation axis AX**2** extends.

The contact part **103** is made of an elastic body and is a plate member having rigidity enough not to deform in the X-axis direction. Each of the contact parts **103** includes, for example, projections **103***a* projecting in the radial direction of the shaft **102**. The projections **103***a* are spaced approximately equally in the circumferential direction of the shaft **102**. However, the shape of the contact part **103** is not limited and may be circular or polygonal when viewed from the X-axis direction.

When the user U performs a lower limb exercise using such a restriction mechanism **100**, the user U moves the chair **3** to the Y-axis negative side so that the caster **33***a* of the chair **3** goes over the contact part **103** to the Y-axis negative side. At this time, since the contact part **103** is made of an elastic body, it is deformed when the caster **33***a* goes over and does not inhibit the movement of the caster **33***a* to the Y-axis negative side. In this way, the caster **33***a* can be arranged on the Y-axis negative side of the contact part **103**.

Next, the user U moves the caster **33***a* of the chair **3** to the Y-axis positive side to bring the caster **33***a* into contact with the contact part **103**, and the caster **33***a* is arranged inside the reference arrangement range A**1**. At this time, the end of the contact part **103** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a*.

Here, the contact part **103** in contact with the caster **33***a* of the chair **3** is deformed to the Y-axis positive side, and the contact part **103** not in contact with the caster **33***a* is not deformed to the Y-axis positive side. Therefore, the contact part **103** arranged between the wheels **33***b* of the caster **33***a* when viewed from the Y-axis direction enters between the wheels **33***b*, and each wheel **33***b* is surrounded by the contact part **103** from the X-axis positive side, Y-axis positive side, and X-axis negative side.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the contact part **103** to the Y-axis positive side. However, since the contact part **103** is made of an elastic body, it is deformed and absorbs the movement of the caster **33***a* to the Y-axis positive side. Furthermore, the end of the contact part **103** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a*.

Therefore, it is possible to suppress the caster **33***a* of the chair **3** from going over the contact part **103** to the Y-axis positive side, and to restrict the movement of the caster **33***a* from the reference arrangement range A**1** to the Y-axis positive side. Here, when the shaft **102** is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**, the caster **33***a* can be more reliably suppressed from going over the contact part **103** to the Y-axis positive side. Moreover, since each wheel **33***b* is sandwiched by the contact parts **103** from the X-axis direction, the movement of the caster **33***a* from the reference arrangement range A**1** in the X-axis direction can also be restricted.

In some embodiments, a projection may be formed to cross the central axis AX**1** of the exercise equipment **2** in the

region on the Y-axis negative side of the reference arrangement range A1 at the base part **41**. This also restricts the movement of the caster **33***a* of the chair **3** from the reference arrangement range A1 to the Y-axis negative side. The projection may be shaped to restrict the movement of the caster **33***a* of the chair **3** to the Y-axis negative side.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the user U moves the chair **3** to the Y-axis positive side so that the caster **33***a* of the chair **3** goes over the contact part **103** to the Y-axis positive side, because a space on the Z-axis positive side of the restriction mechanism **100** is opened, so that the exercise equipment **2** and the chair **3** can be easily separated.

Although the restriction mechanism **100** according to this embodiment is fixed to the exercise equipment **2** through the base part **41**, it may be detachably coupled to the exercise equipment **2**.

Third Embodiment

FIG. **8** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **8**, a restriction mechanism **110** according to this embodiment includes a first contact part **111**, a first lock mechanism **112**, a second contact part **113**, and a second lock mechanism (not shown) in addition to the base part **41**. The position of the restriction mechanism **110** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The first contact part **111** is, for example, a rotating member supported by the base part **41** so as to be able to rotate around a first rotation axis **114** projecting from the base part **41** to the Z-axis positive side. The first contact part **111** is positioned on the Y-axis positive side of the reference arrangement range A1 of the caster **33***a* of the chair **3** and near the corner thereof on the X-axis positive side. The first contact part **111** includes, for example, projections **111***a* projecting in the radial direction of the first rotation axis **114** at approximately equal intervals in the circumferential direction of the first rotation axis **114**.

As viewed from the Z-axis positive side, the first lock mechanism **112** allows counterclockwise rotation of the first contact part **111** and restricts clockwise rotation of the first contact part **111**. The first lock mechanism **112** includes, for example, a locking claw **112***a* energized to the Z-axis positive side.

The locking claw **112***a* includes an inclined surface **112***b* inclined to the Z-axis positive side in the counterclockwise direction of the first contact part **111**. The locking claw **112***a* includes a vertical surface **112***c* approximately parallel to the Z-axis at the end of the first contact part **111** in the locking claw **112***a* on the counterclockwise direction side.

Since the second contact part **113** and the second lock mechanism have a bilaterally symmetric configuration with the central axis AX1 of the exercise equipment **2** as the axis of symmetry with respect to the first contact part **111** and the first lock mechanism **112**, a detailed description is omitted. The second contact part **13** and the second lock mechanism are arranged on the X-axis negative side of the first contact part **111** and the first lock mechanism **112**.

The second contact part **113** has projections **113***a* and is a rotating member supported by the base part **41** so as to be able to rotate around a second rotation axis **115**. The second contact part **113** is arranged on the Y-axis positive side of the reference arrangement range A1 of the caster **33***a* of the chair **3** and near the corner thereof on the X-axis negative side.

At this time, with the projections **111***a* of the first contact part **111** and the projections **113***a* of the second contact part **113** arranged so as to face each other in the X-axis direction, the first contact part **111** and the second contact part **113** are arranged at a distance that the caster **33***a* of the chair **3** cannot pass between the projections **111***a* of the first contact part **111** and the projections **113***a* of the second contact part **113**.

As viewed from the Z-axis positive side, the second lock mechanism allows clockwise rotation of the second contact part **113** and restricts counterclockwise rotation of the second contact part **113**. When the user U performs a lower limb exercise using such a restriction mechanism **110**, the user U pushes one caster **33***a* on the Y-axis negative side of the chair **3** between the first contact part **111** and the second contact part **113** to the Y-axis negative side.

At this time, the first lock mechanism **112** allows counterclockwise rotation of the first contact part **111** and the second lock mechanism allows clockwise rotation of the second contact part **113**. Therefore, the first contact part **111** and the second contact part **113** rotate to allow movements of the caster **33***a* to the Y-axis negative side. Thus, the caster **33***a* of the chair **3** can be arranged on the Y-axis negative side of the first contact part **111** and the second contact part **113**.

Next, the user U moves the caster **33***a* of the chair **3** to the Y-axis positive side to bring the caster **33***a* in contact with the projections **111***a* projecting to the X-axis negative side of the first contact part **111** and the projections **113***a* projecting to the X-axis positive side of the second contact part **113** and to arrange the caster **33***a* inside the reference arrangement range A1.

At this time, the end of the projection **111***a* of the first contact part **111** on the Z-axis positive side and the end of the projection **113***a* of the second contact part **113** on the Z-axis positive side are arranged on the Z-axis positive side of the center of the caster **33***a*. Also, the caster **33***a* is arranged between the projection **111***a* projecting to the Y-axis negative side in the first contact part **111** and the projection **113***a* projecting to the Y-axis negative side in the second contact part **113**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the first contact part **111** and the second contact part **113** to the Y-axis positive side. However, the first lock mechanism **112** restricts clockwise rotation of the first contact part **111** and the second lock mechanism restricts counterclockwise rotation of the second contact part **113**. Therefore, the rotation of the first contact part **111** and the second contact part **113** is restricted.

Moreover, the end of the projection **111***a* of the first contact part **111** on the Z-axis positive side and the end of the projection **113***a* of the second contact part **113** on the Z-axis positive side are arranged on the Z-axis positive side of the center of the caster **33***a*. Therefore, the movement of the caster **33***a* from the reference arrangement range A1 to the Y-axis positive side can be restricted.

In addition, the movement of the caster **33***a* from the reference arrangement range A1 in the X-axis direction can also be restricted, because the caster **33***a* of the chair **3** is sandwiched in the X-axis direction between the projection **111***a* projecting to the Y-axis negative side in the first contact part **111** and the projection **113***a* projecting to the Y-axis negative side in the second contact part **113**.

In some embodiments, a projection may be formed to cross the central axis AX1 of the exercise equipment **2** in the region on the Y-axis negative side of the reference arrangement range A1 at the base part **41**. This also restricts the movement of the caster **33***a* of the chair **3** from the reference arrangement range A1 to the Y-axis negative side. The projection may be shaped to restrict the movement of the caster **33***a* of the chair **3** to the Y-axis negative side.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be easily separated if the user U moves the chair **3** to the Y-axis positive side while pulling up the caster **33***a* to the Z-axis positive side, because a space on the Z-axis positive side of the restriction mechanism **110** is open.

Although the restriction mechanism **110** according to this embodiment is fixed to the exercise equipment **2** through the base part **41**, it may be detachably coupled to the exercise equipment **2**. The first contact part **111** and the second contact part **113** according to this embodiment are configured so that rotation thereof is restricted by the first lock mechanism **112** and the second lock mechanism, and instead they may be configured as one-way clutches. The surfaces of the contact parts may be covered with a friction material such as rubber or silicon.

Fourth Embodiment

FIG. **9** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **9**, a restriction mechanism **120** according to this embodiment includes a first restriction part **121**, a first contact part **122**, a first elastic body **123**, a second restriction part **124**, a second contact part **125**, and a second elastic body **126** in addition to the base part **41**. The position of the restriction mechanism **120** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The first restriction part **121** has, for example, an approximately C-shaped block member as a basic configuration when viewed from the X-axis direction, and includes a notched part **121***a* with the Y-axis negative side thereof open at a part of the first restriction part **121** on the Y-axis positive side. The first restriction part **121** includes a restriction surface **121***b* approximately parallel to the YZ plane at the end of the first restriction part **121** on the X-axis negative side.

The first contact part **122** is arranged inside the notched part **121***a* of the first restriction part **121** and is a rotating member supported by the first restriction part **121** rotatably around the first rotation axis extending in the Z-axis direction. The first contact part **122** includes a projection **122***a* projecting to the X-axis negative side from the notched part **121***a* of the first restriction part **121**.

The projection **122***a* is, for example, an approximately right-angled trapezoidal plate member when viewed from the Z-axis positive side, and includes an inclined surface **122***b* formed at the end of the projection **122***a* on the clockwise direction side of the first contact part **122**. The inclined surface **122***b* is inclined in the counterclockwise direction of the first contact part **122** toward radially outward of the first rotation axis.

The first elastic body **123** energizes the first contact part **122** clockwise when viewed from the Z-axis positive side. In some embodiments, at this time, the first elastic body **123** is composed of a torsion spring. With the first elastic body **123** passed through the first rotation axis, one end of the first elastic body **123** is hooked to the end of the projection **122***a* of the first contact part **122** on the counterclockwise direction side.

The other end of the first elastic body **123** is arranged on the Y-axis negative side of the one end of the first elastic body **123**, and is hooked from the X-axis negative side to a first hook piece provided in the first restriction part **121**. However, the first elastic body **123** may have another configuration as long as it is configured to energize the first contact part **122** clockwise as viewed from the Z-axis positive side.

In such a configuration, in the initial state of the restriction mechanism **120**, the first contact part **122** is energized clockwise by the first elastic body **123** with the projection **122***a* of the first contact part **122** projecting from the notched part **121***a* of the first restriction part **121** to the X-axis negative side, while the end of the first contact part **122** on the clockwise direction side is in contact with the first restriction part **121** to restrict clockwise rotation.

The second restriction part **124**, the second contact part **125**, and the second elastic body **126** are arranged on the X-axis negative side of the first restriction part **121**, the first contact part **122**, and the first elastic body **123**, although a detailed description is omitted, because they are symmetrical with respect to the central axis AX1 of the exercise equipment **2** as the axis of symmetry with respect to the first restriction part **121**, the first contact part **122**, and the first elastic body **123**, respectively.

The second restriction part **124** includes a notched part **124***a* and a restriction surface **124***b*. In some embodiments, a distance between the restriction surface **121***b* of the first restriction part **121** and the restriction surface **124***b* of the second restriction part **124** in the X-axis direction is approximately equal to the width dimension of the caster **33** of the chair **3** in the X-axis direction.

The second contact part **125** includes a projection **125***a* projecting from the notched part **124***a* of the second restriction part **124** to the X-axis positive side and is a rotating member supported by the second restriction part **124** so as to be rotatable about the second rotation axis **127**. The projection **125***a* includes an inclined surface **125***b* inclined in the clockwise direction of the second contact part **125** toward radially outward of the second rotation axis **127**.

Here, in the initial state where the projection **122***a* of the first contact part **122** and the projection **125***a* of the second contact part **125** are arranged so as to face each other in the X-axis direction, the first contact part **122** and the second contact part **125** are arranged between the projection **122***a* of the first contact part **122** and the projection **125***a* of the second contact part **125** with a space that the caster **33** of the chair **3** cannot pass therethrough.

Further, in the initial state where the projection **122***a* of the first contact part **122** and the projection **125***a* of the second contact part **125** are arranged to face each other in the X-axis direction, the reference arrangement range A1 of the caster **33***a* of the chair **3** is arranged inside the restriction surface **121***b* of the first restriction part **121**, the projection **122***a* of the first contact part **122**, the projection **125***a* of the second contact part **125**, and the restriction surface **124***b* of the second restriction part **124**.

As viewed from the Z-axis positive side, in a state where the second elastic body **126** is passed through the second rotation axis **127** so that the second contact part **125** is energized counterclockwise, one end of the second elastic body **126** is hooked to the projection **125***a* of the second contact part **125** and the other end of the second elastic body

126 is hooked to the second hook piece 128 provided in the second restriction part 124 so as to energize the second contact part 125 counterclockwise. However, the second elastic body 126 may have another configuration as long as it is configured to energize the second contact part 125 counterclockwise as viewed from the Z-axis positive side.

When the user U performs a lower limb exercise using such a restriction mechanism 120, the user U pushes one caster 33*a* on the Y-axis negative side of the chair 3 between the first restriction part 121 and the second restriction part 124 on the Y-axis negative side. Thus, the first contact part 122 and the second contact part 125 rotate to allow the caster 33*a* to move to the Y-axis negative side.

When the user U arranges the caster 33*a* on the Y-axis negative side of the chair 3 of the first contact part 122 and the second contact part 125, the first contact part 122 and the second contact part 125 return to their initial states by energizing forces of the first elastic body 123 and the second elastic body 126. As a result, the projection 122*a* of the first contact part 122 and the projection 125*a* of the second contact part 125 are arranged on the Y-axis positive side of the caster 33*a* of the chair 3.

Next, the user U moves the caster 33*a* of the chair 3 to the Y-axis positive side to bring the caster 33*a* into contact with the projection 122*a* of the first contact part 122 and the projection 125*a* of the second contact part 125, and arranges the caster 33*a* inside the reference arrangement range A1. Here, the end of the projection 122*a* of the first contact part 122 on the Z-axis positive side and the end of the projection 125*a* of the second contact part 125 on the Z-axis positive side are arranged on the Z-axis positive side of the center of the caster 33*a* of the chair 3.

In such a state, when the user U performs a lower limb exercise, the caster 33*a* of the chair 3 pushes the first contact part 122 and the second contact part 125 to the Y-axis positive side. However, as described above, the clockwise rotation of the first contact part 122 is restricted by the first restriction part 121 and the counterclockwise rotation of the second contact part 125 is restricted by the second restriction part 124. Therefore, the rotation of the first contact part 122 and the second contact part 125 is restricted.

Moreover, the end of the projection 122*a* of the first contact part 122 on the Z-axis positive side and the end of the projection 125*a* of the second contact part 125 on the Z-axis positive side are arranged on the Z-axis positive side of the center of the caster 33*a* of the chair 3. Therefore, the movement of the caster 33*a* from the reference arrangement range A1 to the Y-axis positive side can be restricted.

Furthermore, since the caster 33*a* of the chair 3 is sandwiched between the restriction surface 121*b* of the first restriction part 121 and the restriction surface 124*b* of the second restriction part 124 in the X-axis direction, the movement of the caster 33*a* from the reference arrangement range A1 in the X-axis direction can also be restricted.

When the lower limb exercise is finished and the chair 3 is moved to the Y-axis positive side of the exercise equipment 2 to separate the exercise equipment 2 and the chair 3, the exercise equipment 2 and the chair 3 can be easily separated if the user U moves the chair 3 to the Y-axis positive side while pulling up the caster 33*a* of the chair 3 to the Z-axis positive side, because a space on the Z-axis positive side of the restriction mechanism 120 is open.

In some embodiments, the restriction mechanism 120 may be configured to be detachable from the exercise equipment 2. In some embodiments, that is, the length of the base part (first base part) 41 in the Y-axis direction is shorter than that of the base part 41 according to the first embodiment or the like. Further, in some embodiments, the second base part 129 provided with the first restriction part 121, the first contact part 122, the first elastic body 123, the second restriction part 124, the second contact part 125, and the second elastic body 126 can be coupled to the end of the first base part 41 on the Y-axis positive side by using, for example, a detachable mechanism 130 such as a bolt.

In this way, the part provided with the first restriction part 121, the first contact part 122, the first elastic body 123, the second restriction part 124, the second contact part 125, and the second elastic body 126 in the restriction mechanism 120 can be easily detached from the exercise equipment 2, thereby improving the versatility of the exercise equipment 2.

However, the first restriction part 121, the first contact part 122, the first elastic body 123, the second restriction part 124, the second contact part 125, and the second elastic body 126 may be provided in the base part 41 in the same way as that in the first embodiment.

In some embodiments, a projection 129*a* may be formed to cross the central axis AX1 of the exercise equipment 2 in the region of the reference arrangement range A1 on the Y-axis negative side in the second base part 129. This also restricts the movement of the caster 33*a* from the reference arrangement range A1 to the Y-axis negative side.

In some embodiments, the restriction mechanism 120 includes a guide part 131 for guiding the caster 33*a* of the chair 3 between the restriction surface 121*b* of the first restriction part 121 and the restriction surface 124*b* of the second restriction part 124. The guide part 131 includes a guide surface 131*a* whose width dimension in the X-axis direction is narrowed toward the Y-axis negative side. With such a configuration, the caster 33*a* of the chair 3 can be easily pushed between the restriction surface 121*b* of the first restriction part 121 and the restriction surface 124*b* of the second restriction part 124.

Fifth Embodiment

FIG. 10 is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. 10, a restriction mechanism 140 according to this embodiment includes a second base part 141, a housing part 142, and a lock mechanism 143 in addition to the base part (first base part) 41. The position of the restriction mechanism 140 relative to the exercise equipment 2 is constrained in the region on the Y-axis positive side of the exercise equipment 2.

The second base part 141 includes a bottom part 141*a* and sidewall parts 141*b* and is fixed to the first base part 41 in a state where it is arranged, for example, on a surface of the first base part 41 on the Z-axis positive side. The bottom part 141*a* is, for example, an approximately rectangular plate member when viewed from the Z-axis direction, and has a step shape in which a height of a part of the bottom part 141*a* on the Y-axis negative side is greater than a part thereof on the Y-axis positive side. At this time, the reference arrangement range A1 of the caster 33*a* of the chair 3 is arranged at the part of the bottom part 141*a* on the Y-axis positive side when viewed from the Z-axis direction.

The sidewall parts 141*b* project from the end of the bottom part 141*a* on the X-axis negative side, the end thereof on the Y-axis negative side, and the end thereof on the X-axis positive side toward the Z-axis positive side. That is, the sidewall parts 141*b* are arranged along the periphery of the bottom part 141*a* except for the end of the bottom part 141*a* on the Y-axis positive side.

The housing part **142** is a box member with a part of the housing part **142** on the Y-axis positive side and a part thereof on the Z-axis positive side open in the initial state shown in FIG. **10**. As shown in FIG. **10**, the housing part **142** can house the caster **33***a* of the chair **3** inside the housing part **142**.

Such a housing part **142** is supported by the second base part **141** on the Y-axis negative side of the housing part **142** in the initial state, as shown in FIG. **10**, rotatably around the rotation axis **144** provided at the corner on the Z-axis negative side.

The rotation axis **144** extends in the X-axis direction and is inserted into the end of the sidewall part **141***b* on the Y-axis positive side of the part of the sidewall part **141***b* in the second base part **141** on the X-axis positive side and the end of the sidewall part **141** on the Y-axis positive side of the part of the sidewall part **141***b* in the second base part **141** on the X-axis negative side. At this time, the housing part **142** is arranged so as to have a bilaterally symmetric configuration with the central axis AX**1** of the exercise equipment **2** as the axis of symmetry.

The lock mechanism **143** has a claw part **143***a*, a guide part **143***b*, and an elastic body **143***c*. The claw part **143***a* is, for example, an approximately L-shaped block member as viewed from the X-axis direction, and has an inclined surface **143***d* at the end of the claw part **143***a* on the Y-axis positive side.

The inclined surface **143***d* is inclined to the Z-axis positive side toward the Y-axis negative side. Such a claw part **143***a* is arranged on a part of the bottom part **141***a* on the Y-axis negative side in the second base part **141** and extends in the Y-axis direction. At this time, in the initial state of the restriction mechanism **140** shown in FIG. **10**, the inclined surface **143***d* of the claw part **143***a* projects to the part of the second base part **141** on the Y-axis positive side.

The guide part **143***b* is an approximately C-shaped block member when viewed from the Y-axis direction. An inner shape of the guide part **143***b* is approximately equal to an outer shape of the part of the claw part **143***a* extending in the Y-axis direction.

The guide part **143***b* is fixed to the part of the bottom part **141***a* on the Y-axis negative side in the second base part **141** with the part of the claw part **143***a* extending in the Y-axis direction passed through the inside of the guide part **143***b*. At this time, the part of the claw part **143***a* extending in the Z-axis direction is arranged on the Y-axis negative side of the guide part **143***b*.

The elastic body **143***c* is arranged between the part of the sidewall part **141***b* on the Y-axis negative side in the second base part **141** and the part of the claw part **143***a* on the Z-axis direction, and energizes the claw part **143***a* to the Y-axis positive side.

When the user U performs a lower limb exercise using such a restriction mechanism **140**, the user U moves one caster **33***a* on the Y-axis negative side of the chair **3** to the Y-axis negative side and houses it inside the housing part **142**. When the user U further moves the caster **33***a* of the chair **3** to the Y-axis negative side, the housing part **142** rotates counterclockwise as viewed from the X-axis positive side.

At this time, since the inclined surface **143***d* of the claw part **143***a* is inclined to the Z-axis positive side toward the Y-axis negative side, the housing part **142** pushes the claw part **143***a* to the Y-axis negative side while the housing part **142** is in contact with the inclined surface **143***d* of the claw part **143***a*.

When the housing part **142** is arranged on the part of the bottom **141***a* on the Y-axis positive side in the second base part **141**, the part of the housing part **142** on the Z-axis negative side (i.e., a part thereof approximately parallel to the XY plane) is arranged at a lower position in the Z-axis direction than the position of the part of the bottom part **141***a* on the Y-axis negative side in the second base part **141**.

Therefore, the claw part **143***a* is pushed out to the Y-axis positive side by the elastic body **143***c*, and the end of the claw part **143***a* on the Y-axis positive side covers the end of the housing part **142** on the Y-axis negative side in the part thereof on the Z-axis negative side. This restricts the rotation of the housing part **142**, and the housing part **142** surrounds the caster **33***a* of the chair **3** from the X-axis positive side, Y-axis positive side, and X-axis negative side.

After that, the caster **33***a* of the chair **3** is moved to the Y-axis positive side to be in contact with the part of the housing part **142** on the Y-axis positive side, and the caster **33***a* is arranged inside the reference arrangement range A**1**. At this time, the end of the housing part **142** on the Z-axis positive side part in the part thereof on the Y-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the housing part **142** to the Y-axis positive side. However, as described above, the rotation of the housing part **142** is restricted by the claw part **143***a*. Moreover, the end of the housing part **142** on the Y-axis positive side in the part of the housing part **142** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

Therefore, the movement of the caster **33***a* from the reference arrangement range A**1** to the Y-axis positive side can be restricted. Further, since the caster **33***a* is sandwiched between the part of the housing part **142** on the X-axis positive side and the part thereof on the X-axis negative side in the X-axis direction, the movement of the caster **33***a* from the reference arrangement range A**1** in the X-axis direction can also be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be easily separated if the user U pushes the claw part **143***a* to the Y-axis negative side to allow the rotation of the housing part **142** and moves the chair **3** to the Y-axis positive side.

Although the restriction mechanism **140** according to this embodiment is fixed to the exercise equipment **2** through the first base part **41**, it may be detachably coupled to the exercise equipment **2**.

Sixth Embodiment

FIG. **11** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. FIG. **12** is a side view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIGS. **11** and **12**, a restriction mechanism **150** according to this embodiment includes a second base part **151**, a first restriction part **152**, a second restriction part **153**, a movable plate **154**, and an elastic body in addition to the base part (first base part) **41**. The position of the restriction mechanism **150** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The second base part **151** is, for example, an approximately rectangular plate member viewed from the Z-axis

positive side, and is fixed to the first base part **41** in a state it is arranged on the surface of the first base part **41** on the Z-axis positive side. The first restriction part **152** is an approximately rectangular block member extending in the Y-axis direction and has a restriction surface **152***a* approximately parallel to the YZ plane at the end of the first restriction part **152** on the X-axis negative side.

The second restriction part **153** is arranged on the X-axis negative side of the first restriction part **152**. The second restriction part **153** is an approximately rectangular block member extending in the Y-axis direction and has a restriction surface **153***a* approximately parallel to the YZ plane at the end of the second restriction part **153** on the X-axis positive side.

These first restriction part **152** and second restriction part **153** are fixed to the part of the second base part **151** on the Y-axis negative side so that the first restriction part **152** and the second restriction part **153** have a bilaterally symmetric configuration with the central axis AX**1** of the exercise equipment **2** as the axis of symmetry. At this time, the distance between the first restriction part **152** and the second restriction part **153** in the X-axis direction should be approximately equal to the width dimension of the caster **33** of the chair **3** in the X-axis direction.

The movable plate **154** is an approximately rectangular plate member viewed from the Z-axis direction and is arranged so as to project from the second base part **151** to the Y-axis positive side. The movable plate **154** is supported by the second base part **151** rotatably around a rotation axis **155** provided at the end of the second base part **151** on the Y-axis positive side. The rotation axis **155** extends in the X-axis direction.

The elastic body energizes the movable plate **154** clockwise as viewed from the X-axis positive side. In some embodiments, the elastic body is composed of, for example, a torsion spring. With the elastic body passed through the rotation axis **155**, one end of the elastic body is fixed to the second base part **151** and the other end of the elastic body is fixed to the movable plate **154**.

However, the elastic body may have another configuration as long as it can energize the movable plate **154** clockwise as viewed from the X-axis positive side. In this embodiment, the elastic body energizes the movable plate **154** clockwise. Alternatively, a weight may be provided at the end of the movable plate **154** on the Y-axis positive side to energize the movable plate **154** clockwise.

In such a configuration, in the initial state of the restriction mechanism **150** shown in FIGS. **11** and **12**, as viewed from the X-axis positive side, the movable plate **154** is rotated clockwise and arranged in a state inclined to the Z-axis negative direction toward the Y-axis positive direction. At this time, the reference arrangement range A**1** of the caster **33***a* of the chair **3** is arranged inside the restriction surface **152***a* of the first restriction part **152**, the movable plate **154**, and the restriction surface **153***a* of the second restriction part **153**.

When the user U performs a lower limb exercise using the restriction mechanism **150**, the user U moves one caster **33***a* on the Y-axis negative side of the chair **3** in the Y-axis negative direction and places it on the movable plate **154**. Then, the movable plate **154** is rotated counterclockwise as viewed from the X-axis positive side due to the weight of the caster **33***a* of the chair **3**, and the surface of the movable plate **154** on the Z-axis negative side is in approximately plane contact with the surface of the second base part **151** on the Z-axis positive side, so that the movable plate **154** is arranged almost parallel to the XY plane.

The user U further moves the caster **33***a* of the chair **3** in the Y-axis negative direction to insert the caster **33***a* between the restriction surface **152***a* of the first restriction part **152** and the restriction surface **153***a* of the second restriction part **153**, and to retreat the caster **33***a* from the surface of the movable plate **154** on the Z-axis positive side. At this time, since the movable plate **154** is energized clockwise as viewed from the X-axis positive side by the elastic body, the movable plate **154** returns to its initial state of clockwise rotation.

This restricts the counterclockwise rotation of the movable plate **154** as viewed from the X-axis positive side, and the caster **33***a* of the chair **3** is surrounded from the X-axis positive side, Y-axis positive side, and X-axis negative side by the restriction surface **152***a* of the first restriction part **152**, the movable plate **154**, and the restriction surface **153***a* of the second restriction part **153**.

After that, the user U moves the caster **33***a* of the chair **3** in the Y-axis positive direction to bring the caster **33***a* into contact with the end of the movable plate **154** on the Y-axis negative side, and arranges the caster **33***a* inside the reference arrangement range A**1**. At this time, the end of the movable plate **154** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* pushes the movable plate **154** to the Y-axis positive side. However, the movable plate **154** is energized clockwise in the initial state of being rotated clockwise. Moreover, the end of the movable plate **154** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

Therefore, counterclockwise rotation of the movable plate **154** is restricted, and the movement of the caster **33***a* of the chair **3** from the reference arrangement range A**1** to the Y-axis positive side can be restricted. Furthermore, since the caster **33***a* of the chair **3** is sandwiched between the restriction surface **152***a* of the first restriction part **152** and the restriction surface **153***a* of the second restriction part **153** from the X-axis direction, the movement of the caster **33***a* from the reference arrangement range A**1** in the X-axis direction can also be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, for example, by providing an extended part extending in the X-axis positive direction on the movable plate **154** and the user U stepping on it to move the chair **3** in the Y-axis positive direction while rotating the movable plate **154** counterclockwise and arranging the movable plate **154** approximately parallel to the XY plane as viewed from the X-axis positive side, the chair **3** can be easily separated from the exercise equipment **2**.

In some embodiments, the restriction mechanism **150** includes a guide part **156** for guiding the caster **33***a* of the chair **3** between the restriction surface **152***a* of the first restriction part **152** and the restriction surface **153***a* of the second restriction part **153**.

The guide part **156** includes a guide surface **156***a* whose width dimension in the X-axis direction is narrowed toward the Y-axis negative side. With such a configuration, the caster **33***a* of the chair **3** can be easily pushed between the restriction surface **152***a* of the first restriction part **152** and the restriction surface **153***a* of the second restriction part **153**.

Although the restriction mechanism **150** according to this embodiment is fixed to the exercise equipment **2** through the first base part **41**, it may be detachably coupled to the exercise equipment **2**.

Seventh Embodiment

FIG. **13** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **13**, a restriction mechanism **160** according to this embodiment includes a hook part **161** and an elastic body in addition to the base part **41**. The position of the restriction mechanism **160** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The hook part **161** is an approximately C-shaped linear member with the Y-axis negative side open as viewed from the Z-axis direction. In some embodiments, at this time, a width dimension W1 of the inside of the hook part **161** in the X-axis direction is approximately equal to the width dimension of the caster **33***a* of the chair **3** in the X-axis direction.

The end of the hook part **161** on the X-axis positive side is coupled to the base part **41** rotatably around the X-axis through a first fixing jig **162**, and the end of the hook part **161** on the X-axis negative side is coupled to the base part **41** rotatably around the X-axis through a second fixing jig **163**.

The hook part **161** extends from the first fixing jig **162** and the second fixing jig **163** to the Y-axis positive side. The hook part **161** is arranged so as to have a bilaterally symmetric configuration with the central axis AX1 of the exercise equipment **2** as the axis of symmetry.

In some embodiments, a recess **41***b* is formed in the base part **41** to house the hook part **161** with the hook part **161** arranged approximately parallel to the XY plane. At this time, the reference arrangement range A1 of the caster **33***a* of the chair **3** is arranged in the area inside the recess **41***b* as viewed from the Z-axis direction.

The elastic body energizes the hook part **161** counterclockwise as viewed from the X-axis positive side. In some embodiments, the elastic body is composed of, for example, a torsion spring. With the elastic body passed through the end of the hook part **161** on the X-axis negative side or the end of the hook part **161** on the X-axis positive side, one end of the elastic body is fixed to the hook part **161** and the other end of the elastic body is fixed to the base part **41**. However, the elastic body only may have another configuration as long as it can energize the hook part **161** counterclockwise when viewed from the X-axis positive side.

With such a configuration, in the initial state of the restriction mechanism **160** shown in FIG. **13**, when viewed from the X-axis positive side, the hook part **161** is rotated counterclockwise and arranged in a state in which it is inclined to the Z-axis positive side toward the Y-axis positive side.

When the user U performs a lower limb exercise using the restriction mechanism **160**, in a state in which the user has rotated the hook part **161** clockwise as viewed from the X-axis positive side and housed in the recess **41***b* of the base part **41**, one caster **33***a* on the Y-axis negative side of the chair **3** is moved to the Y-axis negative side, and the caster **33***a* is arranged in the region inside the recess **41***b* when viewed from the Z-axis direction.

Next, when the user U cancels the state in which the hook part **161** is rotated clockwise, the hook part **161** is rotated counterclockwise and returns to the initial state, because the elastic body is energizing the hook part **161** counterclockwise when viewed from the X-axis positive side.

Then, the caster **33***a* of the chair **3** is hooked from the Y-axis positive side to the hook part **161**, the caster **33***a* is sandwiched by the hook part **161** from the X-axis direction, and the caster **33***a* is arranged inside the reference arrangement range A1. At this time, the end of the hook part **161** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the hook part **161** to the Y-axis positive side. However, the clockwise rotation of the hook part **161** is restricted when viewed from the X-axis positive side, because the hook part **161** is energized counterclockwise by the elastic body. Moreover, the end of the hook part **161** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

Therefore, the hook part **161** maintains the state in which the caster **33***a* of the chair **3** is hooked, and the movement of the caster **33***a* from the reference arrangement range A1 to the Y-axis positive side can be restricted. Further, since the caster **33***a* is sandwiched from the X-axis direction by the hook part **161**, the movement of the caster **33***a* from the reference arrangement range A1 to the X-axis direction can also be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be separated easily if the user U rotates the hook part **161** clockwise as viewed from the X-axis positive side to house the recessed part **41***b* of the base part **41** while moving the chair **3** to the Y-axis positive side.

Although the restriction mechanism **160** according to this embodiment is fixed to the exercise equipment **2** through the base part **41**, it may be detachably coupled to the exercise equipment **2**.

Eighth Embodiment

FIG. **14** is a side view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **14**, a restriction mechanism **170** according to this embodiment includes movable plates **171** and an elastic body **172**. The position of the restriction mechanism **170** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The movable plates **171** are, for example, plate members that are approximately parallel to the XZ plane. A plurality of the movable plates **171** are arranged at intervals in the Y-axis direction. Here, in this embodiment, a recess **173** is formed in the floor surface FL of the facility, and when viewed from the Z-axis direction, a plurality of movable plates **171** are arranged in a region of the recess **173** in the exercise equipment **2** on the Y-axis positive side.

At this time, the movable plates **171** are arranged so as to have a bilaterally symmetric configuration with the central axis AX1 of the exercise equipment **2** as the axis of symmetry. When viewed from the Z-axis direction, the reference arrangement range A1 of the caster **33***a* of the chair **3** is arranged inside the arrangement region of the plurality of the movable plates **171**.

That is, the recess **173** includes the reference arrangement range A1 of the caster **33***a* of the chair **3** when viewed from the Z-axis direction. The recess **173** is covered by a lid part

174. The lid part **174** has a plurality of through holes **174***a* arranged in the Y-axis direction, and the movable plates **171** are inserted into the respective through holes **174***a* in the Z-axis direction.

In some embodiments, at this time, the lid part **174** has a thickness in the Z-axis direction that can support the movable plates **171** in such a way that the movable plates **171** are not inclined in the Y-axis direction while they are inserted into the through holes **174***a*. The elastic body **172** is arranged inside the recess part **173** and energizes the movable plates **171** to the Z-axis positive side.

With such a configuration, in the initial state of the restriction mechanism **170**, all the movable plates **171** project from the lid part **174** to the Z-axis positive side. When the user U performs a lower limb exercise using the restriction mechanism **170**, for example, the user U pushes the movable plates **171** with his/her foot or the like to move the movable plates **171** to the Z-axis negative side to house the movable plates **171** inside of the recess part **173** while moving one caster **33***a* on the Y-axis negative side of the chair **3** to the Y-axis negative side to arrange it on the Z-axis positive side of the plurality of movable plates **171**.

Next, when the user U releases his/her foot pushing the movable plates **171**, the movable plates **171** on which the caster **33***a* is not arranged on the Z-axis positive side are moved to the Z-axis positive side to return to the initial state, because the movable plates **171** are energized to the Z-axis positive side by the elastic body **172**.

Then, the caster **33***a* is sandwiched in the Y-axis direction by the movable plates **171** arranged on the Y-axis negative side of the caster **33***a* of the chair **3** and the movable plates **171** arranged on the Y-axis positive side of the caster **33***a*, and the caster **33***a* is arranged inside the reference arrangement range A**1**. At this time, the end of the movable plate **171** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the movable plates **171** arranged on the Y-axis positive side of the caster **33***a* to the Y-axis positive side, but the movable plates **171** are energized to the Z-axis positive side by the elastic body **172**.

As a result, the movement of the movable plates **171** to the Z-axis negative side is restricted, and the state in which the movable plates **171** project from the lid part **174** to the Z-axis positive side is maintained. Moreover, the end of the movable plate **171** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

Therefore, the movement of the caster **33***a* of the chair **3** from the reference arrangement range A**1** to the Y-axis positive side can be restricted. Moreover, since the caster **33***a* is sandwiched from the Y-axis direction, the movement of the caster **33***a* from the reference arrangement range A**1** to the Y-axis negative side can also be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be easily separated if the user U pushes the movable plates **171** arranged on the Y-axis positive side of the caster **33***a* using his/her foot or the like to move the movable plates **171** to the Z-axis negative side and house them inside the recess part **173** while moving the chair **3** to the Y-axis positive side.

Ninth Embodiment

FIG. **15** is a side view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **15**, a restriction mechanism **180** according to this embodiment includes a base part **181** and projections **182**. The position of the restriction mechanism **180** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The base part **181** is a plate member approximately parallel to the XY plane. Each of the projections **182** is, for example, a plate-shaped elastic member inclined to the Z-axis positive side toward the Y-axis negative side. The plurality of the projections **182** are fixed to the surface of the base part **181** on the Z-axis positive side at intervals in the Y-axis direction. However, each of the projections **182** is not limited to a plate shape and may be a pin shape. In some embodiments, the base part **181** and the projections **182** are integrally formed of an elastic material.

Such a restriction mechanism **180** may be fixed in a region on the Y-axis positive side of the exercise equipment **2** in the floor surface FL of the facility or may be fixed to a surface of the base part **41** on the Z-axis positive side so that, when viewed from the Z-axis direction, the restriction mechanism **180** is arranged in a region including the reference arrangement range A**1** of the caster **33***a* of the chair **3**.

When the user U performs a lower limb exercise using the restriction mechanism **180**, for example, the user U moves one caster **33***a* on the Y-axis negative side of the chair **3** to the Y-axis negative side on the Z-axis positive side of the plurality of projections **182** to arrange it inside the reference arrangement range A**1**.

At this time, since the projection **182** is an elastic member, the projections **182** in which the caster **33***a* is not arranged on the Z-axis positive side return to the state of being inclined to the Z-axis positive side toward the Y-axis negative side. Also, the end of the projections **182** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**.

In such a state, when the user U performs a lower limb exercise, the caster **33***a* of the chair **3** pushes the projections **182** arranged on the Y-axis positive side of the caster **33***a* to the Y-axis positive side, but the projections **182** made of elastic members exert a counterclockwise restoring force when viewed from the Z-axis positive side.

This restricts the clockwise rotation of the projections **182** and maintains the projections **182** projecting from the base part **181** to the Z-axis positive side. Moreover, the end of the projections **182** on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a* of the chair **3**. Therefore, the movement of the caster **33***a* from the reference arrangement range A**1** to the Y-axis positive side can be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be easily separated if the user U moves the caster **33***a* of the chair **3** to the Y-axis positive side while rotating counterclockwise the projections **182** arranged on the Y-axis positive side of the caster **33***a* using his/her foot or the like and pushing them down.

Tenth Embodiment

FIG. **16** is a perspective view showing a specific configuration of a restriction mechanism according to this embodiment. As shown in FIG. **16**, a restriction mechanism **190** according to this embodiment includes a clamp mechanism **191** in addition to the base part **41**. For example, by fixing the clamp mechanism **191** to the base part **41**, the position

of the restriction mechanism **190** relative to the exercise equipment **2** is constrained in the region on the Y-axis positive side of the exercise equipment **2**.

The clamp mechanism **191** is composed of, for example, a general cam-type toggle clamp mechanism, and has a configuration in which a clamp part **191***b* is opened and closed by pushing and pulling a handle **191***a* in the Y-axis direction.

At this time, the clamp part **191***b* forms, when viewed from the Z-axis direction, a ring shape that can house the pivot axis AX**3** of the caster **33***a* of the chair **3** while the clamp part **191***b* is closed. A region inside the clamp part **191***b* in a closed state when viewed from the Z-axis direction overlaps the reference arrangement range A**1** of the caster **33***a* of the chair **3**.

When the user U performs a lower limb exercise using such a restriction mechanism **190**, the user U moves one caster **33***a* on the Y-axis negative side of the chair **3** to the Y-axis negative side and arranges the pivot axis AX**3** of the caster **33***a* inside the clamp part **191***b* in an open state.

Next, the user U operates the handle **191***a* to close the clamp part **191***b*, moves the caster **33***a* of the chair **3** to the Y-axis positive side to bring the pivot axis AX**3** of the caster **33***a* into contact with the end of the inner periphery of the clamp part **191***b* in a closed state on the Y-axis positive side, and arranges the caster **33***a* inside the reference arrangement range A**1**. At this time, the end of the clamp part **191***b* on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a*.

In such a state, when the user U performs a lower limb exercise, the pivot axis AX**3** of the caster **33***a* of the chair **3** pushes the clamp part **191***b* of the clamp mechanism **191** to the Y-axis positive side, but the clamp part **191***b* is in the closed state. Moreover, the end of the clamp part **191***b* on the Z-axis positive side is arranged on the Z-axis positive side of the center of the caster **33***a*. Therefore, the movement of the caster **33***a* from the reference arrangement range A**1** to the Y-axis positive side can be restricted.

When the lower limb exercise is finished and the chair **3** is moved to the Y-axis positive side of the exercise equipment **2** to separate the exercise equipment **2** and the chair **3**, the exercise equipment **2** and the chair **3** can be easily separated if the user U operates the handle **191***a* of the clamp mechanism **191** to open the clamp part **191***b* and moves the chair **3** to the Y-axis positive side.

Although the clamp part **191***b* of the clamp mechanism **191** according to this embodiment forms a ring shape in the closed state, as shown in FIG. **17**, it may be configured to sandwich the caster **33***a* of the chair **3**. Although the restriction mechanism **190** according to this embodiment is fixed to the exercise equipment **2** through the base part **41**, it may be detachably coupled to the exercise equipment **2**.

Another Embodiment

In the restriction mechanisms according to the above embodiments, for example, the contact part or the like is arranged based on the reference arrangement range A**1** at one place of the caster **33***a* of the chair **3**. Alternatively, a plurality of contact parts or the like may be arranged in the Y-axis direction.

For example, as shown in FIG. **18**, a plurality of protruding contact parts **201** may be arranged in the Y-axis direction. In this way, the contact parts **201** can be selected appropriately according to the length of the user U's leg. That is, the reference arrangement range A**1** of the caster **33***a* of the chair **3** can be changed appropriately according to the user U. It is also possible to arrange a plurality of the contact parts according to the first to tenth embodiment in the Y-axis direction and to make it possible to adjust the reference arrangement range A**1** of the caster **33***a* in the Y-axis direction.

The lower limb exercise device according to the above embodiment may include a moving mechanism to move the contact part in the Y-axis direction of the exercise equipment **2**. Also in this case, the position of the contact part in the Y-axis direction can be adjusted appropriately according to the length of the user U's leg. In some embodiments, in this case, the moving mechanism is configured in such a way that the contact part or the like can be moved in the Y-axis direction of the exercise equipment **2**, for example, the contact part or the like can be moved by driving the moving mechanism with a motor or operating a lever.

In some embodiments, the moving mechanism is configured so that the relative position between the exercise equipment **2** and the contact part can be adjusted, for example, by coupling the exercise equipment **2** to the contact part with a linear guide including a lock mechanism that can change the relative position between the exercise equipment **2** and the contact part. Thus, the position of the reference arrangement range A**1** of the caster **33***a* can be adjusted in the Y-axis direction.

For example, as shown in FIGS. **19** to **22**, the restriction mechanism may be composed of a constraint mechanism for constraining the chair **3** by driving one end **202***b* of a constraint part **202** by a motor (e.g., elastic part **203**), a lever operation **204**, or the like, while the other end **202***a* of the constraint part **202** is fixed in the region of the reference arrangement range A**1** on the Y-axis negative side, and pulling (stretching) the plurality of the casters **33** of the chair **3** from the Y-axis positive side to the Y-axis negative side, or winding (rotating) so as to wrap the casters **33**, and fixing the one end **202***b* of the constraint part **202**. In this case, the constraint part **202** may not constrain the plurality of casters **33** of the chair **3**, and instead may constrain only the caster **33***a*. Thus, the position of the reference arrangement range A**1** of the caster **33***a* can be adjusted in the Y-axis direction.

In short, the restriction mechanism may be configured to restrict the movement of the caster **33***a* of the chair **3** from the reference arrangement range A**1** to at least the Y-axis positive side. Therefore, the contact part may be, for example, a plate member arranged near the end of the reference arrangement range A**1** of the caster **33***a* of the chair **3** on the Y-axis positive side or may be a plurality of pin members arranged in the X-axis direction.

In some embodiments, the restriction mechanism has a configuration in which the restriction of movement of the caster **33***a* of the chair **3** to the Y-axis negative side becomes less than the restriction of movement thereof to the Y-axis positive side. With such a configuration, once the caster **33***a* is moved to the Y-axis negative side after the lower limb exercise is finished, and then the chair **3** is moved to the Y-axis positive side so as to avoid the restriction mechanism, the exercise equipment **2** and the chair **3** can be easily separated.

From the disclosure thus described, it will be obvious that the embodiments of the disclosure may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the disclosure, and all such modifications as would be obvious to one skilled in the art are intended for inclusion within the scope of the following claims.

What is claimed is:

1. A lower limb exercise device for enabling a user to perform a lower limb exercise while the user is seated on a chair, the lower limb exercise device comprising:

exercise equipment for the user to perform the lower limb exercise; and

a restriction mechanism configured to restrict movement of at least one caster of the chair from a reference arrangement range of the caster during the lower limb exercise,

wherein the restriction mechanism includes a contact part where the caster that moves away from the exercise equipment is brought into contact,

wherein a position of the contact part relative to the exercise device is constrained in a region on a side moving away from the exercise equipment in a front-rear direction of the lower limb exercise device,

wherein an upper end of the contact part is arranged higher than a center of the caster with the caster arranged inside the reference arrangement range and the contact part arranged at an uppermost position, and

wherein the contact part is a movable plate that can move in an up-down direction of the lower limb exercise device and is energized upward of the lower limb exercise device.

2. The lower limb exercise device according to claim 1, wherein an upper part of the restriction mechanism is open.

3. The lower limb exercise device according to claim 1, wherein the restriction mechanism is capable of adjusting a position of the reference arrangement range of the caster in the front-rear direction.

4. The lower limb exercise device according to claim 3, wherein the position of the reference arrangement range of the caster is made adjustable in the front-rear direction by providing a plurality of the restriction mechanisms in the front-rear direction of the lower limb exercise device.

5. The lower limb exercise device according to claim 3, wherein the position of the reference arrangement range of the caster is made adjustable in the front-rear direction by moving the restriction mechanism in the front-rear direction of the lower limb exercise device.

6. The lower limb exercise device according to claim 1, wherein a plurality of the contact parts are arranged in the front-rear direction of the lower limb exercise device.

7. The lower limb exercise device according to claim 1, wherein the restriction mechanism is detachable from the exercise equipment.

8. A lower limb exercise system comprising:

the lower limb exercise device according to claim 1; and

the chair.

9. The lower limb exercise system according to claim 8, wherein

the exercise equipment comprises:

a pair of left and right pedals on which the user's feet are placed; and

a rotation mechanism configured to rotate the pedals by the user's feet pushing down the pedals.

10. A lower limb exercise device for enabling a user to perform a lower limb exercise while the user is seated on a chair, the lower limb exercise device comprising:

exercise equipment for the user to perform the lower limb exercise; and

a restriction mechanism configured to restrict movement of at least one caster of the chair from a reference arrangement range of the caster during the lower limb exercise,

wherein the restriction mechanism includes a grounding part of the caster, a position of the grounding part relative to the exercise equipment is constrained in a region on a side moving away from the exercise equipment in a front-rear direction of the lower limb exercise equipment, and a frictional force on the side moving away from the exercise equipment is greater than a frictional force on the side of the exercise equipment,

wherein the grounding part includes a projection that is inclined upward of the lower limb exercise device toward the exercise equipment, and

wherein the projection is made of an elastic body and a plurality of the projections are arranged in the front-rear direction of the lower limb exercise device.

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