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LEVER DEVICE AND WORKING MACHINE INCLUDING THE SAME

Abstract

A lever device includes a switching mechanism to switch a direction of a biasing force of a tension spring on a lever rotatably supported by a movable body via a second support shaft. The switching mechanism includes a rotational body to rotate together with the lever and including a first spring hook portion and a first engagement portion positioned with an axis of the second support shaft therebetween, and a link rotatably supported by the movable body via a third support shaft and including a second spring hook portion and a second engagement portion positioned with an axis of the third support shaft therebetween. As the first engagement portion is moved by rotation of the rotational body about the second support shaft, the second engagement portion rotates about the third support shaft to move the second spring hook portion to a side to which the first spring hook portion moves.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation application of International Application No. PCT/JP2023/046115, filed on Dec. 22, 2023, which claims the benefit of priority to Japanese Patent Application No. 2022-208916, filed on Dec. 26, 2022. The entire contents of each of these applications are hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION
1. Field of the Invention
[0002] The present invention relates to lever devices and working machines including such lever devices.
2. Description of the Related Art
[0003] A lever device disclosed in Japanese Unexamined Patent Application Publication No. 2019-116753 is known.
[0004] A lever device disclosed in Japanese Unexamined Patent Application Publication No. 2019-116753 includes a movable body supported by a fixed body (support bracket) fixed to a machine body so as to be rotatable between a lowered position and a raised position in which the movable body has rotated upward from the lowered position, and a lever to be operated to rotate the movable body. The lever is operable between a pushed-down position and a pulled-up position in which the lever has been pulled up from the pushed-down position, and the movable body is rotationally operated between the lowered position and the raised position by the lever being operated between the pushed-down position and the pulled-up position. Also, the lever is held in the pushed-down position and the pulled-up position by the biasing force of a tension spring. The direction of the biasing force of the tension spring is switched by a switching mechanism. The switching mechanism switches the direction of the biasing force of the tension spring so that the biasing force acts in a direction in which the lever is pulled down in the pushed-down position and the biasing force acts in a direction in which the lever is pulled up in the pulled-up position.
SUMMARY OF THE INVENTION
[0005] However, depending on the location at which the lever device is installed, there is a case where the rotation angle (rotation amount) of the movable body cannot be made large. When the rotation angle of the movable body is small, the rotation angle of the lever cannot be made large, and it is difficult to sufficiently exert the biasing force of the tension spring on the lever in the pushed-down position and the pulled-up position.
[0006] Example embodiments of the present invention provide lever devices each of which is capable of exerting a biasing force of a tension spring on a lever even when an angle of rotation of a movable body is small, and working machines each including such lever devices.
[0007] A lever device according to an example embodiment of the present invention includes a fixed body, a movable body rotatably supported by the fixed body via a first support shaft, a lever to be operated to rotate the movable body about the first support shaft, the lever being supported by a second support shaft provided at the movable body such that the lever is rotatable between a pushed-down position and a pulled-up position, the pulled-up position being a position of the lever

rotated upward from the pushed-down position, a tension spring to bias the lever, and a switching mechanism to switch a direction of a biasing force of the tension spring to change between when the lever is in the pushed-down position and when the lever is in the pulled-up position such that the biasing force of the tension spring acts in a direction in which the lever is pulled down when the lever is in the pushed-down position and acts in a direction in which the lever is pulled up when the lever is in the pulled-up position, wherein the switching mechanism includes a rotational body to rotate together with the lever about the second support shaft, the rotational body including a first spring hook portion and a first engagement portion positioned such that an axis of the second support shaft is located between the first spring hook portion and the first engagement portion, and a link rotatably supported by the movable body via a third support shaft, the link including a second spring hook portion and a second engagement portion positioned such that an axis of the third support shaft is located between the second spring hook portion and the second engagement portion, the tension spring is connected between the first spring hook portion and the second spring hook portion, and the link is positioned such that the first engagement portion and the second engagement portion are engageable with each other and such that the first engagement portion is movable by rotation of the rotational body about the second support shaft to cause the second engagement portion to move and rotate about the third support shaft to move the second spring hook portion to a side to which the first spring hook portion moves.

[0008] One of the first engagement portion and the second engagement portion may include a pin parallel to the second support shaft or the third support shaft. The other of the first engagement portion and the second engagement portion may include a groove or a hole to receive the pin.

[0009] A side to which the first spring hook portion moves when the lever is pulled up may be a first side, and a side opposite to the first side may be a second side. The lever device may be configured such that the direction of the biasing force of the tension spring which acts on the lever as the lever is operated is switched between the direction in which the lever is pulled down and the direction in which the lever is pulled up because, when the lever is pulled up and the rotational body rotates about the second support shaft, the first spring hook portion moves to the first side while the first engagement portion and the second engagement portion move to the second side and the second spring hook portion moves to the first side, and when the lever is pushed down and the rotational body rotates about the second support shaft, the first spring hook portion moves to the second side while the first engagement portion and the second engagement portion move to the first side and the second spring hook portion moves to the second side.

[0010] The movable body may be rotatable between a lowered position and a raised position, the raised position being a position of the movable body rotated upward from the lowered position about the first support shaft. The pushed-down position of the lever may correspond to the lowered position of the movable body. The lever may be configured to be operated to a raising-operation position which is a position of the lever operated to rotate the movable body to the raised position. The pulled-up position of the lever may be a position of the lever further pulled up from the raising-operation position relative to the movable body in the raised position.

[0011] The lever device may further include a guide body provided at the fixed body, and a guide plate including a guide groove to receive the guide body and configured to rotate together with the lever about the second support shaft. The guide groove may include a first groove portion to restrict the movable body in the lowered position from rotating in a raising direction and allow the lever to rotate in the direction in which the lever is pulled up, a second groove portion to allow the movable body to rotate by an operation of the lever, and a third groove portion to restrict the movable body in the raised position from rotating in the raising direction and allow the lever to rotate about the second support shaft. The third groove portion may include a locking portion to restrict the movable body from rotating in a lowering direction from the raised position when the lever is in the pulled-up position.

[0012] The movable body may include a support tube to rotatably support the second support shaft

about an axis thereof. The lever may be attached to the second support shaft at one of opposite ends in an axial direction of the support tube. The guide plate may be fixed to the second support shaft at the other of the opposite ends in the axial direction of the support tube.
[0013] A working machine according to an example embodiment of the present invention includes the above-described lever device.
[0014] The lever may be an operation lock lever to switch one or more actuators included in the working machine between an operable state and an inoperable state.
[0015] The above and other elements, features, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of the example embodiments with reference to the attached drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0016] A more complete appreciation of example embodiments of the present invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings described below.
[0017] FIG. **1** is an overall side view of a working machine.
[0018] FIG. **2** is a perspective view of a machine body and an operation unit.
[0019] FIG. **3** is a perspective view illustrating a state in which a manipulating device is supported by a support frame.
[0020] FIG. **4** is a side view of the manipulating device in a lowered position with a console cover removed.
[0021] FIG. **5** is a side view of the manipulating device in a raised position with the console cover removed.
[0022] FIG. **6** is a perspective view of the manipulating device with the console cover removed.
[0023] FIG. **7** is a perspective view of the manipulating device with the console cover removed.
[0024] FIG. **8** is a perspective view of the manipulating device with the console cover removed.
[0025] FIG. **9** is a perspective view of a fixed body and the like.
[0026] FIG. **10** is a perspective view of a movable body, a switching mechanism, and the like.
[0027] FIG. **11** is a perspective view of the movable body.
[0028] FIG. **12** is an exploded perspective view of the switching mechanism and its surroundings.
[0029] FIG. **13** is a perspective view of the switching mechanism.
[0030] FIG. **14** is a schematic side view of the movable body in the lowered position, a lever, and the switching mechanism.
[0031] FIG. **15** is an enlarged view of the switching mechanism in FIG. **14**.
[0032] FIG. **16** is a schematic side view of the movable body in the middle of rotation, the lever, and the switching mechanism.
[0033] FIG. **17** is an enlarged view of the switching mechanism in FIG. **16**.
[0034] FIG. **18** is a schematic side view of the movable body in the middle of rotation, the lever, and the switching mechanism.
[0035] FIG. **19** is an enlarged view of the switching mechanism in FIG. **18**.
[0036] FIG. **20** is a schematic side view of the movable body in the raised position, the lever, and the switching mechanism.
[0037] FIG. **21** is an enlarged view of the switching mechanism in FIG. **20**.
[0038] FIG. **22** is a schematic side view of the lever in a pulled-up position, the movable body in the raised position, and the switching mechanism.
[0039] FIG. **23** is an enlarged view of the switching mechanism in FIG. **22**.

DETAILED DESCRIPTION OF THE EXAMPLE EMBODIMENTS

[0040] Example embodiments will now be described with reference to the accompanying drawings, wherein like reference numerals designate corresponding or identical elements throughout the various drawings. The drawings are to be viewed in an orientation in which the reference numerals are viewed correctly.

[0041] Hereinafter, example embodiments of the present invention will be described with reference to the drawings as appropriate.

[0042] FIG. **1** is a schematic side view illustrating an overall configuration of a working machine **1** according to the present example embodiment. In the present example embodiment, a backhoe, which is a turning working machine, is exemplified as the working machine **1**.

[0043] As illustrated in FIG. **1**, the working machine **1** includes a machine body (turning base) **2**, a traveling device **3**, and a working device **4**. An operator's seat **6** on which an operator (driver) is seated and four-pillar-type ROPS **15** are mounted on the machine body **2**. The ROPS **15** has a canopy specification including a roof **19**.

[0044] In the present example embodiment, a direction toward the front of the operator seated on the operator's seat **6** of the working machine **1** (arrow A**1** direction in FIG. **1**) is described as a forward side (machine-body forward side), a direction toward the rear of the operator (arrow A**2** direction in FIG. **1**) is described as a rearward side (machine-body rearward side), and an arrow A**3** direction in FIG. **1** is described as a front-rear direction (machine-body front-rear direction). Also, a direction toward the left of the operator (near side in FIG. **1**) is described as a leftward side, and a direction toward the right of the operator (far side in FIG. **1**) is described as a rightward side.

[0045] Also, a horizontal direction that is a direction orthogonal to the front-rear direction A**3** is described as a machine-body width direction. A direction from a central portion to a right portion or a left portion in a width direction of the machine body **2** is described as an outward side in the machine-body width direction. That is, the outward side in the machine-body width direction is a direction away from the center in the width direction of the machine body **2** in the machine-body width direction. A direction opposite to the outward side in the machine-body width direction is described as an inward side in the machine-body width direction. That is, the inward side in the machine-body width direction is a direction toward the center in the width direction of the machine body **2** in the machine-body width direction.

[0046] As illustrated in FIG. **1**, the traveling device **3** is a crawler type traveling device that supports the machine body **2** such that the machine body **2** is allowed to travel, and includes a traveling frame **3**A, a first traveling device **3**L provided leftward of the traveling frame **3**A, and a second traveling device **3**R provided rightward of the traveling frame **3**A. The first traveling device **3**L and the second traveling device **3**R are driven by a traveling motor M**1** which is a hydraulic motor (hydraulic actuator). In the present example embodiment, the crawler type traveling device **3** is used, but this does not imply any limitation, and a wheel type traveling device or the like may be used. A dozer device **7** is attached to a front portion of the traveling device **3**. The dozer device **7** can be driven by a dozer cylinder which is a hydraulic cylinder (hydraulic actuator).

[0047] As illustrated in FIG. **1**, the machine body **2** includes a turning base plate **5** that includes a thick plate material and defines a bottom portion of the machine body **2** (see FIG. **3**). The turning base plate **5** is supported on the traveling frame **3**A of the traveling device **3** via a turning bearing **8** so as to be turnable about a turning axis X**1** that is an axis extending in an up-down direction. The turning base plate **5** is driven to turn about the turning axis X**1** by a turning motor (not illustrated). Additionally, the machine body **2** includes, in a front portion thereof, a support bracket **9** and a swing bracket **10** that support the working device **4**. The support bracket **9** protrudes forward from the machine body **2**. Specifically, the support bracket **9** is fixed to a front portion of the turning base plate **5** and protrudes forward from the turning base plate **5**. The swing bracket **10** is attached to a front portion of the support bracket **9** so as to be swingable about a vertical axis (an axis extending in the up-down direction). A hood **14** that covers a mounted object such as a prime

mover (engine) is provided on the machine body **2**. A weight **25** that balances the weight with the working device **4** is provided at a rear portion of the machine body **2**. The working machine **1** of the present example embodiment is a compact backhoe, and the operator's seat **6** is provided above the prime mover (prime mover chamber).

[0048] As illustrated in FIG. **1**, the working device **4** includes a boom **11**, an arm **12**, and a bucket **13**. A proximal portion of the boom **11** is pivotally attached to an upper portion of the swing bracket **10** so as to be rotatable about a horizontal axis (an axis extending in the machine-body width direction). The arm **12** is pivotally attached to a distal end portion of the boom **11** so as to be rotatable about a horizontal axis. The bucket **13** is provided at a distal end portion of the arm **12** so as to be capable of performing a shoveling motion and a dumping motion. The shoveling motion is a motion of swinging the bucket **13** in a direction toward the boom **11**, and is, for example, a motion of shoveling earth and sand or the like. Also, the dumping motion is a motion of swinging the bucket **13** in a direction away from the boom **11**, and is, for example, a motion of dropping (discharging) shoveled earth and sand or the like.

[0049] The swing bracket **10** is swingable by extension/contraction of a swing cylinder (not illustrated). The boom **11** is swingable by extension/contraction of a boom cylinder C**2**. The arm **12** is swingable by extension/contraction of an arm cylinder C**3**. The bucket **13** is capable of performing the shoveling motion and the dumping motion by extension/contraction of a bucket cylinder C**4**. The swing cylinder, the boom cylinder C**2**, the arm cylinder C**3**, and the bucket cylinder C**4** are hydraulic cylinders (hydraulic actuators).

[0050] As illustrated in FIG. **2**, an operation unit **18** is mounted on the machine body **2**. The operation unit **18** includes the operator's seat **6**, a traveling lever **16** (see FIG. **1**) provided forward of the operator's seat **6**, a manipulating device (left manipulating device) **17**L provided leftward of the operator's seat **6** and a manipulating device (right manipulating device) **17**R provided rightward of the operator's seat **6**, and the like. The traveling lever **16** is an operation member that operates the traveling device **3**. The manipulating devices **17**L and **17**R are devices that perform, for example, a swinging operation of the boom **11**, a swinging operation of the arm **12**, operations of the shoveling motion and the dumping motion of the bucket **13**, a turning operation of the machine body **2**, and the like. A floor portion **21** on which the operator places his/her feet is provided on an upper surface of the machine body **2** and forward of the operator's seat **6**. The floor portion **21** includes, for example, a floor mat being laid on a step plate that is provided above the turning base plate **5** with a space therebetween and supported by the turning base plate **5**.

[0051] As illustrated in FIG. **3**, the left manipulating device **17**L is attached to a support frame **20**. The support frame **20** is a frame that supports the hood **14**, the operator's seat **6**, the ROPS **15**, and the like, and is attached to a member fixed on the turning base plate **5**. The left manipulating device **17**L includes a console cover **22**, a manipulating lever (left manipulating lever) **23**L, a remote control valve **24**, an armrest **26**L, and a lever device **27**.

[0052] The console cover **22** covers the remote control valve **24**, the lever device **27**, and the like. The left manipulating lever **23**L is provided at a front and upper portion of the left manipulating device **17**L, and is operable to be pivoted forward/rearward and leftward/rightward. The remote control valve **24** is a pilot valve that is operated with the left manipulating lever **23**L, and is provided below the left manipulating lever **23**L. The remote control valve **24** is housed in the console cover **22**. The armrest **26**L is a structure on which an elbow and the like of the operator is placed, and is provided rearward of the left manipulating lever **23**L.

[0053] As illustrated in FIGS. **4** to **8**, the lever device **27** includes a lever **30**, a fixed body **31**, a movable body **32**, a tension spring **47**, a switching mechanism **33**, and a guide plate **52**. A front portion of the lever **30** protrudes forward from the console cover **22** (see FIG. **2**). A proximal portion of the lever **30**, the movable body **32**, the tension spring **47**, and the switching mechanism **33** are covered with the console cover **22**.

[0054] As illustrated in FIG. **2**, the right manipulating device **17**R includes a console cover **34**, a

manipulating lever (right manipulating lever) **23**R, a remote control valve (not illustrated), an armrest **26**R, a dozer lever **35**, and a plurality of switches **36**.

[0055] The console cover **34** covers a frame of the right manipulating device **17**R. The frame of the right manipulating device **17**R is attached to the machine body **2**. The right manipulating lever **23**R is provided at a front and upper portion of the right manipulating device **17**R, and is operable to be pivoted forward/rearward and leftward/rightward. The remote control valve is a pilot valve that is operated with the right manipulating lever **23**R, and is provided below the right manipulating lever **23**R and covered with the console cover **34**. The armrest **26**R is a structure on which an elbow and the like of the operator is placed, and is provided rearward of the right manipulating lever **23**R. The dozer lever **35** is a lever that operates the dozer device **7**. The plurality of switches **36** are provided at an upper surface of the console cover **34**, and are switches that operate various devices provided in the working machine **1**.

[0056] The left manipulating lever **23**L (remote control valve **24**) can operate two operation targets (hydraulic actuators) provided in the working machine **1**. For example, the left manipulating lever **23**L can operate the turning motor that turns the machine body **2** (can operate the machine body **2** to turn) and can operate the arm cylinder C**3** (can operate the arm **12** to swing).

[0057] The right manipulating lever **23**R can also operate two operation targets (hydraulic actuators) provided in the working machine **1**. For example, the right manipulating lever **23**R can operate the boom cylinder C**2** (can operate the boom **11** to swing) and can operate the bucket cylinder C**4** (can operate the bucket **13** to swing).

[0058] As illustrated in FIG. **2**, the operation unit **18** is provided with a seatbelt device. The seatbelt device includes a seatbelt to which a tongue is attached, a belt winding structure **28** including a retractor that winds and stores the seatbelt, and a buckle **29** that is engaged with the tongue. The belt winding structure **28** is provided leftward of a rear and lower portion of the operator's seat **6**, and in the vicinity of the rear of the left manipulating device **17**L. The belt winding structure **28** is attached to a stay (not illustrated) provided leftward of a rear and lower portion of the ROPS **15**. The buckle **29** is provided rightward of the rear and lower portion of the operator's seat **6**.

[0059] Next, the lever device **27** of the present example embodiment will be first schematically described.

[0060] The lever **30** is an operation lock lever (unload lever) that switches a hydraulic actuator mounted on the working machine **1** between an operable state and an inoperable state, and the lever device **27** is an operation lock lever device (unload lever device) including the operation lock lever. Thus, in the following description, the lever device **27** is described as the operation lock lever device, and the lever **30** is described as the operation lock lever. However, the lever device **27** is not limited to the operation lock lever device (unload lever device), and the lever **30** is not limited to the operation lock lever (unload lever). For example, the lever **30** may be an operation lock lever that switches an electric actuator (not illustrated) included in the working machine **1** between an operable state and an inoperable state, instead of the hydraulic actuator described above or in addition to the hydraulic actuator described above. Additionally or alternatively, the lever **30** may be an operation lock lever that outputs a signal to switch an actuator included in the working machine **1** between an operable state and an inoperable state to a controller that controls a motion of the actuator. Also, the lever **30** may be used for another purpose without being limited to the purpose of use for locking the operation of the actuator.

[0061] Next, respective portions (the operation lock lever **30**, the fixed body **31**, the movable body **32**, the tension spring **47**, the switching mechanism **33**, the guide plate **52**, and the like) of the lever device **27** will be described.

[0062] The operation lock lever **30** is operated to rotate the movable body **32** upward or downward (operated to raise or lower the movable body **32**). As illustrated in FIG. **6**, the operation lock lever **30** includes a lever proximal portion **30***b*, a lever main body **30***a*, and a grip **30***c*. The lever proximal portion **30***b* is rotatably supported by the movable body **32**. In other words, the operation

lock lever **30** is rotatably supported by the movable body **32**. In a use state of the left manipulating device **17**L illustrated in FIGS. **1** and **4**, a lower section **30***d* of the lever main body **30***a* is inclined obliquely forward and downward, and a front section **30***e* extends obliquely forward and upward from a front portion of the lower section **30***d*. The grip **30***c* is a section for being gripped and is provided on an upper portion of the front section **30***e* of the lever main body **30***a*. Also, the lever main body **30***a* is provided leftward of the left manipulating lever **23**L (see FIG. **2**). The operation lock lever **30** is located in a position to hinder the operator from getting on/off the working machine **1** in the use state of the left manipulating device **17**L. Also, in a non-use state of the left manipulating device **17**L illustrated in FIG. **5**, in which the operation lock lever **30** has rotated rearward and upward together with the movable body **32** from the use state, the operation lock lever **30** is located in a position retracted from a passage for the operator to get on/off.

[0063] As illustrated in FIG. **3**, the fixed body **31** is attached to the support frame **20**. Specifically, the fixed body **31** is fixed to a plurality of rods **37** fixed to the support frame **20** by bolts **38** (see FIG. **9**). As illustrated in FIG. **9**, the fixed body **31** includes a first structure **31**A and a second structure **31**B made of plate materials. The first structure **31**A defines an upper and front portion of the fixed body **31**, and the second structure **31**B defines a rear and lower portion of the fixed body **31**.

[0064] As illustrated in FIG. **9**, a support shaft (first support shaft) **39** is provided at the rear and lower portion (second structure **31**B) of the fixed body **31**. Specifically, the first support shaft **39** has an axis extending in the machine-body width direction, has a right end portion fixed to the second structure **31**B, and protrudes leftward. A receiver **40** is provided at the upper and front portion of the fixed body **31** (first structure **31**A). The receiver **40** includes an elastic material **40**B such as rubber being fixed to a stay plate **40**A fixed to a front portion of the first structure **31**A. A guide body **43** is provided at an upper portion and a middle portion in the front-rear direction of the fixed body **31** (first structure **31**A). The guide body **43** includes a support pin **44**, a roller **46**, a washer **45**, and the like. The support pin **44** is a rod having an axis extending in the machine-body width direction, penetrates through the first structure **31**A, and is fixed to the first structure **31**A. The support pin **44** protrudes leftward from the first structure **31**A. The roller **46** is provided leftward of the first structure **31**A and is fitted onto the support pin **44** so as to be rotatable about the axis thereof. The washer **45** is fitted onto the support pin **44** on the left of the roller **46** and is prevented from coming off by a retaining pin (not illustrated). Alternatively, the guide body **43** may not include the roller **46**, the washer **45**, and the like. That is, the guide body **43** may only include the support pin **44**. Also, an attachment stay **41** is fixed to a left surface of an upper and rear portion of the fixed body **31** (first structure **31**A). A position restrictor (stopper) **42** is attached to the attachment stay **41**.

[0065] As illustrated in FIGS. **4** to **8**, the movable body **32** is provided with the left manipulating lever **23**L, the remote control valve **24**, the armrest **26**L, a detection switch **51**, the operation lock lever **30**, the tension spring **47**, the switching mechanism **33**, the guide plate **52**, and the like. The movable body **32** is supported by the first support shaft **39** provided at the fixed body **31** so as to be rotatable about the axis thereof.

[0066] The movable body **32** is rotatable (the position of the movable body **32** is changeable) between a lowered position P**1** illustrated in FIG. **4** and a raised position P**2** illustrated in FIG. **5**, which is a position of the movable body **32** rotated upward from the lowered position P**1** about the first support shaft **39**. When the movable body **32** is operated to the raised position P**2**, for example, the working device **4** (the boom cylinder C**2**, the arm cylinder C**3**, the bucket cylinder C**4**) and the machine body **2** (turning motor) are inoperable, and when the movable body **32** is operated to the lowered position P**1**, the working device **4** is operable and the machine body **2** is operable to turn.

[0067] In the raised position P**2**, all or main hydraulic actuators (the boom cylinder C**2**, the arm cylinder C**3**, the bucket cylinder C**4**, the swing cylinder, the dozer cylinder, the traveling motor M**1**, the turning motor, a hydraulic actuator detachably connected to a service port, and the like) of the

working machine **1** may be inoperable, that is, supply with a hydraulic fluid may be stopped.
[0068] In the present example embodiment, since the belt winding structure **28** is located rearward of the left manipulating lever **23**L, the rotation amount of the movable body **32** is limited by the belt winding structure **28** when the movable body **32** is rotated rearward from the lowered position P**1**. That is, the rotation angle of the movable body **32** from the lowered position P**1** to the raised position P**2** about the first support shaft **39** cannot be made large. In the present example embodiment, the rotation angle is 20°, for example. The rotation angle is not limited to this. For example, the rotation angle can be set to 15° to 25°, for example.
[0069] The operation lock lever **30** is operable to a pushed-down position S**1** illustrated in FIG. **4** and a pulled-up position S**2** illustrated in FIG. **5**. The pushed-down position S**1** corresponds to the lowered position P**1**, and the pulled-up position S**2** corresponds to the raised position P**2**.
[0070] In the following description, a direction in which the movable body **32** rotates upward from the lowered position P**1** is referred to as a raising direction, and a direction in which the movable body **32** rotates downward from the raised position P**2** is referred to as a lowering direction. Also, a direction in which the operation lock lever **30** rotates upward from the pushed-down position S**1** is referred to as a pull-up direction, and a direction in which the operation lock lever **30** rotates downward from the pulled-up position S**2** is referred to as a push-down direction.
[0071] As illustrated in FIGS. **10** and **11**, the movable body **32** includes a first wall portion **53** that is a left wall portion and a second wall portion **54** that is a right wall portion. The first wall portion **53** and the second wall portion **54** are provided with a space therebetween in the machine-body width direction. The movable body **32** includes a supported portion **55** supported by the first support shaft **39** so as to be rotatable about the axis thereof. The supported portion **55** includes a tube having an axis extending in the machine-body width direction, and is fixed to a lower portion of the first wall portion **53**. Specifically, a lower section **53***a* that is the lower portion of the first wall portion **53** is narrower in the front-rear direction as extending downward, and the supported portion **55** is fixed to a lower portion of the lower section **53***a*. Also, a left end portion of the supported portion **55** penetrates through the first wall portion **53** and is fixed thereto. Thus, the supported portion **55** protrudes rightward from the first wall portion **53** (the lower portion of the lower section **53***a*).
[0072] As illustrated in FIG. **9**, the supported portion **55** is fitted onto the first support shaft **39** from the left so as to be rotatable about the axis thereof. Also, the supported portion **55** is prevented from coming off from the first support shaft **39** by a bolt **58** screwed into a washer **56** and a screw hole **57** in the first support shaft **39**. Accordingly, the movable body **32** is supported by the fixed body **31** (first support shaft **39**) so as to be rotatable about an axis extending in the machine-body width direction.
[0073] As illustrated in FIGS. **10** and **11**, a contact **63** made of an elastic material is fixed to a front portion of a lower end portion of the second wall portion **54**. The contact **63** is in contact with the receiver **40** of the fixed body **31** when the movable body **32** is in the lowered position P**1** (see FIG. **8**). Accordingly, the rotation of the movable body **32** in the lowering direction is restricted. A contact plate **59** is fixed to a rear and lower portion of the second wall portion **54**. As illustrated in FIG. **5**, the contact plate **59** is in contact with the position restrictor **42** of the fixed body **31** when the movable body **32** is in the raised position P**2**. Accordingly, the rotation of the movable body **32** in the raising direction is restricted.
[0074] As illustrated in FIG. **10**, a support plate **60** is fixed to a middle portion in the machine-body width direction of the supported portion **55**. The support plate **60** is provided so that plate surfaces thereof face in the machine-body width direction, and the supported portion **55** penetrates through and is fixed to a lower portion of the support plate **60**. An assist spring **61** is provided rightward of the support plate **60**, on the supported portion **55**. That is, the assist spring **61** is provided between the support plate **60** and the second structure **31**B of the fixed body **31** (see FIG. **6**). The assist spring **61** includes a torsion coil spring having an axis extending in the machine-body width

direction, and is provided so that the supported portion **55** is inserted through the assist spring **61**. In other words, the assist spring **61** is loosely fitted onto the supported portion **55**. One end of the assist spring **61** is retained at the support plate **60**. As illustrated in FIG. **8**, another end of the assist spring **61** is retained at the second structure **31**B (fixed body **31**). The biasing force of the assist spring **61** acts in a direction in which the movable body **32** is rotated in the raising direction. The assist spring **61** assists the upward rotation operation of the movable body **32**.

[0075] As illustrated in FIG. **11**, the movable body **32** includes an attachment bracket **62** provided between a front and upper portion of the first wall portion **53** and a front portion of the second wall portion **54**. The attachment bracket **62** includes a front wall **62***a*, an upper wall **62***b*, and a rear wall **62***d*. The front wall **62***a* couples front end portions of the first wall portion **53** and the second wall portion **54** to each other. A front portion of the upper wall **62***b* couples upper end portions of the first wall portion **53** and the second wall portion **54** to each other. A right portion of the upper wall **62***b* extends rearward. Also, the upper wall **62***b* defines a valve attachment portion to which the remote control valve **24** is attached (see FIG. **4**). The rear wall **62***d* extends downward from a rear end of the right portion of the upper wall **62***b*. Also, the rear wall **62***d* is narrower than the distance between the first wall portion **53** and the second wall portion **54**, and is provided closer to the second wall portion **54** and fixed to the second wall portion **54**. An attachment stay **64** to attach the armrest **26**L is attached to an upper portion of the rear wall **62***d* (see FIG. **4**).

[0076] As illustrated in FIG. **11**, a support stay **65** is fixed to a lower portion of the rear wall **62***d*. Specifically, the support stay **65** is provided rearward of the lower portion of the rear wall **62***d* so that plate surfaces thereof face in the machine-body width direction, and is fixed to a rear surface of the rear wall **62***d*. A support tube **66** is provided between the support stay **65** and the second wall portion **54**. Specifically, a left portion of the support tube **66** penetrates through the support stay **65**, protrudes leftward from the support stay **65**, and is fixed to the support stay **65**. A right end portion of the support tube **66** penetrates through the second wall portion **54** and is fixed to the second wall portion **54**.

[0077] As illustrated in FIGS. **10** and **11**, the movable body **32** is provided with a pair of front and rear reinforcing plates **67**F and **67**R. A lower end of the front reinforcing plate **67**F is fixed to a front upper portion of the supported portion **55**, and the front reinforcing plate **67**F extends obliquely forward and upward from the supported portion **55** along a right surface of the first wall portion **53** and extends forward at an upper portion thereof. The front reinforcing plate **67**F is fixed to the right surface of the first wall portion **53** and the front wall **62***a* of the attachment bracket **62**. A lower end of the rear reinforcing plate **67**R is fixed to a rear upper portion of the supported portion **55**. The rear reinforcing plate **67**R has a first section **67***a* that extends obliquely rearward and upward from the supported portion **55** along the right surface of the first wall portion **53**, and a second section **67***b* that couples rear portions of the first wall portion **53** and the second wall portion **54**. The first section **67***a* is fixed to the right surface of the first wall portion **53** and is connected to a left portion of the second section **67***b*.

[0078] As illustrated in FIG. **4**, the detection switch **51** is attached to a rear portion of a left surface of the first wall portion **53** (movable body **32**). A contact plate **68** is provided below a front portion of the detection switch **51** and is fixed to the left surface of the first wall portion **53**. Also, a reinforcing portion **71** of the lever proximal portion **30***b* of the operation lock lever **30** is provided leftward of the first wall portion **53** and forward of the detection switch **51**.

[0079] As illustrated in FIGS. **12** and **13**, the lever proximal portion **30***b* includes a rotational body **69**, a coupling portion **70**, and the reinforcing portion **71**. The rotational body **69** includes a plate material including plate surfaces facing in the machine-body width direction and including a vertically long shape that is long in the up-down direction. The rotational body **69** is rotatably supported by the movable body **32** via a support shaft (second support shaft) **72**. Specifically, as illustrated in FIG. **13**, a support boss **73** including a tube is fixed to a middle portion in the longitudinal direction of a right surface of the rotational body **69**. The support boss **73** has an axis

extending in the machine-body width direction and is provided at the middle portion in the longitudinal direction of the rotational body **69**. Specifically, the support boss **73** is provided at a position higher than a central portion in the longitudinal direction of the rotational body **69**. As illustrated in FIG. **12**, the second support shaft **72** is inserted through the support tube **66** of the movable body **32** from the right, and is supported by the support tube **66** so as to be rotatable about an axis thereof. A left portion of the second support shaft **72** protrudes leftward from the support tube **66**, and the support boss **73** is fitted onto the portion of the second support shaft **72** protruding leftward from the support tube **66** and fixed by a pin, a screw, or the like. Thus, the rotational body **69** is supported by the support tube **66** so as to be rotatable about the axis extending in the machine-body width direction together with the second support shaft **72**. In other words, the lever proximal portion **30***b* (operation lock lever **30**) is supported by the movable body **32** so as to be rotatable about an axis extending in the machine-body width direction together with the second support shaft **72**.

[0080] As illustrated in FIGS. **12** and **13**, the coupling portion **70** couples the rotational body **69** and a proximal portion of the lever main body **30***a* (a rear portion of the lower section **30***d*). The coupling portion **70** includes a first section **70***a* integrally extending forward from the rotational body **69** and a second section **70***b* extending leftward from a front end of the first section **70***a*. The proximal portion of the lever main body **30***a* is fixed to a left portion of the second section **70***b*.

[0081] As illustrated in FIGS. **12** and **13**, the reinforcing portion **71** includes a first section **71***a* fixed to an upper end of the coupling portion **70** and a second section **71***b* extending downward from a left portion of the first section **71***a*. The second section **71***b* of the reinforcing portion **71** is located rearward of the second section **70***b* of the coupling portion **70**, and a rear end of the proximal portion of the lever main body **30***a* is fixed to the second section **71***b*. As illustrated in FIG. **4**, a lower portion of the second section **71***b* of the reinforcing portion **71** is located forward of the detection switch **51** (see FIG. **4**), and presses a contact of the detection switch **51** when the operation lock lever **30** is in the pushed-down position S**1**. The detection switch **51** is connected to a controller of a hydraulic circuit, and the controller brings a hydraulic fluid delivered from a hydraulic pump into a state of being able to be supplied to each hydraulic actuator in a state in which the contact of the detection switch **51** is pressed. The contact plate **68** restricts the second section **71***b* of the reinforcing portion **71** so as not to excessively press the contact of the detection switch **51**. The lower portion of the second section **71***b* of the reinforcing portion **71** is separated from the contact of the detection switch **51** as the operation lock lever **30** is rotated in the pull-up direction, and the controller brings the hydraulic fluid delivered from the hydraulic pump into a state of not being able to be supplied to each hydraulic actuator in a state in which the detection switch **51** does not detect the reinforcing portion **71**.

[0082] As illustrated in FIGS. **12** and **13**, the rotational body **69** is provided with a first spring hook portion **74** and a first engagement portion **75**. The first spring hook portion **74** is fixedly provided at one end portion in the longitudinal direction (upper portion) of the rotational body **69**, and the first engagement portion **75** is fixedly provided at another end portion in the longitudinal direction (lower portion) of the rotational body **69**. Also, the second support shaft **72** is located at the middle portion in the longitudinal direction of the rotational body **69**. Thus, as illustrated in FIGS. **14** and **15**, the first spring hook portion **74** and the first engagement portion **75** are positioned such that the axis of the second support shaft **72** is located between the first spring hook portion **74** and the first engagement portion **75**. As illustrated in FIG. **12**, the first spring hook portion **74** includes a pin having an axis extending in the machine-body width direction, has a right portion fixed to the rotational body **69**, and protrudes leftward from the rotational body **69**. As illustrated in FIG. **13**, the first engagement portion **75** includes a pin (parallel to the second support shaft **72** or a third support shaft **77**) having an axis extending in the machine-body width direction, and protrudes rightward from the rotational body **69**.

[0083] The tension spring **47** is a spring that biases the operation lock lever **30**.

[0084] As illustrated in FIGS. **12**, **13**, and **14**, the switching mechanism **33** includes the above-described rotational body **69**, and further includes a link **76**. In the present example embodiment, the rotational body **69** defining a portion of the switching mechanism **33** is common to the rotational body **69** defining the lever proximal portion **30***b*, but this does not imply any limitation. The rotational body **69** defining the switching mechanism **33** may be a body different from the rotational body **69** defining the lever proximal portion **30***b*. Even in this case, the rotational body **69** defining the switching mechanism **33** is provided so as to rotate together with the operation lock lever **30** about the second support shaft **72**.
[0085] The switching mechanism **33** switches the direction of the biasing force of the tension spring **47** between a direction in which the operation lock lever **30** is pulled down and a direction in which the operation lock lever **30** is pulled up in accordance with the rotation operation of the operation lock lever **30**. Specifically, the switching mechanism **33** switches the direction of the biasing force of the tension spring **47** to change between when the operation lock lever **30** is in the pushed-down position S**1** and when the operation lock lever **30** is in the pulled-up position S**2** such that the biasing force of the tension spring **47** acts in the direction in which the operation lock lever **30** is pulled down when the operation lock lever **30** is in the pushed-down position S**1** and acts in the direction in which the operation lock lever **30** is pulled up when the operation lock lever **30** is in the pulled-up position S**2**.
[0086] As illustrated in FIGS. **12**, **13**, and **14**, the link **76** is provided rightward of a lower portion of the rotational body **69**, and is rotatably supported by the movable body **32** via the support shaft (third support shaft) **77**. Specifically, the third support shaft **77** includes a rod having an axis extending in the machine-body width direction, and is fixed to a middle portion in the longitudinal direction of the link **76** so as to protrude rightward. The link **76** is provided leftward of the support plate **60** of the movable body **32**. A tubular boss portion **78** having an axis extending in the machine-body width direction is provided at an upper portion of the support plate **60**. The third support shaft **77** is inserted through the boss portion **78** of the support plate **60** so as to be rotatable about the axis extending in the machine-body width direction, and is prevented from coming off by a washer **79** and a retaining pin.
[0087] As illustrated in FIGS. **12**, **13**, and **14**, the link **76** includes a second spring hook portion **80** and a second engagement portion **81**. The second spring hook portion **80** is fixedly provided at one end portion in the longitudinal direction (lower portion) of the link **76**, and the second engagement portion **81** is fixedly provided at another end portion in the longitudinal direction (upper portion) of the link **76**. Also, the third support shaft **77** is fixed to the middle portion in the longitudinal direction of the link **76**. Thus, as illustrated in FIGS. **14** and **15**, the second spring hook portion **80** and the second engagement portion **81** are positioned such that the axis of the third support shaft **77** is located between the second spring hook portion **80** and the second engagement portion **81**.
[0088] The second spring hook portion **80** includes a pin having an axis extending in the machine-body width direction, includes a right portion fixed to the link **76**, and protrudes leftward from the link **76**.
[0089] As illustrated in FIGS. **13** and **14**, the second engagement portion **81** includes a groove that is elongated in the longitudinal direction of the link **76** and is open at an end portion of the link **76**. The first engagement portion **75** (pin) can be inserted into the groove (**81**) from an open side of the groove (**81**). The first engagement portion **75** is movable in the longitudinal direction in the groove (**81**). Thus, the link **76** is provided so that the first engagement portion **75** and the second engagement portion **81** are engaged with each other. Specifically, the link **76** is provided to butt against the lever proximal portion **30***b* such that the second engagement portion **81** engages with the first engagement portion **75**. Also, the link **76** rotates about the third support shaft **77** as the second engagement portion **81** moves as the first engagement portion **75** is moved by the rotation of the lever proximal portion **30***b* about the second support shaft **72**.
[0090] In the present example embodiment, the first engagement portion **75** includes the pin

parallel to the second support shaft **72** or the third support shaft **77**, and the second engagement portion **81** includes the groove with one end open, but this does not imply any limitation. The first engagement portion **75** may include the groove, and the second engagement portion **81** may include the pin. Also, the second engagement portion **81** includes the groove open at the end portion of the link **76**, but the second engagement portion **81** may include a hole (long hole) instead of the groove. The hole differs from the groove in the present example embodiment in that the open side of the groove is closed (the hole is defined by an annular edge). Also, when the second engagement portion **81** includes the pin, the first engagement portion **75** includes the groove or the hole (long hole).

[0091] As illustrated in FIG. **12**, the tension spring **47** includes a tension coil spring. The tension spring **47** is provided between the rotational body **69** and the second section **71***b* of the reinforcing portion **71** and inward (rightward) of the first wall portion **53** of the movable body **32**. The tension spring **47** is extended between the first spring hook portion **74** and the second spring hook portion **80**. Specifically, one end of the tension spring **47** is hooked on and retained at the first spring hook portion **74**. Another end of the tension spring **47** is hooked on and retained at the second spring hook portion **80**.

[0092] As illustrated in FIG. **12**, an insertion hole **82** through which a left end portion of the second spring hook portion **80** is inserted is provided in the lower portion of the first wall portion **53** of the movable body **32**. A lower edge of the insertion hole **82** is in a substantially arc shape centered on the third support shaft **77**, and an upper edge of the insertion hole **82** is in a substantially straight line shape. Since the biasing force of the tension spring **47** acts on the second spring hook portion **80** in the direction in which the second spring hook portion **80** is pulled up upward, the upper edge of the insertion hole **82** is in the straight line shape to provide a gap between the upper edge and the second spring hook portion **80** so that the second spring hook portion **80** is not pressed against the upper edge of the insertion hole **82**.

[0093] The insertion hole **82** has a role of fixing the link **76** (second spring hook portion **80**) so that the link **76** does not revolve when the tension spring **47** is assembled.

[0094] A procedure of assembling the tension spring **47** is described now. First, the link **76** is attached to the movable body **32** so as to revolve about the third support shaft **77**. Next, the operation lock lever **30** is attached to the movable body **32**. Next, the movable body **32** is assembled to the fixed body **31** together with the assist spring **61**, and the other end of the assist spring **61** is first retained at the fixed body **31**. Next, the one end of the assist spring **61** is retained at the support plate **60** at the position of the free angle of the torsion coil spring. Next, the tension spring **47** is hooked on the first spring hook portion **74** and the second spring hook portion **80** while being extended. At this time, when the link **76** is not restricted in the revolution direction and the link **76** is free to revolve, the link **76** revolves, therefore the distance between the first spring hook portion **74** and the second spring hook portion **80** becomes smaller than the free length of the tension spring **47**, and the tension spring **47** comes off. In the present example embodiment, when the tension spring **47** is hooked on the first spring hook portion **74** and the second spring hook portion **80**, the second spring hook portion **80** has been inserted through the insertion hole **82**, the second spring hook portion **80** is retained at (is in contact with) a rear end of the insertion hole **82**, and therefore the link **76** is fixed so as not to revolve. Accordingly, when the tension spring **47** is assembled, it is not necessary for a worker to fix the link **76**, and therefore the tension spring **47** can be easily assembled.

[0095] The groove, which is the second engagement portion **81** provided in the link **76**, is open upward, and the pin, which is the first engagement portion **75**, can be inserted from the open side. Accordingly, the lever proximal portion **30***b* (rotational body **69**) can be easily assembled from above in a state in which the link **76** is assembled.

[0096] As illustrated in FIG. **12**, the guide plate **52** is fixed to the second support shaft **72**. Specifically, the guide plate **52** is provided rightward of the second wall portion **54** of the movable

body **32** and leftward of the fixed body **31**, and an upper portion of the guide plate **52** is fixed to a right end of the second support shaft **72**. The operation lock lever **30** is attached to the second support shaft **72** at the left (one of opposite ends) in the axial direction of the support tube **66**, and the guide plate **52** is fixed to the second support shaft **72** at the right (the other of the opposite ends) in the axial direction of the support tube **66**. Thus, the guide plate **52** rotates together with the operation lock lever **30** about an axis extending in the machine-body width direction.

[0097] The lever proximal portion **30***b* is provided in the movable body **32**, the second support shaft **72** is inserted through the support tube **66** and the support boss **73** in a state in which the guide plate **52** is fixed to the right end of the second support shaft **72**, and then the support boss **73** is attached to the left portion of the second support shaft **72**. Accordingly, the lever proximal portion **30***b* and the guide plate **52** can be easily assembled to the movable body **32**.

[0098] As illustrated in FIG. **9**, a guide groove **83** that is guided by the guide body **43** of the fixed body **31** is provided in a lower portion of the guide plate **52**. The roller **46** of the guide body **43** is inserted into the guide groove **83**. The roller **46** is relatively movable in the guide groove **83** and rotatable in the guide groove **83**.

[0099] FIGS. **14** and **15** illustrate a state in which the movable body **32** is in the lowered position P**1**, and in this state, the guide groove **83** is located below the second support shaft **72**. The guide groove **83** has a first groove portion **83***a* in an upper portion, a second groove portion **83***b* in an intermediate portion, and a third groove portion **83***c* in a lower portion. The guide groove **83** (the first groove portion **83***a*, the second groove portion **83***b*, and the third groove portion **83***c*) is continuous. Specifically, a rear portion of the first groove portion **83***a* communicates with an upper portion of the second groove portion **83***b*, and a lower portion of the second groove portion **83***b* communicates with a front portion of the third groove portion **83***c*. The first groove portion **83***a* is in an arc shape centered on an axis **72***a* of the second support shaft **72** so as to extend in the front-rear direction. The roller **46** can relatively move about the second support shaft **72** in the first groove portion **83***a*. The second groove portion **83***b* is extends obliquely forward and downward from the rear portion of the first groove portion **83***a*. The roller **46** can relatively move about the first support shaft in the second groove portion **83***b*. Also, in the upper portion of the second groove portion **83***b*, the roller **46** can relatively move about the second support shaft **72** in the second groove portion **83***b*. The third groove portion **83***c* extends rearward from the lower portion of the second groove portion **83***b*. The roller **46** can relatively move about the second support shaft **72** in the third groove portion. Also, the third groove portion **83***c* is open downward at a rear portion thereof. Accordingly, the roller **46** can be inserted into the guide groove **83** from an open side of the third groove portion **83***c*.

[0100] In a state in which the movable body **32** is in the lowered position P**1** and the operation lock lever **30** is in the pushed-down position S**1** illustrated in FIGS. **14** and **15**, the roller **46** is located at a front end portion of the first groove portion **83***a*. In the state in which the roller **46** is located at the front end portion of the first groove portion **83***a*, a lower edge (first restrictor) **83***d* of the first groove portion **83***a* is in contact with the roller **46**, and therefore upward rotation of the guide plate **52** about the first support shaft **39** is restricted. Accordingly, the movable body **32** is restricted from rotating in the raising direction about the first support shaft **39**. Also, the operation lock lever **30** and the guide plate **52** can rotate in the direction in which the operation lock lever **30** is pulled up. That is, the first groove portion **83***a* restricts the movable body **32** in the lowered position P**1** from rotating in the raising direction and allows the operation lock lever **30** to rotate in the direction in which the operation lock lever **30** is pulled up.

[0101] Also, in the state in which the operation lock lever **30** is in the pushed-down position S**1**, a front edge (second restrictor) **83***e* of the first groove portion **83***a* is in contact with the roller **46**, and therefore the guide plate **52** is restricted from rotating rearward about the second support shaft **72**. Accordingly, the operation lock lever **30** is restricted from rotating from the pushed-down position S**1** in the push-down direction about the second support shaft **72**.

[0102] In a state illustrated in FIGS. **16** and **17**, in which the operation lock lever **30** has
[0103] been pulled up from the pushed-down position S**1** and the guide plate **52** has rotated about the second support shaft **72**, the roller **46** is located at a rear end portion of the first groove portion **83***a*. When the roller **46** is located at the rear end portion of the first groove portion **83***a*, the roller **46** can relatively move in the second groove portion **83***b*, and the restriction of the upward rotation of the guide plate **52** about the first support shaft **39** by the contact of the first restrictor **83***d* with the roller **46** is released. That is, the second groove portion **83***b* allows the movable body **32** to rotate by the operation of the operation lock lever **30**.
[0104] Also, in a state illustrated in FIGS. **20** and **21**, in which the operation lock lever **30** has been further pulled up from the position illustrated in FIGS. **16** and **17** and the movable body **32** has rotated about the first support shaft **39**, the roller **46** is located at a front end portion of the third groove portion **83***c*. When the roller **46** is located at the front end portion of the third groove portion **83***c*, as illustrated in FIG. **20**, the contact plate **59** is in contact with the position restrictor **42**, and the rotation of the movable body **32** in the raising direction is restricted. That is, the movable body **32** is in the raised position P**2**. Also, in this state, the roller **46** can relatively move about the second support shaft **72** in the third groove portion **83***c*. That is, the third groove portion **83***c* allows the operation lock lever **30** to rotate about the second support shaft **72** relative to the movable body **32** located in the raised position P**2**. When the operation lock lever **30** is further pulled up from the position illustrated in FIG. **20** to bring the operation lock lever **30** to the pulled-up position S**2** illustrated in FIG. **22**, the roller **46** is located at a rear end portion in the third groove portion **83***c*. In this position, an upper edge (locking portion) **83***f* of the third groove portion **83***c* is in contact with the roller **46**, and therefore the downward rotation of the guide plate **52** about the first support shaft **39** is restricted. Accordingly, the movable body **32** is restricted from rotating in the lowering direction about the first support shaft **39**. That is, the third groove portion **83***c* has the locking portion **83***f* that restricts the movable body **32** from rotating in the lowering direction from the raised position P**2** when the operation lock lever **30** is in the pulled-up position S**2**.
[0105] Next, a motion of the switching mechanism **33** will be described with reference to FIGS. **14** to **23**.
[0106] In the state in which the movable body **32** is in the lowered position P**1** and the operation lock lever **30** is in the pushed-down position S**1** as illustrated in FIG. **14**, a central axis **84** of the tension spring **47** is located forward of the second support shaft **72** as illustrated in FIG. **15**, and the biasing force of the tension spring **47** acts in the direction in which the operation lock lever **30** is pulled down. In the state in which the operation lock lever **30** is in the pushed-down position S**1**, the roller **46** is located at the front end portion of the first groove portion **83***a*, and the rotation of the operation lock lever **30** in the push-down direction is restricted. Therefore the operation lock lever **30** is held in the pushed-down position SI by the biasing force of the tension spring **47**.
[0107] When the operation lock lever **30** is pulled up from the state in the pushed-down position S**1** illustrated in FIG. **14** about the second support shaft **72**, the movable body **32** remains in the lowered position P**1**, and the roller **46** relatively moves rearward in the first groove portion **83***a*. Therefore the operation lock lever **30** and the guide plate **52** rotate in the raising direction about the second support shaft **72** (see FIG. **16**). In so doing, the rotational body **69** rotates clockwise together with the operation lock lever **30**, the first spring hook portion **74** moves rearward, and the first engagement portion **75** moves forward. Also, the second engagement portion **81** moves forward as the first engagement portion **75** moves forward, the link **76** rotates counterclockwise about the third support shaft **77**, and the second spring hook portion **80** moves rearward. That is, the first spring hook portion **74** and the second spring hook portion **80** move to the same side. When the first spring hook portion **74** and the second spring hook portion **80** move rearward, the central axis **84** of the tension spring **47** moves in a direction toward the axis **72***a* of the second support shaft **72**.
[0108] As illustrated in FIGS. **16** and **17**, when the roller **46** moves to the rear end portion of the

first groove portion **83***a*, the movable body **32** is allowed to rotate in the raising direction about the first support shaft **39**. Also, in the state in which the roller **46** is located at the rear end portion of the first groove portion **83***a*, the first spring hook portion **74**, the second support shaft **72**, and the third support shaft **77** are arranged substantially on a straight line.

[0109] When the operation lock lever **30** is further pulled up from the state illustrated in FIG. **16**, the roller **46** relatively moves in the upper portion toward the lower portion of the second groove portion **83***b* (see FIGS. **18** and **19**). When the roller **46** relatively moves in the upper portion of the second groove portion **83***b*, a force in the raising direction is transferred from the operation lock lever **30** to the movable body **32** via the second support shaft **72** and the support tube **66**, so that the movable body **32** rotates in the raising direction about the first support shaft **39**, and the operation lock lever **30** and the guide plate **52** also rotate in the pull-up direction about the second support shaft **72**. When the operation lock lever **30** rotates in the pull-up direction about the second support shaft **72**, similarly to the above-described motion, the first spring hook portion **74** and the second spring hook portion **80** move rearward, and the central axis **84** of the tension spring **47** moves rearward in a direction away from the axis **72***a* of the second support shaft **72** as illustrated in FIG. **19**, so that the biasing force of the tension spring **47** is switched to the direction in which the operation lock lever **30** is pulled up.

[0110] When the operation lock lever **30** is further pulled up from the state illustrated in FIG. **18** and the roller **46** relatively moves from the middle portion to the lower end portion of the second groove portion **83***b*, the movable body **32**, the operation lock lever **30**, the guide plate **52**, the rotational body **69**, and the link **76** rotate together in the raising direction about the first support shaft **39**.

[0111] As illustrated in FIGS. **20** and **21**, when the roller **46** relatively moves to the lower end portion of the second groove portion **83***b*, the movable body **32** is in the raised position P**2**, and the contact plate **59** is in contact with the position restrictor **42**. Therefore the rotation of the movable body **32** in the raising direction is restricted. The position of the operation lock lever **30** which has been operated to rotate the movable body **32** to the raised position P**2** is not the pulled-up position S**2** but is a raising-operation position S**3** short of the pulled-up position S**2**. When the operation lock lever **30** is in the raising-operation position S**3**, the roller **46** is located at the front end portion of the third groove portion **83***c* (the lower end portion of the second groove portion **83***b*) as illustrated in FIG. **20**.

[0112] When the operation lock lever **30** is further pulled up from the raising-operation position S**3** relative to the movable body **32** in the raised position P**2**, the guide plate **52** rotates forward about the second support shaft **72**, the first spring hook portion **74** and the second spring hook portion **80** move rearward similarly to the above-described motion, and the central axis **84** of the tension spring **47** further moves in the direction away from the axis **72***a* of the second support shaft **72** as illustrated in FIG. **23**. Therefore the biasing force of the tension spring **47** in the direction in which the operation lock lever **30** is pulled up further increases.

[0113] When the operation lock lever **30** is pushed down from the pulled-up position S**2** to the pushed-down position S**1**, the biasing force of the tension spring **47** is switched by a motion reverse to the above-described motion.

[0114] The switching motion for the biasing force of the tension spring **47** is described in other words. It is assumed that the rear to which the first spring hook portion **74** moves in a case where the operation lock lever **30** is operated to be pulled up is a first side, and the front opposite to the first side is a second side (see FIG. **15**). When the operation lock lever **30** is operated to be pulled up and the rotational body **69** rotates about the second support shaft **72**, the first spring hook portion **74** moves to the first side (rear) while the first engagement portion **75** and the second engagement portion **81** move to the second side (front) and the second spring hook portion **80** moves to the first side (rear). When the operation lock lever **30** is pushed down and the rotational body **69** rotates about the second support shaft **72**, the first spring hook portion **74** moves to the

second side (front) while the first engagement portion **75** and the second engagement portion **81** move to the first side (rear) and the second spring hook portion **80** moves to the second side. With this, the central axis **84** of the tension spring **47** moves to the first side (rear) of the second support shaft **72** or the second side (front) of the second support shaft **72**, and the direction of the biasing force of the tension spring **47** is switched. That is, the direction of the biasing force of the tension spring **47** acting on the operation lock lever **30** is switched between the direction in which the operation lock lever **30** is pulled down and the direction in which the operation lock lever **30** is pulled up as the operation lock lever **30** is operated.

[0115] Also, when the operation lock lever **30** is in the pulled-up position S**2**, the roller **46** is located at the rear end portion of the third groove portion **83***c*, so that the rotation of the operation lock lever **30** in the pull-up direction is restricted. Thus, in the state in which the operation lock lever **30** is in the pulled-up position S**2**, the operation lock lever **30** is held in the pulled-up position S**2** by the biasing force of the tension spring **47**.

[0116] According to the above, the second spring hook portion **80** moves to the side to which the first spring hook portion **74** is moved by the rotation of the link **76** due to the movement of the first engagement portion **75** by the operation of the operation lock lever **30**. Accordingly, the central axis **84** of the tension spring **47** can be sufficiently separated from the second support shaft **72** in the pushed-down position S**1** and the pulled-up position S**2**. Even when the rotation angle of the movable body **32** is small, the biasing force (holding force) of the tension spring **47** on the operation lock lever **30** can be exerted.

[0117] Example embodiments of the present invention provide lever devices **27** and working machines **1** described in the following items. [0118] (Item 1) A lever device **27** including a fixed body **31**, a movable body **32** rotatably supported by the fixed body **31** via a first support shaft **39**, a lever **30** to be operated to rotate the movable body **32** about the first support shaft **39**, the lever **30** being supported by a second support shaft **72** provided at the movable body **32** such that the lever **30** is rotatable between a pushed-down position S**1** and a pulled-up position S**2**, the pulled-up position S**2** being a position of the lever **30** rotated upward from the pushed-down position S**1**, a tension spring **47** to bias the lever **30**, and a switching mechanism **33** to switch a direction of a biasing force of the tension spring **47** to change between when the lever is in the pushed-down position and when the lever is in the pulled-up position such that the biasing force of the tension spring **47** acts in a direction in which the lever **30** is pulled down when the lever **30** is in the pushed-down position S**1** and acts in a direction in which the lever **30** is pulled up when the lever **30** is in the pulled-up position S**2**, wherein the switching mechanism **33** includes a rotational body **69** to rotate together with the lever **30** about the second support shaft **72**, the rotational body **69** including a first spring hook portion **74** and a first engagement portion **75** positioned such that an axis of the second support shaft **72** is located between the first spring hook portion **74** and the first engagement portion **75**, and a link **76** rotatably supported by the movable body **32** via a third support shaft **77**, the link **76** including a second spring hook portion **80** and a second engagement portion **81** positioned such that an axis of the third support shaft **77** is located between the second spring hook portion **80** and the second engagement portion **81**, the tension spring **47** is connected between the first spring hook portion **74** and the second spring hook portion **80**, and the link **76** is positioned such that the first engagement portion **75** and the second engagement portion **81** are engageable with each other and such that the first engagement portion **75** is movable by rotation of the rotational body **69** about the second support shaft **72** to cause the second engagement portion **81** to move and rotate about the third support shaft **77** to move the second spring hook portion **80** to a side to which the first spring hook portion **74** moves.

[0119] With the lever device **27** according to item 1, when the link **76** rotates as the first engagement portion **75** is moved by operation of the lever **30**, the second spring hook portion **80** moves to the side to which the first spring hook portion **74** moves. Accordingly, the central axis of the tension spring **47** can be separated to an appropriate position from the center of the second

support shaft **72** in the pushed-down position S**1** and the pulled-up position S**2**, and the biasing force of the tension spring **47** can be exerted on the lever **30** even when the angle of rotation of the movable body **32** is small. [0120] (Item 2) The lever device **27** according to item **1**, wherein one of the first engagement portion **75** and the second engagement portion **81** includes a pin parallel to the second support shaft **72** or the third support shaft **77**, and the other of the first engagement portion **75** and the second engagement portion **81** includes a groove or a hole to receive the pin.
[0121] The lever device **27** according to item 2 achieves the following: when the link **76** rotates as the first engagement portion **75** is moved by operation of the lever **30**, the second spring hook portion **80** is moved to the side to which the first spring hook portion **74**. [0122] (Item 3) The lever device **27** according to item 1 or 2, wherein a side to which the first spring hook portion **74** moves when the lever **30** is pulled up is a first side, and a side opposite to the first side is a second side, and the lever device **27** is configured such that the direction of the biasing force of the tension spring **47** which acts on the lever **30** as the lever **30** is operated is switched between the direction in which the lever **30** is pulled down and the direction in which the lever **30** is pulled up because: when the lever **30** is pulled up and the rotational body **69** rotates about the second support shaft **72**, the first spring hook portion **74** moves to the first side while the first engagement portion **75** and the second engagement portion **81** move to the second side and the second spring hook portion **80** moves to the first side; and when the lever **30** is pushed down and the rotational body **69** rotates about the second support shaft **72**, the first spring hook portion **74** moves to the second side while the first engagement portion **75** and the second engagement portion **81** move to the first side and the second spring hook portion **80** moves to the second side.
[0123] Also with the lever device **27** according to item 3, the central axis of the tension spring **47** can be appropriately separated from the center of the second support shaft **72** in the pushed-down position S**1** and the pulled-up position S**2**, and the biasing force of the tension spring **47** can be exerted on the lever **30** even when the rotation angle of the movable body **32** is small. [0124] (Item 4) The lever device **27** according to any one of items 1 to 3, wherein the movable body **32** is rotatable between a lowered position P**1** and a raised position P**2**, the raised position P**2** being a position of the movable body **32** rotated upward from the lowered position P**1** about the first support shaft **39**, the pushed-down position S**1** of the lever **30** corresponds to the lowered position P**1** of the movable body **32**, the lever **30** is configured to be operated to a raising-operation position S**3** which is a position of the lever **30** operated to rotate the movable body **32** to the raised position P**2**, and the pulled-up position S**2** of the lever **30** is a position of the lever **30** further pulled up from the raising-operation position S**3** relative to the movable body **32** in the raised position P**2**.
[0125] With the lever device **27** according to item 4, the movement amounts of the first spring hook portion **74** and the second spring hook portion **80** can be increased when the lever **30** is raised.
[0126] (Item 5) The lever device **27** according to item 4, further including a guide body **43** provided at the fixed body **31**, and a guide plate **52** including a guide groove **83** to receive the guide body **43** and configured to rotate together with the lever **30** about the second support shaft **72**, wherein the guide groove **83** includes a first groove portion **83***a* to restrict the movable body **32** in the lowered position P**1** from rotating in a raising direction and allow the lever **30** to rotate in the direction in which the lever **30** is pulled up, a second groove portion **83***b* to allow the movable body **32** to rotate by an operation of the lever **30**, and a third groove portion **83***c* to restrict the movable body **32** in the raised position P**2** from rotating in the raising direction and allow the lever **30** to rotate about the second support shaft **72**, and the third groove portion **83***c* includes a locking portion **83***f* to restrict the movable body **32** from rotating in a lowering direction from the raised position P**2** when the lever **30** is in the pulled-up position S**2**.
[0127] With the lever device **27** according to item 5, in the configuration in which the biasing force of the tension spring **47** can be exerted on the lever **30** even when the angle of rotation of the movable body **32** is small, the movable body **32** can be restricted from unintentionally rotating downward. [0128] (Item 6) The lever device **27** according to item 5, wherein the movable body **32**

includes a support tube **66** to rotatably support the second support shaft **72** about an axis thereof, the lever **30** is attached to the second support shaft **72** at one of opposite ends in an axial direction of the support tube **66**, and the guide plate **52** is fixed to the second support shaft **72** at the other of the opposite ends in the axial direction of the support tube **66**.
[0129] With the lever device **27** according to item **6**, the guide plate **52** can be easily attached to the movable body **32**. [0130] (Item 7) A working machine **1** according to the present example embodiment includes the lever device **27** according to any one of items 1 to 6. [0131] (Item 8) The working machine **1** according to item 7, wherein the lever **30** is an operation lock lever to switch one or more actuators included in the working machine **1** between an operable state and an inoperable state.
[0132] With the working machine **1** according to item 8, even when the angle of rotation of the movable body **32** is small, the biasing force of the tension spring **47** can be exerted on the lock lever.
[0133] While example embodiments of the present invention have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing from the scope and spirit of the present invention. The scope of the present invention, therefore, is to be determined solely by the following claims.

Claims

1. A lever device comprising: a fixed body; a movable body rotatably supported by the fixed body via a first support shaft; a lever to be operated to rotate the movable body about the first support shaft, the lever being supported by a second support shaft provided at the movable body such that the lever is rotatable between a pushed-down position and a pulled-up position, the pulled-up position being a position of the lever rotated upward from the pushed-down position; a tension spring to bias the lever; and a switching mechanism to switch a direction of a biasing force of the tension spring to change between when the lever is in the pushed-down position and when the lever is in the pulled-up position such that the biasing force of the tension spring acts in a direction in which the lever is pulled down when the lever is in the pushed-down position and acts in a direction in which the lever is pulled up when the lever is in the pulled-up position; wherein the switching mechanism includes: a rotational body to rotate together with the lever about the second support shaft, the rotational body including a first spring hook portion and a first engagement portion positioned such that an axis of the second support shaft is located between the first spring hook portion and the first engagement portion; and a link rotatably supported by the movable body via a third support shaft, the link including a second spring hook portion and a second engagement portion positioned such that an axis of the third support shaft is located between the second spring hook portion and the second engagement portion; the tension spring is connected between the first spring hook portion and the second spring hook portion; and the link is positioned such that the first engagement portion and the second engagement portion are engageable with each other and such that the first engagement portion is movable by rotation of the rotational body about the second support shaft to cause the second engagement portion to move and rotate about the third support shaft to move the second spring hook portion to a side to which the first spring hook portion moves.
2. The lever device according to claim 1, wherein one of the first engagement portion and the second engagement portion includes a pin parallel to the second support shaft or the third support shaft; and the other of the first engagement portion and the second engagement portion includes a groove or a hole to receive the pin.
3. The lever device according to claim 1, wherein a side to which the first spring hook portion moves when the lever is pulled up is a first side, and a side opposite to the first side is a second side; and the lever device is configured such that the direction of the biasing force of the tension

spring which acts on the lever as the lever is operated is switched between the direction in which the lever is pulled down and the direction in which the lever is pulled up because: when the lever is pulled up and the rotational body rotates about the second support shaft, the first spring hook portion moves to the first side while the first engagement portion and the second engagement portion move to the second side and the second spring hook portion moves to the first side; and when the lever is pushed down and the rotational body rotates about the second support shaft, the first spring hook portion moves to the second side while the first engagement portion and the second engagement portion move to the first side and the second spring hook portion moves to the second side.

4. The lever device according to claim 1, wherein the movable body is rotatable between a lowered position and a raised position, the raised position being a position of the movable body rotated upward from the lowered position about the first support shaft; the pushed-down position of the lever corresponds to the lowered position of the movable body; the lever is configured to be moved to a raising-operation position which is a position of the lever operated to rotate the movable body to the raised position; and the pulled-up position of the lever is a position of the lever further pulled up from the raising-operation position relative to the movable body in the raised position.

5. The lever device according to claim 4, further comprising: a guide body provided at the fixed body; and a guide plate including a guide groove to receive the guide body and configured to rotate together with the lever about the second support shaft; wherein the guide groove includes: a first groove portion to restrict the movable body in the lowered position from rotating in a raising direction and allow the lever to rotate in the direction in which the lever is pulled up; a second groove portion to allow the movable body to rotate by an operation of the lever; and a third groove portion to restrict the movable body in the raised position from rotating in the raising direction and allow the lever to rotate about the second support shaft; and the third groove portion includes a locking portion to restrict the movable body from rotating in a lowering direction from the raised position when the lever is in the pulled-up position.

6. The lever device according to claim 5, wherein the movable body includes a support tube to rotatably support the second support shaft about an axis thereof; the lever is attached to the second support shaft at one of opposite ends in an axial direction of the support tube; and the guide plate is fixed to the second support shaft at the other of the opposite ends in the axial direction of the support tube.

7. A working machine comprising the lever device according to claim 1.

8. The working machine according to claim 7, wherein the lever is an operation lock lever to switch one or more actuators included in the working machine between an operable state and an inoperable state.