

Title of the Invention

WORKING MACHINE

Field of the Invention

The present invention relates to a working machine.

Background Art

Known examples of a working machine such as a crane include a working machine including a machine body, a hoisting member supported on the machine body to be capable of hoisting, and a support member that supports the hoisting member to be capable of hoisting behind the hoisting member. JP 2018-2384 A discloses a technique in which a gantry as the support member supports a boom as the hoisting member from behind. The technique is configured such that the crane further includes a boom hoisting winch mounted on the machine body, and a boom hoisting rope pulled out from the boom hoisting winch is connected to a leading end part of the boom using a sheave provided at the leading end part of the gantry and a boom guy line. When the boom hoisting winch winds up and winds out the boom hoisting rope, the boom is raised and lowered with respect to the machine body together with the gantry.

The technique described in JP 2018-2384 A enables the gantry to be changed in attitude between an erected attitude and a lying attitude. The gantry partly extends backward and upward in the erected attitude to support the boom from behind. The gantry falls backward from the erected attitude in the lying attitude to take an attitude along the machine body. The present technique is further configured such that a leading end part of a connector suspended from the leading end part of the gantry in the erected attitude is coupled to the machine body in the lying attitude to hold the gantry in the lying attitude, and thus the machine body can be transported and stored.

Applying the technique described in JP 2018-2384 A to a crane in which a counterweight is mounted on a rear end part of a machine body causes a problem that a connector interferes with the counterweight when a gantry falls, thereby damaging the connector or the counterweight. As described above, working machines includes many members that are changed in attitude as necessary, and thus require a technique for preventing interference between a plurality of members during the change in attitude without requiring labor of an operator.

Summary of the Invention

The present invention has been made in view of the above problems, and an object of the present invention is to prevent a second member suspended from a first member from

interfering with another third member during change in attitude of the first member in a working machine.

The present invention provides a working machine. The working machine includes: a base part; a first member with a proximal end part supported by the base part rotatable about a first fulcrum part, the first member being capable of changing in attitude between a first attitude and a second attitude along with the rotation; a second member with an upper end part supported by the first member to be rotatable about a second fulcrum part, the second member being suspended from the first member in a state where the first member is in the first attitude; a third member disposed below the second member in a state where the first member is in the first attitude; and an interlocking mechanism that causes the second member to rotate about the second fulcrum part to prevent interference between the second member and the third member in conjunction with change in attitude of the first member from the first attitude to the second attitude.

Brief Description of the Drawings

Fig. 1 is a side view of a crane according to an embodiment of the present invention.

Fig. 2 is a side view illustrating a state in which a gantry falls with respect to a machine body in a crane according to an embodiment of the present invention.

Fig. 3 is a side view illustrating a state in which a gantry falls with respect to a machine body in a crane according to an embodiment of the present invention.

Fig. 4 is a side view illustrating a state of an interlocking mechanism when a gantry falls down in a crane according to an embodiment of the present invention.

Fig. 5 is a side view illustrating a state of an interlocking mechanism when a gantry falls down in a crane according to an embodiment of the present invention.

Fig. 6 is a side view illustrating a state of an interlocking mechanism when a gantry falls down in a crane according to an embodiment of the present invention.

Fig. 7 is a side view illustrating a state of an interlocking mechanism when a gantry falls down in a crane according to an embodiment of the present invention.

Fig. 8 is a side view illustrating a state in which an attitude holder is coupled to a counterweight in a crane according to an embodiment of the present invention.

Fig. 9 is a side view illustrating a state in which an attitude holder is coupled to a counterweight in a crane according to another embodiment of the present invention.

Fig. 10 is a side view illustrating a state of an interlocking mechanism when a gantry falls down in a crane according to a modified embodiment of the present invention.

Fig. 11 is a side view illustrating a state in which a rear strut of a crane according to a modified embodiment of the present invention is raised.

Description of Embodiments

An embodiment of the present invention will be described below with reference to the drawings. Fig. 1 is a side view of a crane 100 (working machine) according to the present embodiment. Although each of the subsequent drawings including Fig. 1 shows each of directions of “up”, “down”, “right”, “left”, “front”, and “rear”, the directions are shown for convenience to describe structure of the crane 100 according to the present embodiment, and do not limit a usage mode or the like of the working machine according to the present invention.

The crane 100 includes a lower travelling body 1 capable of travelling on the ground, an upper slewing body 2 (machine body, base part) disposed above the lower travelling body 1, and a boom 3 as a hoisting member. The upper slewing body 2 is provided at its front end part with a cab. The cab corresponds to a driver's seat of the crane. The upper slewing body 2 is mounted on the lower travelling body 1 to be able to slew about a slewing center CL (Fig. 1) extending vertically. The upper slewing body 2 includes a slewing frame 21 as a base.

The boom 3 is supported by the slewing frame 21 of the upper slewing body 2 to be capable of hoisting.

The crane further includes a pair of left and right gantries 4 (first member, support member), a counterweight 5 (third member), a pair of left and right boom guy lines 6, a lower spreader 8A and an upper spreader 8B, a boom hoisting rope 9, a boom hoisting winch 10 (winch), a boom point sheave 11, an idler sheave 12, a hook 13, a hoisting rope 14, and a hoisting drum 15.

The pair of left and right gantries 4 is attached to a rear part of the slewing frame 21 of the upper slewing body 2 (behind the boom 3). The pair of left and right gantries 4 is rotatably supported by the upper slewing body 2 behind the boom 3 to be able to change in attitude between an erected attitude (first attitude) in which the gantry 4 stands up with respect to the upper slewing body 2 and a lying attitude (second attitude, see Fig. 3) in which the gantry 4 lies down on the upper slewing body 2. Each gantry 4 functions as a support column for supporting the boom 3 in the erected attitude. Fig. 1 illustrates the gantry 4 on the right appearing on a front side of the drawing.

The counterweight 5 is mounted on and supported by the slewing frame 21 behind the gantry 4, and has a function of maintaining balance of the crane 100 when the crane lifts a lifting load.

The lower spreader 8A and the upper spreader 8B each include a plurality of sheaves. The lower spreader 8A is supported at a leading end part of the gantry 4. The upper spreader 8B is connected to a leading end part of the boom 3 by a boom guy line 6.

After being pulled out from the boom hoisting winch 10 and hung on a sheave (not

illustrated) at the leading end part of the gantry 4, the boom hoisting rope 9 is then wound multiple times between the lower spreader 8A and the upper spreader 8B. The boom hoisting winch 10 is disposed behind the slewing frame 21, more specifically, behind the boom 3 and in front of the counterweight 5. The boom hoisting rope 9 pulled out has a leading end fixed to near the boom hoisting winch 10 of the upper slewing body 2. The boom hoisting winch 10 winds up and pays out the boom hoisting rope 9 to change a distance between the lower spreader 8A and the upper spreader 8B, thereby raising and lowering the boom 3 while rotating the boom 3 relative to the gantry 4.

The hoisting drum 15 is provided at a central part of the slewing frame 21. The boom point sheave 11 and the idler sheave 12 are rotatably supported in the leading end part of the boom 3. The hoisting rope 14 pulled out from the hoisting drum 15 has a leading end part provided with a hook 13 for a lifting load. Then, one end of the hoisting rope 14 is fixed to the leading end part of the boom 3 after the hoisting rope 14 is wound between the boom point sheave 11 at the leading end part of the boom 3 and a sheave of a sheave block (not illustrated) provided on the hook 13. In contrast, the other end of the hoisting rope 14 is wound around the hoisting drum 15 via the boom point sheave 11 and the idler sheave 12. Thus, when the hoisting drum 15 winds up or pays out the hoisting rope 14, a distance between the boom point sheave 11 and a sheave of the hook 13 is changed, and thus the hook 13 suspended from the leading end part of the boom 3 is wound up or down.

Figs. 2 and 3 are each a side view illustrating a state in which the gantry 4 falls with respect to the upper slewing body 2 in the crane 100 according to the present embodiment. Fig. 2 illustrates the gantry 4 in the erected attitude with a two-dot chain line, and the gantry 4 having fallen from the erected attitude by a predetermined angle with a solid line. Fig. 3 illustrates the gantry 4 with a one-dot chain line in a state where the gantry 4 further falls than the gantry 4 indicated by a solid line in Fig. 2, and the gantry 4 indicated by a solid line in Fig. 3 corresponds to a state of being in the lying attitude.

As illustrated in Fig. 2, the slewing frame 21 includes a pair of left and right vertical walls 21H. Each of the vertical walls 21H has a predetermined vertical height and extends long in a front-rear direction. Fig. 2 illustrates the vertical wall 21H on the right appearing on a front side of the drawing. The counterweight 5 described above is formed by stacking a plurality of weight bodies 50. Fig. 2 illustrates the counterweight 5 including weight bodies 50 at three stages.

Each of the pair of left and right gantries 4 includes a compression member 41 and a tension member 42 (Fig. 2). Each of the compression member 41 and the tension member 42 is supported by the upper slewing body 2, and is disposed to form a substantially triangular shape when viewed along a left-right direction.

Specifically, the compression member 41 includes a proximal end part that is rotatably supported at a substantially central part in the front-rear direction of the vertical wall 21H of the slewing frame 21 with a proximal end fulcrum part 41P (first fulcrum part) as a fulcrum. Figs. 2 and 3 each illustrate the gantry 4 in an erected attitude with a two-dot chain line, in which the compression member 41 extends and inclines backward and upward from the proximal end fulcrum part 41P. The compression member 41 includes a rotation end part provided with the sheave described above attached, the rotation end part being opposite to the proximal end part.

The tension member 42 is supported by the vertical wall 21H behind the compression member 41 and immediately in front of the counterweight 5. The tension member 42 includes an upper member 42A and a lower member 42B. The upper member 42A constitutes an upper part of the tension member 42, and the lower member 42B constitutes a lower part of the tension member 42. The upper member 42A includes a leading end part (upper end part) that is rotatably supported around an upper fulcrum part 42Q (third fulcrum part) at a leading end part of the compression member 41. In contrast, the lower member 42B includes a proximal end part (lower end part) that is rotatably connected to and supported by a lower fulcrum part 42P provided at a rear end part of the vertical wall 21H. Between the leading end part of the upper member 42A and the proximal end part of the lower member 42B, a central fulcrum part 42S is further disposed. The tension member 42 is configured to be able to bend and stretch at the central fulcrum part 42S as a fulcrum.

The gantry 4 further includes a cylinder 43 (Fig. 2). The cylinder 43 is a hydraulic cylinder, and expands and contracts by receiving supply of hydraulic oil discharged from a hydraulic pump (not illustrated). The cylinder 43 includes a rod part with a leading end part that is rotatably connected to a rear side surface of the compression member 41, and a cylinder body with a proximal end part that is rotatably supported by a support mechanism (not illustrated) that supports the hoisting drum 15 (Fig. 1). Expansion and contraction operation of the cylinder 43 enables the gantry 4 to be changed in attitude between the erected attitude and the lying attitude.

The crane 100 further includes a lashing link 70 (second member, attitude holder) (Fig. 2). The lashing link 70 includes an upper end part supported by the compression member 41 of the gantry 4 in a rotatable manner about a lashing link fulcrum part 70P (second fulcrum part portion). The lashing link 70 is suspended by its own weight from the gantry 4 in a state where the gantry 4 is in an erected attitude. The lashing link 70 is coupled to the counterweight 5 in a state where the gantry 4 is in a lying attitude to hold the gantry 4 in the lying attitude. The lashing link 70 in another embodiment may be coupled to the upper slewing body 2 instead of the counterweight 5.

When the gantry 4 tries to fall down as indicated by a solid line in the crane 100 in which

the counterweight 5 is mounted on a rear end part of the upper slewing body 2 as illustrated in Fig. 2, the lashing link 70 may interfere with the counterweight 5 during the falling down of the gantry 4 to damage the lashing link 70 or the counterweight 5. As described above, the crane 100 includes many members that change in attitude as necessary, and thus require a technique for preventing interference between a plurality of members during the change in attitude without requiring labor of an operator.

To solve the above problem, the crane 100 in the present embodiment includes an interlocking mechanism 7S. The interlocking mechanism 7S has a function of rotating the lashing link 70 backward about the lashing link fulcrum part 70P as illustrated in Fig. 2 to prevent interference between the lashing link 70 and the counterweight 5 in conjunction with change in attitude of the gantry 4 from the erected attitude to the lying attitude.

Figs. 4 to 7 are each a side view illustrating a state of the interlocking mechanism when the gantry 4 falls down in the crane 100 according to the present embodiment. The interlocking mechanism 7S transmits a force for bending the tension member 42 about the central fulcrum part 42S (Fig. 2) to the lashing link 70 in conjunction with rotation of the compression member 41 about the proximal end fulcrum part 41P from the erected attitude to the lying attitude, thereby rotating the lashing link 70 backward.

With reference to Fig. 4, the compression member 41 includes the leading end part in which a support plate 41T having a partially wide width is disposed. The tension member 42 and the lashing link 70 are rotatably supported by the support plate 41T, and the interlocking mechanism 7S is interposed in a region therebetween. Specifically, the upper end part of the upper member 42A of the tension member 42 is supported by a lower part (part close to a base end) of the support plate 41T in a rotatable manner about the upper fulcrum part 42Q. Then, the lashing link fulcrum part 70P of the lashing link 70 is rotatably supported by the leading end part (support plate 41T) of the compression member 41 behind an upper end part of the tension member 42.

The interlocking mechanism 7S includes a protrusion 42M and a transmission link 80 (transmission part). The lashing link 70 includes a lashing link pin 70Q disposed at a position away forward from the lashing link fulcrum part 70P. The lashing link pin 70Q is a pin protruding in the left-right direction at the upper end part of the lashing link 70.

The protrusion 42M is a substantially triangular member attached to an outer peripheral surface of the upper end part of the upper member 42A. The protrusion 42M is fixed to the upper member 42A by a plurality of bolts. As illustrated in Fig. 4, the upper end part of the upper member 42A includes the outer peripheral surface in an arc shape about the upper fulcrum part 42Q, and the protrusion 42M is attached to a part of the outer peripheral surface to provide a cam structure.

The transmission link 80 is a link structure disposed to be able to bend and stretch

between the upper fulcrum part 42Q and the lashing link fulcrum part 70P. The transmission link 80 is supported by the support plate 41T. The transmission link 80 transmits a pressing force received from the protrusion 42M to the lashing link 70 to rotate the lashing link 70 backward, the pressing force being received along with rotation of the protrusion 42M about the upper fulcrum part 42Q. The transmission link 80 includes a first link 81 and a second link 82.

The first link 81 is located close to the tension member 42 in the transmission link 80. The first link 81 includes a pushed-up part 81T (first end part), a first connecting part 81P (second end part), and a link fulcrum part 81S. The pushed-up part 81T is disposed at an end part of the first link 81 and can come into contact with the protrusion 42M to be pushed up by the protrusion 42M. The pushed-up part 81T has an L shape as illustrated in Fig. 4. The first connecting part 81P corresponds to an end part of the first link 81, the end part being opposite to the pushed-up part 81T. The link fulcrum part 81S is disposed between the pushed-up part 81T and the first connecting part 81P, and is rotatably supported by the support plate 41T.

The second link 82 includes a second connecting part 82P (third end part) and an engagement hook 82T (fourth end part). The second connecting part 82P is connected to the first connecting part 81P of the first link 81 in a rotatable manner about a connecting fulcrum part 80S. In other words, the first link 81 and the second link 82 can bend and stretch at the connecting fulcrum part 80S in Fig. 6 as a fulcrum. The engagement hook 82T is an end part of the second link 82, the end part being opposite to the second connecting part 82P. The engagement hook 82T is rotatably connected to the lashing link pin 70Q of the lashing link 70. When the locking member 83 is attached to the engagement hook 82T engaged with the lashing link pin 70Q, detachment between the engagement hook 82T and the lashing link pin 70Q is prevented.

Fig. 4 illustrates members with respective fulcrums (central axes) for rotation, the fulcrums being parallel to each other and extending in the left-right direction.

Next, movement of the interlocking mechanism 7S along with change in attitude of the gantry 4 will be described in detail with reference to Figs. 2 to 7. When the gantry 4 is in an erected attitude as indicated by a two-dot chain line in Fig. 2, the lashing link 70 is in an attitude of being suspended vertically downward from the lashing link fulcrum part 70P as illustrated in Fig. 4. Then, the counterweight 5 is disposed below the lashing link 70 as illustrated in Fig. 3 in a state where the gantry 4 is in an erected attitude.

The transmission link 80 is in an attitude in which the first link 81 extends in a substantially horizontal direction according to a barycentric position of each of the first link 81 and the second link 82. The tension member 42 of the gantry 4 also extends along a vertical direction, thereby resulting in that the protrusion 42M is disposed at a position spaced forward from the pushed-up part 81T as illustrated in Fig. 4.

When the compression member 41 of the gantry 4 starts to fall backward as indicated by the solid line in Fig. 2 from the state above, the tension member 42 starts to bend at the central fulcrum part 42S as a fulcrum in conjunction with the compression member 41. When the upper member 42A of the tension member 42 rotates about the upper fulcrum part 42Q, the protrusion 42M approaches the pushed-up part 81T as illustrated in Fig. 5. After that, the protrusion 42M pushes up the pushed-up part 81T as illustrated in Fig. 6, and then the first link 81 rotates counterclockwise in Fig. 6 at the link fulcrum part 81S as a fulcrum. As a result, the second link 82 coupled to the first link 81 at the connecting fulcrum part 80S is pulled in a lower right direction in Fig. 6, so that the lashing link 70 rotates (swings up) backward at the lashing link fulcrum part 70P as a fulcrum.

The rotation of the lashing link 70 causes the lashing link 70 to move backward above the counterweight 5 as indicated by a solid line in Fig. 2, and eventually, the lashing link 70 is disposed along a rear surface of the counterweight 5 as indicated by a one-dot chain line and a solid line in Fig. 3.

Additionally, the lashing link 70 in the present embodiment includes a lower end part provided with a connector 71 attached as illustrated in Fig. 3. The connector 71 constitutes the attitude holder of the present invention together with the lashing link 70. Fig. 8 is a side view illustrating a state in which the connector 71 is coupled to the counterweight 5. The connector 71 is in a substantially V-shape, and includes a connecting hook 71P at its leading end part, and a pin hole 71Q formed opposite to the connecting hook 71P. Then, the counterweight 5 includes a rear lower end part provided with a weight connection part 55 that is partially cut out, and an engagement pin 55P extending in the left-right direction is disposed in the weight connection part 55. As illustrated in Fig. 8, an operator engages the connecting hook 71P of the connector 71 with the weight connection part 55, and rotates (pushes up) the connector 71 in a direction indicated by the arrow. As a result, the pin hole 71Q of the connector 71 is matched with a pin hole 70S formed at the lower end part of the lashing link 70 as illustrated in Fig. 3, and both the holes are coupled by a connecting pin (not illustrated). As a result, the lashing link 70 and the connector 71 are engaged with the counterweight 5, and thus the gantry 4 can be held (locked) in the lying attitude.

When the gantry 4 is in the lying attitude, as illustrated in Fig. 7, a predetermined gap (play) is formed between the protrusion 42M and the pushed-up part 81T. In other words, the first link 81 (cam follower) is not restrained in a direction away from the protrusion 42M (cam). Thus, the operator can swing the lashing link 70 within a predetermined range to align the pin hole 71Q of the connector 71 with the pin hole 70S of the lashing link 70. If the protrusion 42M is strongly engaged with the pushed-up part 81T, the lashing link 70 is less likely to be swung, thus taking time and effort to align the pin holes.

Fig. 9 is a side view illustrating a state in which a connector 72 according to another embodiment is coupled to the counterweight 5. The connector 72 has a shorter L shape than the connector 71, and includes a connecting hook 72P and a pin hole 72Q. As with the connector 71 described above, when the connector 72 with the connecting hook 72P engaged with the engagement pin 55P is rotated in a direction indicated by the arrow in Fig. 9, the lashing link 70 and the connector 72 can be coupled. In this case, a lashing link longer than the lashing link 70 according to the present embodiment is used.

As described above, the present embodiment enables the interlocking mechanism 7S to prevent the lashing link 70 suspended from the gantry 4 from interfering with the counterweight 5 when the gantry 4 is changed in attitude from the first attitude to the second attitude. As a result, the lashing link 70 or the counterweight 5 can be prevented from being damaged while the gantry 4 is safely changed in attitude. Thus, the counterweight 5 is not required to be partly removed according to the locus of the leading end part of the lashing link 70 for preventing interference between the lashing link 70 and the counterweight 5, so that weight of the counterweight 5 can be sufficiently secured to secure hanging capability of the crane 100. In particular, the counterweight 5 is formed by stacking the plurality of weight bodies 50 in the present embodiment, so that the plurality of weight bodies 50 can have a common shape by avoiding the partial lack as described above.

When the gantry 4 is brought into the lying attitude, the lashing link 70 is coupled to the counterweight 5. Thus, the crane 100 can be transported and stored while the gantry 4 is maintained in the lying attitude. The lashing link 70 also can be attached to the gantry 4 regardless of an attitude of the gantry 4, so that time and effort required for attaching the lashing link 70 can be saved.

Additionally, the interlocking mechanism 7S transmits force of bending operation of the tension member 42 along with change in attitude of the compression member 41 to the lashing link 70 in the present embodiment, so that the lashing link 70 can be stably rotated backward to prevent interference between the lashing link 70 and the counterweight 5. Thus, interference between the lashing link 70 and the counterweight 5 can be prevented by using driving force for falling the gantry 4 without using a dedicated driving device for rotating the lashing link 70.

When the protrusion 42M presses the transmission link 80 along with rotation of the tension member 42, the transmission link 80 transmits a pressing force to the lashing link 70 to enable the lashing link 70 to be easily rotated backward. As a result, the lashing link 70 is smoothly rotated backward in conjunction with change in attitude of the compression member 41 and bending operation of the tension member 42, so that interference between the lashing link 70 and the counterweight 5 can be stably prevented.

The transmission link 80 includes the first link 81 and the second link 82 in the present embodiment. Thus, when the first link 81 and the second link 82 are bent and stretched in conjunction with the bending operation of the tension member 42 including the protrusion 42M, the lashing link 70 can be easily rotated backward. Additionally, a combination of the first link 81 and the second link 82 enables a direction of an acting force to be suitably changed, the acting force being transmitted from the tension member 42 to the lashing link 70, so that a degree of freedom at the time of mounting the interlocking mechanism 7S can be increased. Each of the first link 81 and the second link 82 has a limited movable range, so that unintended behavior of these link members can be prevented.

The protrusion 42M is detachable from the upper end part of the tension member 42 in the present embodiment. Thus, when the lashing link 70 is not required to be rotated, such as when the counterweight 5 is not attached to the upper slewing body 2, the protrusion 42M is removed from the tension member 42 to enable preventing unnecessary rotation of the lashing link 70. Then, interference between the lashing link 70 and the counterweight 5 can be prevented by attaching the protrusion 42M to the tension member 42 as necessary.

The crane 100 including the interlocking mechanism 7S according to an embodiment of the present invention has been described above. The crane 100 as described above enables the lashing link 70 suspended from the gantry 4 to be prevented from interfering with the counterweight 5 when the gantry 4 is changed in attitude. The present invention is not limited to these embodiments. The present invention enables modified embodiments below.

(1) Although the base member, the first member, the second member, and the third member according to the present invention are described in the above embodiments by using the upper slewing body 2, the gantry 4, the lashing link 70, and the counterweight 5, respectively, the present invention is not limited thereto. As the base member, the first member, the second member, and the third member, the interlocking mechanism 7S may be applied to the boom 3, a jib (not illustrated), a jib backstop, a sheave provided at a leading end part of the boom, and the like.

(2) Although the gantry 4 has been described as the support member according to the present invention, the present invention is not limited thereto. The support member may be another member such as a mast. The gantry 4 is not limited to the structure including the compression member 41 and the tension member 42, and may be formed of a single member.

(3) The hoisting member according to the present invention is not limited to the boom 3, and may be another member capable of hoisting.

(4) The counterweight 5 is not limited to one including the plurality of weight bodies 50, and may be a single member.

(5) Fig. 10 is a side view illustrating a state of the interlocking mechanism 7S when the

gantry 4 falls down in the crane 100 according to a modified embodiment of the present invention. The interlocking mechanism 7S in the present modified embodiment includes a pressing member 91 and a guide member 92 instead of the transmission link 80 according to the previous embodiment. The pressing member 91 includes one end part 911 that can come into contact with the protrusion 42M, and another end part 912 that is disposed opposite to the one end part 911 and can come into contact with the lashing link 70. The guide member 92 guides the pressing member 91 in a movable manner along a direction connecting the one end part 911 and the other end part 912.

When the upper member 42A of the tension member 42 rotates in the present modified embodiment, the protrusion 42M presses the one end part 911 backward. As a result, the pressing member 91 is moved along the guide member 92, and the other end part 912 presses the lashing link 70 backward to rotate the lashing link 70 about the lashing link fulcrum part 70P. Even such a structure enables the lashing link 70 to be stably prevented from interfering with the counterweight 5 when the gantry 4 is fallen. In particular, the pressing member 91 is moved while being guided by the guide member 92 in conjunction with bending operation of the tension member 42 including the protrusion 42M, so that the lashing link 70 can be easily rotated backward.

The interlocking mechanism 7S is not limited to the above aspect, and may rotate the lashing link 70 using a driving force of a hydraulic cylinder, an electric motor, or the like. The interlocking mechanism 7S is also not limited to the structure of pushing up the lashing link 70, and may have a structure of pulling up the lashing link 70 (pulling structure).

(6) Fig. 11 is a side view illustrating a state in which a rear strut 21A of a crane 100 according to another modified embodiment of the present invention is raised. The crane 100 illustrated in Fig. 11 includes a lower travelling body 1, an upper slewing body 2, a boom 3, a jib (not illustrated), and the rear strut 21A and a front strut 22A rotatably supported by a leading end part of the boom 3. The jib (not illustrated) is pivotally supported by a jib foot fulcrum part 3T disposed at the leading end part of the boom 3. Fig. 11 illustrates a state during assembly of the crane 100, in which the rear strut 21A is erected above the front strut 22A from a state where the boom 3 and each strut are laid down on the ground. The rear strut 21A includes a proximal end part provided with a strut backstop 25 attached. The strut backstop 25 includes a leading end part that comes into contact with a back surface of the boom 3 erected to prevent further rotation of the rear strut 21A. The strut backstop 25 includes a proximal end part (upper end part) that is rotatably supported by the rear strut 21A about a rotation center axis (second fulcrum part) extending in the left-right direction. The strut backstop 25 is brought into an attitude suspended from the rear strut 21A in the middle of rotation of the rear strut 21A.

To erect the rear strut 21A, a leading end part 14T of a hoisting rope 14 is temporarily

connected to the rear strut 21A. When a winch 32 winds up the hoisting rope 14, the rear strut 21A is rotated in a direction of an arrow DA. At this time, a leading end part of the rear strut 21A may be lifted by a hook 80A of an auxiliary crane.

Then, a jib hoisting rope 44 (44A, 44B) pulled out from a jib hoisting winch 34 is wound around a sheave 47 at the leading end part of the rear strut 21A and a sheave 48 at a leading end part of the front strut 22A via a guide roller 46 fixed to the leading end part of the boom 3. As in Fig. 1, the boom hoisting rope 9 and the pair of left and right boom guy lines 6 are connected to the leading end part of the boom 3.

When the rear strut 21A is rotated in the direction of the arrow DA in the state of Fig. 11, the leading end part (lower end part in Fig. 11) of the strut backstop 25 interferes with the guide roller 46. Thus, the strut backstop 25 is desired to be temporarily flipped backward on its leading end side using a structure similar to that of the previous embodiment. As a result, the leading end part of the strut backstop 25 can be brought into contact with the back surface of the boom 3 beyond the guide roller 46.

That is, the present modified embodiment includes the boom 3 corresponding to the base part of the present invention, the rear strut 21A corresponding to the first member of the present invention, the strut backstop 25 corresponding to the second member of the present invention, and the guide roller 46 corresponding to the third member of the present invention. Then, a connection part between the boom 3 and the rear strut 21A, or a rotation fulcrum of the rear strut 21A, corresponds to the first fulcrum part of the present invention. Additionally, an attitude of the rear strut 21A during assembly of the crane 100 corresponds to the first attitude of the present invention, and an attitude of the rear strut 21A during operation of the crane 100 corresponds to the second attitude of the present invention. Then, a connection part between the rear strut 21A and the strut backstop 25 corresponds to the second fulcrum part of the present invention. The interlocking mechanism 7S similar to that of the above embodiment may be provided corresponding to each of the above members.

The present invention provides a working machine. The working machine includes: a base part; a first member with a proximal end part supported by the base part rotatable about a first fulcrum part, the first member being capable of changing in attitude between a first attitude and a second attitude along with the rotation; a second member with an upper end part supported by the first member to be rotatable about a second fulcrum part, the second member being suspended from the first member in a state where the first member is in the first attitude; a third member disposed below the second member in a state where the first member is in the first attitude; and an interlocking mechanism that causes the second member to rotate about the second fulcrum part to prevent interference between the second member and the third member in conjunction with change

in attitude of the first member from the first attitude to the second attitude.

This configuration enables the interlocking mechanism to prevent the second member suspended from the first member from interfering with the third member when the first member is changed in attitude from the first attitude to the second attitude. As a result, the second member or the third member can be prevented from being damaged while the first member is safely changed in attitude.

The above configuration may be as follows: the base part is a machine body; a hoisting member is further provided and supported by the machine body to be capable of hoisting; the first member includes the proximal end part supported by the machine body behind the hoisting member in a rotatable manner about the first fulcrum part, and a rotation end part on a side opposite to the proximal end part, the first member being capable of changing in attitude between an erected attitude as the first attitude in which the first member is erected with respect to the machine body and a lying attitude as the second attitude in which the first member is laid down with respect to the machine body, and the first member serving as a support member supporting the hoisting member in the erected attitude; the third member is a counterweight supported by the machine body behind the support member; the second member includes the upper end part supported by the rotation end part of the support member in a rotatable manner about the second fulcrum part, the second member being suspended from the rotation end part in a state where the support member is in the erected attitude, and the second member serving as an attitude holder that holds the support member in the lying attitude by being coupled to the counterweight or the machine body in a state where the support member is in the lying attitude; and the interlocking mechanism rotates the attitude holder backward in conjunction with rotation of the support member to prevent interference between the attitude holder and the counterweight along with change in attitude of the support member from the erected attitude to the lying attitude.

The present configuration enables preventing the attitude holder from interfering with the counterweight when the support member is changed in attitude from the erected attitude to the lying attitude. When the support member is brought into the lying attitude, the attitude holder is coupled to the counterweight or the machine body, and thus the working machine can be transported and stored while the support member is maintained in the lying attitude. The attitude holder also can be attached to the support member regardless of an attitude of support member, so that time and effort required for attaching the attitude holder can be saved.

The above configuration may be as follows: the support member includes a compression member rotatably supported about the first fulcrum part behind the hoisting member, and a tension member including an upper end part supported by a leading end part of the compression member in a rotatable manner about a third fulcrum part, and a lower end part connected to the machine

body, the tension member being able to bend and stretch about a bending fulcrum part disposed between the upper end part and the lower end part as a fulcrum; the second fulcrum part of the attitude holder is rotatably supported by the leading end part of the compression member behind the upper end part of the tension member; and the interlocking mechanism rotates the attitude holder backward by transmitting a force of bending the tension member about the bending fulcrum part along with rotation of the compression member about the first fulcrum part from the erected attitude to the lying attitude.

The present configuration causes the interlocking mechanism to transmit a force of bending operation of the tension member to the attitude holder in conjunction with change in attitude of the compression member, thereby rotating the attitude holder backward, and thus enables interference between the attitude holder and the counterweight to be stably prevented.

The above configuration may be as follows: the interlocking mechanism includes a protrusion disposed on the upper end part of the tension member, and a transmission part that transmits pressing force received from the protrusion to the attitude holder along with rotation of the protrusion about the third fulcrum part to rotate the attitude holder backward.

The present configuration causes the protrusion to press the transmission part along with the rotation of the tension member to allow the transmission part to transmit the pressing force to the attitude holder, and thus enable the attitude holder to be easily rotated backward. As a result, the attitude holder is smoothly rotated backward in conjunction with change in attitude of the compression member and bending operation of the tension member, so that interference between the attitude holder and the counterweight can be stably prevented.

The above configuration may be as follows: the transmission part includes: a first link including a first end part capable of coming into contact with the protrusion, a second end part opposite to the first end part, and a link fulcrum part disposed between the first end part and the second end part, and rotatably supported by the leading end part of the compression member; and a second link including a third end part rotatably connected to the second end part of the first link, and a fourth end part that is opposite to the third end part and rotatably connected to a position away from the second fulcrum part in the attitude holder.

The present configuration causes the first link and the second link to bend and stretch in conjunction with bending operation of the tension member including the protrusion, and thus enables the attitude holder to be easily rotated backward.

The above configuration may be as follows: the transmission part includes: a pressing member including one end part capable of coming into contact with the protrusion, and another end part disposed opposite to the one end part and capable of coming into contact with the attitude holder; and a guide member that guides the pressing member in a movable manner along a

direction connecting the one end part and the other end part.

The present configuration causes the pressing member to be moved in conjunction with bending operation of the tension member including the protrusion while the pressing member is guided by the guide member, and thus enables the attitude holder to be easily rotated backward.

The above configuration may be as follows: the protrusion is detachably attached to the upper end part of the tension member.

The present configuration allows the protrusion to be detached from the tension member when the attitude holder does not need to rotate, such as when the counterweight is not mounted on the machine body, and thus enables preventing unnecessary rotation of the attitude holder. Additionally, interference between the attitude holder and the counterweight can be prevented by attaching the protrusion to the tension member as necessary.

The present invention enables preventing a second member suspended from a first member from interfering with another third member during change in attitude of the first member in a working machine.

Claims

1. A working machine comprising:

a base part;

a first member with a proximal end part supported by the base part rotatable about a first fulcrum part, the first member being capable of changing in attitude between a first attitude and a second attitude along with the rotation;

a second member with an upper end part supported by the first member to be rotatable about a second fulcrum part, the second member being suspended from the first member in a state where the first member is in the first attitude;

a third member disposed below the second member in a state where the first member is in the first attitude; and

an interlocking mechanism that causes the second member to rotate about the second fulcrum part to prevent interference between the second member and the third member in conjunction with change in attitude of the first member from the first attitude to the second attitude.

2. The working machine according to claim 1, wherein

the base part is a machine body,

the working machine further includes a hoisting member that is supported by the machine body to be capable of hoisting,

the first member includes the proximal end part supported by the machine body behind the hoisting member in a rotatable manner about the first fulcrum part, and a rotation end part on a side opposite to the proximal end part, the first member being capable of changing in attitude between an erected attitude as the first attitude in which the first member is erected with respect to the machine body and a lying attitude as the second attitude in which the first member is laid down with respect to the machine body, and the first member serving as a support member supporting the hoisting member in the erected attitude,

the third member is a counterweight supported by the machine body behind the support member,

the second member includes the upper end part supported by the rotation end part of the support member in a rotatable manner about the second fulcrum part, the second member being suspended from the rotation end part in a state where the support member is in the erected attitude, and the second member serving as an attitude holder that holds the support member in the lying attitude by being coupled to the counterweight or the machine body in a state where the support member is in the lying attitude, and

the interlocking mechanism rotates the attitude holder backward in conjunction with rotation of the support member to prevent interference between the attitude holder and the counterweight along with change in attitude of the support member from the erected attitude to the lying attitude.

3. The working machine according to claim 2, wherein
the support member includes:

a compression member rotatably supported about the first fulcrum part behind the hoisting member; and

a tension member including an upper end part supported by a leading end part of the compression member in a rotatable manner about a third fulcrum part, and a lower end part connected to the machine body, the tension member being able to bend and stretch about a bending fulcrum part disposed between the upper end part and the lower end part as a fulcrum,

the second fulcrum part of the attitude holder is rotatably supported by the leading end part of the compression member behind the upper end part of the tension member, and

the interlocking mechanism rotates the attitude holder backward by transmitting a force of bending the tension member about the bending fulcrum part along with rotation of the compression member about the first fulcrum part from the erected attitude to the lying attitude.

4. The working machine according to claim 3, wherein
the interlocking mechanism includes:

a protrusion disposed on the upper end part of the tension member; and

a transmission part that transmits pressing force received from the protrusion to the attitude holder along with rotation of the protrusion about the third fulcrum part to rotate the attitude holder backward.

5. The working machine according to claim 4, wherein
the transmission part includes:

a first link including a first end part capable of coming into contact with the protrusion, a second end part opposite to the first end part, and a link fulcrum part disposed between the first end part and the second end part, and rotatably supported by the leading end part of the compression member; and

a second link including a third end part rotatably connected to the second end part of the first link, and a fourth end part that is opposite to the third end part and rotatably connected to a position away from the second fulcrum part in the attitude holder.

6. The working machine according to claim 4, wherein
the transmission part includes:
 - a pressing member including one end part capable of coming into contact with the protrusion, and another end part disposed opposite to the one end part and capable of coming into contact with the attitude holder; and
 - a guide member that guides the pressing member in a movable manner along a direction connecting the one end part and the other end part.
7. The working machine according to claim 4, wherein
the protrusion is detachably attached to the upper end part of the tension member.