

DESCRIPTION**TITLE OF INVENTION: JIB ANCHORING DEVICE****TECHNICAL FIELD**

[0001]

The present invention relates to a jib anchoring device provided on a crane including a boom, and a jib mounted on a distal end of the boom to be raised and lowered.

BACKGROUND ART

[0002]

Patent Literature 1 discloses, on a crane including a tower and a jib, a jib anchoring device for locking the jib in a folded state to the tower. In Patent Literature 1, a locking pin is connected to one end of a lock release lever provided on the tower side, and a connecting member extending to a boom foot is connected to the other end of the lock release lever. When an actuator (drive unit) pulls the connecting member, the lock release lever is pivotally moved around a pivot point, and a state that the locking pin locks a locking shaft on the jib side is released.

CITATION LIST**PATENT LITERATURE**

[0003]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2015-155727

[0004]

In Patent Literature 1, when the actuator becomes inoperable, an operator is allowed to set a state that the locking pin locks the locking shaft on the jib side, and is also allowed to release the locking state by operating to dismount the connecting member from the actuator, and push or pull the connecting member.

[0005]

However, in Patent Literature 1, the connecting member is required to have a rigidity that the connecting member does not deform over several ten meters from the boom foot to the lock release lever. Consequently, the mass of the connecting member increases, and the ability of the crane may be affected. Further, an operation of assembling the connecting member also becomes cumbersome.

SUMMARY OF INVENTION

[0006]

An object of the present invention is to provide a jib anchoring device that enables locking and unlocking of a jib, without the need of a pushing operation by an operator on the ground, even

when a drive unit becomes inoperable.

MEANS FOR SOLVING THE PROBLEMS

[0007]

What is provided by the present invention is a jib anchoring device provided on a crane including a boom, and a jib mounted on a distal end of the boom to be raised and lowered, the jib being foldable with respect to the boom, the jib anchoring device being operative to anchor the jib to the boom. The jib anchoring device includes: a locking portion provided on the boom; a locked portion provided on the jib, and operative to be locked by the locking portion, when the jib is folded with respect to the boom; a lock switching member movable between a lock permissible position and a lock release position, operative to switch a locking state of the locked portion by the locking portion, configured to allow the locking portion to lock the locked portion when located at the lock permissible position, and configured to release locking of the locked portion by the locking portion when located at the lock release position; a biasing portion for biasing the lock switching member in such a way that the lock switching member is located at the lock permissible position; a drive unit mounted on the locking portion, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion; a power transmission mechanism mounted on the locking portion, configured to allow power of the drive unit to be transmitted to the lock switching member when being in an energized state, and configured to prevent power of the drive unit from being transmitted to the lock switching member when being in a de-energized state; and a pulling member connected to the lock switching member, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion by being pulled by an operator, when the power transmission mechanism is in the de-energized state.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

FIG. 1 is a side view of a crane according to a first embodiment of the present invention.

FIG. 2 is an enlarged plan view of a jib anchoring device according to the first embodiment of the present invention.

FIG. 3 is a cross-sectional view of the jib anchoring device according to the first embodiment of the present invention, taken along the line A-A in FIG. 2.

FIG. 4 is a cross-sectional view of the jib anchoring device according to the first embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram illustrating a state that a locked portion is locked to a locking portion.

FIG. 5 is a cross-sectional view of the jib anchoring device according to the first embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram

illustrating a state that locking of the locked portion to the locking portion is released.

FIG. 6 is a cross-sectional view of a jib anchoring device according to a second embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram illustrating a state that a locked portion is locked to a locking portion.

FIG. 7 is a cross-sectional view of the jib anchoring device according to the second embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram illustrating a state that locking of the locked portion to the locking portion is released.

FIG. 8 is a cross-sectional view of the jib anchoring device according to the second embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram illustrating a state that the locked portion is not locked to the locking portion.

FIG. 9 is a cross-sectional view of the jib anchoring device according to the second embodiment of the present invention, taken along the line B-B in FIG. 2, and is a diagram illustrating a state that the locked portion is being locked to the locking portion.

DESCRIPTION OF EMBODIMENTS

[0009]

In the following, preferred embodiments according to the present invention are described with reference to the drawings.

[0010]

[First Embodiment]

FIG. 1 is a side view of a tower crane 20 (crane) according to a first embodiment of the present invention. A jib anchoring device 1 according to the present embodiment is provided on the tower crane 20. The tower crane 20 includes a crawler type lower traveling body 21, and an upper turning body 22 turnably mounted on the lower traveling body 21. The tower crane 20 may be a traveling type crane using a moving mechanism (e.g. a wheel) other than a crawler, or may be a fixed crane without a moving mechanism. Further, an object to which the present invention is applied is not limited to a tower crane. For example, the present invention is also applicable to another crane such as a luffing crane.

[0011]

The tower crane 20 includes an operation room 23, a tower 24 (boom), a jib 25, a gantry 26, a strut 27, a lower spreader 28, a winch (not illustrated), a counterweight 29, a backstop device 30, a hook 33, a jib guy line 34, a jib hoisting lower spreader 35, a jib guy line 36, a jib hoisting upper spreader 37, a jib hoisting rope 38, a boom guy line 39, an upper spreader 40, a boom hoisting rope 41, and a plurality of unillustrated winches.

[0012]

The operation room 23 is provided at a front portion of the upper turning body 22. The

tower 24 is connected to the front portion of the upper turning body 22 to be raised and lowered with respect to the upper turning body 22. One end of the boom guy line 39 is connected to a distal end of the tower 24.

[0013]

The jib 25 is connected to the distal end of the tower 24 to be raised and lowered with respect to the tower 24. The jib 25 is foldable with respect to the tower 24, as will be described later. A jib point sheave 31 is provided at a distal end of the jib 25. The hook 33 hangs from the jib point sheave 31 via a hoisting rope 32. In FIG. 1, a work state being a state in which the jib 25 extends obliquely upward toward the front side is indicated by the solid line, and a locked state being a state that the jib 25 is folded and locked to a front surface of the tower 24 is indicated by the two-dotted chain line.

[0014]

The gantry 26 is mounted on a rear portion of the upper turning body 22. The strut 27 has a triangular shape in a side plan view, and is mounted on the distal end of the tower 24. The strut 27 includes a front strut portion 27b and a rear strut portion 27a. A distal end of the front strut portion 27b of the strut 27 and the distal end of the jib 25 are connected by the jib guy line 34.

[0015]

The jib hoisting rope 38 hangs between the jib hoisting lower spreader 35 mounted on the back side of a lower portion of the tower 24, and the jib hoisting upper spreader 37 connected to one end of the jib guy line 36. The other end of the jib guy line 36 is connected to a distal end of the rear strut portion 27a of the strut 27.

[0016]

The lower spreader 28 is mounted on an upper end of the gantry 26. The boom hoisting rope 41 hangs between the lower spreader 28, and the upper spreader 40 connected to the other end of the boom guy line 39.

[0017]

A plurality of winches are disposed at a central portion of the upper turning body 22. Among the winches, a hook winch raises or lowers the hook 33 by winding or unwinding the hoisting rope 32. Further, a jib hoisting winch raises or lowers the strut 27 around a connecting point with respect to the distal end of the tower 24 by winding or unwinding the jib hoisting rope 38. Consequently, the jib 25 is raised or lowered around the connecting point with respect to the tower 24. Further, a boom hoisting winch raises or lowers the tower 24 around a boom foot pin 42 being a pivot point of the tower 24 by winding or unwinding the boom hoisting rope 41.

[0018]

The counterweight 29 is loaded on the rear portion of the upper turning body 22. The backstop device 30 is provided on the back side of the lower portion of the tower 24. Biasing the tower 24 forward by a spring 30a of the backstop device 30 prevents the tower 24 from falling backward even in a state that the tower 24 is raised substantially at 90 degrees with respect to a horizontal direction.

[0019]

Details of the jib anchoring device 1 are described. FIG. 2 is an enlarged plan view of the jib anchoring device 1 according to the present embodiment. FIG. 3 is a cross-sectional view taken along the line A-A in FIG. 2. FIGS. 4 and 5 are each a cross-sectional view taken along the line B-B in FIG. 2.

[0020]

As illustrated in FIG. 2, the jib anchoring device 1 includes a locking device 2 (locking portion), and a locked device 3 (locked portion), and enables to anchor the jib 25 to the tower 24. As illustrated in FIG. 1, the locking device 2 is provided on the front surface of the tower 24. The locked device 3 is provided on the jib 25. The locked device 3 is provided at a position facing the locking device 2, when the jib 25 is folded with respect to the tower 24. Locking the locked device 3 by the locking device 2 in a folded state of the jib 25 enables locking of the jib 25 to the tower 24 in the air.

[0021]

As illustrated in FIGS. 4 and 5, the locking device 2 includes a locking pin 51 extending in the up-down direction, a tower bracket 52, a casing 53 (FIG. 3), and a pin blocking member 58. The locking pin 51 achieves locking and unlocking of the jib 25 by moving between a locking position (position illustrated in FIG. 4) where the locking pin 51 locks a locking shaft 61 of the locked device 3, and a release position (position illustrated in FIG. 5) where locking of the locking shaft 61 is released.

[0022]

The tower bracket 52 is fixed to the tower 24. The tower bracket 52 is provided with a locking frame 56 including an upper plate 56S and a lower plate 56T (FIGS. 4 and 5). The upper plate 56S and the lower plate 56T are disposed to face each other with a gap in the up-down direction. A guide cylinder 56a is disposed on the upper plate 56S of the locking frame 56, and a locking hole 56b is formed in the lower plate 56T at a position facing the guide cylinder 56a. The locking pin 51 is movable between a locking position being a position where the locking pin 51 fits in the locking hole 56b, and a release position being a position where the locking pin 51 is displaced upward from the locking hole 56b by moving up and down within the guide cylinder 56a along an axis direction of the locking pin 51.

[0023]

The pin blocking member 58 is provided within the locking frame 56. The pin blocking member 58 is movable between the upper plate 56S and the lower plate 56T in the front-rear direction within the locking frame 56, and is biased forward by a spring 58a. As illustrated in FIG. 5, when the locking pin 51 is in the release position, the locking pin 51 is biased by the spring 58a up to a position where the pin blocking member 58 closes a part of the guide cylinder 56a. Thus, the locking pin 51 is blocked by the pin blocking member 58, and is not allowed to move to the locking position, specifically, enter into the locking hole 56b through a space between the upper plate 56S and the lower plate 56T.

[0024]

As illustrated in FIG. 2, the locked device 3 provided on the jib 25 includes the locking shaft 61, a jib bracket 62 mounted on the jib 25, and a pair of left and right shaft support brackets 63. Causing the locking shaft 61 to be locked by the locking pin 51 locks the jib 25 in a folded state to the tower 24. The paired left and right support brackets 63 are provided on the jib bracket 62 to protrude toward the tower bracket 52. Bearings 63a are respectively provided on distal ends of the paired left and right shaft support brackets 63, and the locking shaft 61 intersecting (orthogonally intersecting) the locking pin 51 is supported by the paired left and right bearings 63a.

[0025]

Further, as illustrated in FIG. 3, the jib anchoring device 1 includes a lock release lever 4 (lock switching member), a spring 5 (biasing portion), a motor 6 (drive unit), a clutch 7 (power transmission mechanism), and a decelerator.

[0026]

The lock release lever 4 is connected to the clutch 7 to be pivotally movable around an axis extending in the front-rear direction of the clutch 7. The locking pin 51 is connected to a left end (right end on the plane of FIG. 3) of the lock release lever 4 in such a way as to extend downward. The lock release lever 4 is movable (pivotally movable) between a lock permissible position and a lock release position, and is operative to switch a locking state of the locked device 3 by the locking device 2. The lock release lever 4 allows the locking device 2 to lock the locked device 3, when being located at the lock permissible position, and releases locking of the locked device 3 by the locking device 2, when being located at the lock release position. In other words, the lock release lever 4 is movable (pivotally movable) between the lock permissible position (position illustrated in FIG. 3) where the locking pin 51 is moved to the locking position, and the lock release position (not illustrated) where the locking pin 51 is moved to the release position.

[0027]

The lock release lever 4 includes a protrusion 4a disposed at a right end (left end on the plane of FIG. 3) thereof, and extending obliquely downward. The protrusion 4a protrudes from the tower bracket 52 of the locking device 2 in a direction orthogonal to the axis direction of the tower 24, when the lock release lever 4 is located at the lock permissible position. In the present embodiment, the protrusion 4a protrudes from the tower bracket 52 of the locking device 2 in the width direction of the tower 24 (the arrow DT in FIG. 3, the left-right direction), when the lock release lever 4 is located at the lock permissible position. However, the protruding direction is not limited to the above. Causing the protrusion 4a to protrude from the locking device 2 when the lock release lever 4 is located at the lock permissible position allows an operator to view the protrusion 4a from the operation room 23. When the lock release lever 4 is located at the lock release position, a peripheral edge 4S continuing to the protrusion 4a is disposed (to overlap) along an end surface 52S of the tower bracket 52. Therefore, the operator is obstructed from viewing the protrusion 4a as described above. The difference in the protrusion state of the protrusion 4a allows the operator to recognize a state of the lock release lever 4, specifically, a state of the locking pin 51.

[0028]

The spring 5 interconnects the tower bracket 52 and the lock release lever 4. In the present embodiment, the spring 5 is disposed between a shaft of the clutch 7 and the locking pin 51 in the lock release lever 4, and is connected to the vicinity of the shaft of the clutch 7. The spring 5 biases the lock release lever 4 in such a way that the lock release lever 4 is located at the lock permissible position. The position of the spring 5 is not limited to the above.

[0029]

The motor 6 and the clutch 7 are mounted on the locking device 2. Specifically, the motor 6 and the clutch 7 are accommodated together with the decelerator within the casing 53 provided in the tower bracket 52. The motor 6 is operative to move (turn) the lock release lever 4 from the lock permissible position to the lock release position against a biasing force of the spring 5. The decelerator is disposed between the motor 6 and the clutch 7, and behind the clutch 7 illustrated in FIG. 3.

[0030]

The clutch 7 is an electromagnetic clutch, and is switched between an energized state and a de-energized state by receiving input of energizing current from a predetermined power supply. The clutch 7 transmits power of the motor 6 to the lock release lever 4 (allows power of the motor 6 to be transmitted to the lock release lever 4) when being in an energized state. Thus, when the clutch 7 is in an energized state, the lock release lever 4 does not freely turn, and is allowed to turn while being constrained by the motor 6. On the other hand, when the clutch 7 is in a de-energized

state, power of the motor 6 is not transmitted to the lock release lever 4 (power of the motor 6 is prevented from being transmitted to the lock release lever 4). Thus, when the clutch 7 is in a de-energized state, the lock release lever 4 freely turns without being constrained by the motor 6.

[0031]

Further, as illustrated in FIG. 3, the jib anchoring device 1 includes a rope 8 (pulling member). The rope 8 is connected to a right end (left end on the plane of FIG. 3) of the lock release lever 4. More specifically, the rope 8 includes one end to be connected to a portion of the lock release lever 4 between the shaft of the clutch 7 and the protrusion 4a, and the other end on a side opposite to the one end and to be held by the operator on the ground. Allowing the operator to pull the rope 8 when the clutch 7 is in a de-energized state allows the lock release lever 4 to move from the lock permissible position to the lock release position against a biasing force of the spring 5. Further, allowing the operator to stop pulling the rope 8 when the clutch 7 is in the de-energized state allows the lock release lever 4 to move from the lock release position to the lock permissible position by the biasing force of the spring 5. The lock release lever 4 may be configured to move from the lock release position to the lock permissible position by the own weight of the locking pin 51.

[0032]

As illustrated in FIG. 3, the jib anchoring device 1 further includes two limit switches (detection units) 9 and 10, and a controller 11. The limit switch 9 is mounted on the tower bracket 52 on a side opposite to the locking pin 51 when viewed from the clutch 7. When the lock release lever 4 is moved from the lock permissible position to the lock release position, a lower side surface of the lock release lever 4 comes into contact with the limit switch 9. Thus, the limit switch 9 detects that the lock release lever 4 has moved from the lock permissible position to the lock release position.

[0033]

The limit switch 10 is mounted on the tower bracket 52 at a position below a left end (right end on the plane of FIG. 3) of the lock release lever 4. When the lock release lever 4 is moved from the lock release position to the lock permissible position, a lower surface of the right end of the lock release lever 4 comes into contact with the limit switch 10. Thus, the limit switch 10 detects that the lock release lever 4 has moved from the lock release position to the lock permissible position.

[0034]

The controller 11 controls driving and stopping of the motor 6, based on a position of the lock release lever 4. Specifically, the controller 11 includes a transmission control unit operative to switch the clutch 7 between the energized state and the de-energized state, and a drive control

unit operative to control driving and stopping of the motor 6, based on detection results of the limit switches 9 and 10. When an operation switch (locking switch) disposed in the operation room 23 and configured to instruct the operator to lock the jib 25 is turned on during a time when the limit switch 10 detects that the lock release lever 4 is in the lock permissible position, the controller 11 causes the clutch 7 to switch from a de-energized state to an energized state, and causes the motor 6 to rotate. Further, when the limit switch 9 detects that the lock release lever 4 has moved from the lock permissible position to the lock release position, the controller 11 causes the motor 6 to stop rotating, and causes the clutch 7 to switch from an energized state to a de-energize state.

[0035]

The embodiment is not limited to a configuration in which the limit switch 9 detects that the lock release lever 4 has moved from the lock permissible position to the lock release position, and may include a configuration in which a servo motor (detection unit) is employed as the motor 6. In the above modified configuration, the motor 6 detects, from a rotational angle thereof, that the lock release lever 4 has moved from the lock permissible position to the lock release position. The controller 11 causes the motor 6 to stop rotating, and causes the clutch 7 to switch to a de-energized state, based on a signal to be output from the motor 6 in response to movement of the lock release lever 4 to the lock release position.

[0036]

Next, an operation of the jib anchoring device 1 is described.

[0037]

As illustrated in FIG. 4, causing the locking pin 51 in a locking position to lock the locking shaft 61 located on the tower 24 side with respect to the locking pin 51 allows the jib 25 to be locked to the front surface of the tower 24. Detection that the jib 25 is in a locked state is notified to the operator by causing the controller 11 to output a predetermined signal to a monitor lamp provided in the operation room 23 according to detection results of the limit switches 9 and 10, and causing the monitor lamp to emit light. Further, the operator is allowed to view the protrusion 4a of the lock release lever 4 from the operation room 23. In this state, the clutch 7 is in a de-energized state.

[0038]

When locking of the jib 25 is released, the operator turns on an operation switch (release switch) disposed in the operation room 23, and configured to release locking of the jib 25. Then, as illustrated in FIG. 3, the clutch 7 is switched to an energized state, and the motor 6 is rotated by the controller 11. Transmitting rotation of the motor 6 by the clutch 7 allows the lock release lever 4 to move from the lock permissible position to the lock release position (arrow D1 in FIG. 3).

[0039]

Consequently, as illustrated in FIG. 5, the locking pin 51 is moved to the release position, and the locking state of the locking shaft 61 is released. Then, the locking shaft 61 is pushed toward the pin blocking member 58 by a biasing force of the spring 58a. At this occasion, the operator operates the tower crane 20 in such a way that the jib 25 is raised and lowered in so as to swing the jib 25 forward away from the tower 24 and releases locking of the jib 25. At this occasion, the locking pin 51 is blocked by the pin blocking member 58, and the locking pin 51 does not return to the locking position.

[0040]

When the limit switch 9 in FIG. 3 detects that the lock release lever 4 has moved to the lock release position, the clutch 7 is switched to a de-energized state, and rotation of the motor 6 is stopped by the controller 11. Detection by the limit switch 9 that locking of the jib 25 is released is notified to the operator via the monitor lamp provided in the operation room 23 by causing the controller 11 to output a predetermined signal.

[0041]

When the clutch 7 is switched to the de-energized state, the lock release lever 4 attempts to move to the lock permissible position by a biasing force of the spring 5. However, as illustrated in FIG. 5, since the locking pin 51 is blocked by the pin blocking member 58, the lock release lever 4 does not return to the lock permissible position.

[0042]

When the jib 25 is locked, the jib 25 is folded toward the front surface of the tower 24 in the state illustrated in FIG. 5. At this occasion, the clutch 7 is in a de-energized state. When the jib 25 is folded, the locking shaft 61 comes into contact with the pin blocking member 58, and pushes the pin blocking member 58 toward the tower 24 against a biasing force of the spring 58a. Consequently, blocking of the locking pin 51 by the pin blocking member 58 is released, and the lock release lever 4 moves from the lock release position to the lock permissible position (arrow D2 in FIG. 3) by a biasing force of the spring 5, and concurrently, the locking pin 51 moves from the release position to the locking position for preventing disengagement of the locking shaft 61, thereby locking the jib 25 to the tower 24. The limit switch 10 detects that the lock release lever 4 has moved to the lock permissible position again. Detection by the limit switch 10 that the jib 25 is locked is notified to the operator via the monitor lamp provided in the operation room 23 by causing the controller 11 to output a predetermined signal. Further, the operator is allowed to view the protrusion 4a of the lock release lever 4 again from the operation room 23.

[0043]

The operator on the ground can move the lock release lever 4 from the lock permissible

position to the lock release position against a biasing force of the spring 5 by pulling the rope 8 illustrated in FIG. 3 in a locked state of the jib 25. Thus, it is possible to release locking of the locked device 3 to the locking device 2 without depending on power of the motor 6. Further, when the operator weakens the pulling force applied to the rope 8, the lock release lever 4 is allowed to move from the lock release position to the lock permissible position again by the biasing force of the spring 5. This enables manual locking and unlocking.

[0044]

As described above, in the jib anchoring device 1 according to the present embodiment, it is possible to lock the locked device 3 to the locking device 2 by setting the clutch 7 to a de-energized state, and moving the lock release lever 4 from the lock release position to the lock permissible position by the spring 5, when the jib 25 in a folded state with respect to the tower 24 is anchored to the tower 24. On the other hand, it is possible to release locking of the locked device 3 to the locking device 2 by setting the clutch 7 to an energized state, and moving the lock release lever 4 from the lock permissible position to the lock release position by the motor 6, when the jib 25 anchored to the tower 24 is released from the tower 24. Alternatively, it is possible to release locking of the locked device 3 to the locking device 2 by setting the clutch 7 to a de-energized state, and moving the lock release lever 4 from the lock permissible position to the lock release position by the rope 8, when the jib 25 anchored to the tower 24 is released from the tower 24. In this way, setting the clutch 7 to a de-energized state enables locking of the locked device 3 to the locking device 2, and also enables to release locking of the locked device 3 to the locking device 2. Therefore, not only in a case where the motor 6 (actuator) is operable, but also in a case where the motor 6 becomes inoperable, locking and unlocking of the jib 25 are enabled. Further, since sizes of the motor 6 and the clutch 7 to be mounted on the locking device 2 are smaller than that of the connecting member in Patent Literature 1, it is possible to use, as the motor 6 and the clutch 7, lightweight members as compared with the connecting member. Further, since the lock release lever 4 is allowed to move to the lock permissible position by the spring 5 by setting the clutch 7 to a de-energized state, the operator does not have to operate the rope 8 in a pushing direction. Thus, rigidity as required for the connecting member in Patent Literature 1 is not required for the rope 8. Therefore, it is possible to use, as the rope 8, a lightweight member as compared with the connecting member. This enables to reduce the mass of the tower 24. Further, the motor 6 and the clutch 7 do not have to be dismounted, once being mounted on the locking device 2. Furthermore, the rope 8 does not require assembling as required for the connecting member. This enables to improve the assembling performance.

[0045]

The protrusion 4a protrudes from the locking device 2 in a direction orthogonal to the

axis direction of the tower 24 in such a way that the operator is allowed to view the protrusion 24a from the operation room 23 of the tower crane 20, when the lock release lever 4 is located at the lock permissible position. The operator can confirm that the lock release lever 4 is located at the lock permissible position, specifically, the locked device 3 is locked to the locking device 2 by viewing the protrusion 4a from the operation room 23.

[0046]

Further, in the present embodiment, the drive control unit of the controller 11 controls driving and stopping of the motor 6, based on a position of the lock release lever 4 by detection results of the limit switches 9 and 10. This allows the motor 6 to drive, when the lock release lever 4 is located at the lock permissible position, and allows the motor 6 to stop driving, when the lock release lever 4 is located at the lock release position.

[0047]

[Second Embodiment]

Next, a jib anchoring device 101 according to a second embodiment is described with reference to the drawings. Description about a configuration common to the first embodiment, and advantageous effects provided by the configuration is omitted, and points (such as a configuration of a locking device) different from the first embodiment are mainly described. Note that same members as those in the first embodiment are designated by same reference numerals as those in the first embodiment.

[0048]

FIGS. 6 to 9 are diagrams corresponding to cross-sectional views of the jib anchoring device 101 according to the present embodiment, taken along the line B-B in FIG. 2. The jib anchoring device 101 according to the present embodiment includes a locking device 102, in place of a locking device 2. The locking device 102 includes a latch 71, and a latch support bracket 73 (a bracket, a support member). The latch 71 achieves locking and unlocking of a jib 25 by moving between a locking position (position illustrated in FIG. 6) where the latch 71 locks a locking shaft 61 of a locked device 3, and a release position (position illustrated in FIG. 7) where locking of the locking shaft 61 is released.

[0049]

The latch 71 is pivotally connected to the latch support bracket 73 mounted on a tower bracket 72 via a support pin 73a. The latch 71 includes a downward protruding claw 71a. An engaging groove 71b engageable with the locking shaft 61 is formed in the latch 71 on a side of the latch support bracket 73 with respect to the claw 71a. Further, a slope 71c inclined downward toward the latch support bracket 73 (in such a way as to approach the engaging groove 71b) is formed on the latch 71 on a side opposite to the engaging groove 71b with respect to the claw 71a.

[0050]

The latch 71 is movable (pivotally movable) between a locking position where the locking shaft 61 fits in the engaging groove 71b, and a release position where the locking shaft 61 is displaced from the engaging groove 71b.

[0051]

A spring 74 is interposed between a lower portion of the latch 71 with respect to the support pin 73a, and the latch support bracket 73. The latch 71 is biased to be located at the locking position by the spring 74.

[0052]

A lock release lever 4 is connected to a distal end of the latch 71 on a side opposite to the latch support bracket 73 via a rope 75. A position of the lock release lever 4 at which the rope 75 is connected is a position similar to a portion of the lock release lever 4 where the locking pin 51 in FIG. 3 is supported.

[0053]

Next, an operation of the jib anchoring device 101 is described.

[0054]

As illustrated in FIG. 6, engaging the locking shaft 61 in the engaging groove 71b of the latch 71 in the locking position locks the jib 25 to a front surface of a tower 24. Similarly to the first embodiment, detection that the jib 25 is in a locked state is notified to an operator via a monitor lamp provided in an operation room 23. Further, the operator is allowed to view a protrusion 4a (FIG. 3) of the lock release lever 4 from the operation room 23. In this state, a clutch 7 (see FIG. 3) is in a de-energized state.

[0055]

When locking of the jib 25 is released, the operator turns on an operation switch in the operation room 23. Then, the clutch 7 is set to an energized state, and a motor 6 is rotated by a controller 11. Transmitting rotation of the motor 6 by the clutch 7 allows the lock release lever 4 to move from a lock permissible position to a lock release position (arrow D1 in FIG. 3).

[0056]

Consequently, as illustrated in FIG. 7, a distal end of the latch 71 is pulled up by the rope 75, and the locking state of the locking shaft 61 is released. At this occasion, the operator operates the jib anchoring device 101 in such a way that the jib 25 is raised and lowered to swing forward away from the tower 24 and releases locking of the jib 25. When movement of the lock release lever 4 to the lock release position is detected by a limit switch 9, the clutch 7 is switched to a de-energized state, and rotation of the motor 6 is stopped by the controller 11. Detection by the limit switch 9 that locking of the jib 25 is released is notified to the operator via the monitor

lamp provided in the operation room 23.

[0057]

When the clutch 7 is switched to the de-energized state, the lock release lever 4 is moved to the lock permissible position by a biasing force of a spring 5 (arrow D2 in FIG. 3). Further, as illustrated in FIG. 8, the latch 71 is moved to the locking position by a biasing force of the spring 74.

[0058]

When the jib 25 is locked, the jib 25 is folded toward the front surface of the tower 24 in the state illustrated in FIG. 8. At this occasion, the clutch 7 is in a de-energized state. When the jib 25 is folded, as illustrated in FIG. 9, the locking shaft 61 comes into contact with the slope 71c of the latch 71, and slidably moves along the slope 71c, thereby allowing the latch 71 to pivotally move toward the release position against the biasing force of the spring 74. Then, when the locking shaft 61 climbs over the claw 71a, as illustrated in FIG. 6, the locking shaft 61 engages in the engaging groove 71b, and the jib 25 is locked to the tower 24. A limit switch 10 detects that the lock release lever 4 has moved to the lock permissible position. Detection by the limit switch 10 that the jib 25 is locked is notified to the operator via the monitor lamp provided in the operation room 23. Further, the operator is allowed to view the protrusion 4a of the lock release lever 4 from the operation room 23.

[0059]

In a locked state of the jib 25, as illustrated in FIG. 3, the operator can move the lock release lever 4 from the lock permissible position to the lock release position against a biasing force of the spring 5 by pulling the rope 8. This enables to release locking of the locked device 3 to the locking device 2 without depending on power of the motor 6.

[0060]

The present embodiment provides advantageous effects similar to those in the first embodiment. A connecting rod constituted of a rigid member or the like may be disposed, in place of the rope 75 according to the present embodiment.

[0061]

In the foregoing, the embodiments according to the present invention have been described. However, the embodiments merely describe specific examples, and do not specifically limit the present invention. A specific configuration and the like can be designed and modified as necessary. Further, the advantageous effects described in the embodiments according to the present invention are merely some of the most preferred advantageous effects provided by the present invention. The advantageous effects according to the present invention are not limited to those described in the embodiments according to the present invention.

[0062]

As described above, what is provided by the present invention is a jib anchoring device provided on a crane including a boom, and a jib mounted on a distal end of the boom to be raised and lowered, the jib being foldable with respect to the boom, the jib anchoring device being operative to anchor the jib to the boom. The jib anchoring device includes: a locking portion provided on the boom; a locked portion provided on the jib, and operative to be locked by the locking portion, when the jib is folded with respect to the boom; a lock switching member movable between a lock permissible position and a lock release position, operative to switch a locking state of the locked portion by the locking portion, configured to allow the locking portion to lock the locked portion when located at the lock permissible position, and configured to release locking of the locked portion by the locking portion when located at the lock release position; a biasing portion for biasing the lock switching member in such a way that the lock switching member is located at the lock permissible position; a drive unit mounted on the locking portion, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion; a power transmission mechanism mounted on the locking portion, configured to allow power of the drive unit to be transmitted to the lock switching member when being in an energized state, and configured to prevent power of the drive unit from being transmitted to the lock switching member when being in a de-energized state; and a pulling member connected to the lock switching member, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion by being pulled by an operator, when the power transmission mechanism is in the de-energized state.

[0063]

In the above configuration, the jib anchoring device may preferably further include a transmission control unit operative to switch the power transmission mechanism between the energized state and the de-energized state. The transmission control unit may lock the locked portion by the locking portion by setting the power transmission mechanism to a de-energized state, and allowing the lock switching member to move from the lock release position to the lock permissible position by a biasing force of the biasing portion so as to anchor, to the boom, the jib in a folded state with respect to the boom, and the transmission control unit may release locking of the locked portion by the locking portion by setting the power transmission mechanism to an energized state, and allowing the lock switching member to move from the lock permissible position to the lock release position by power of the drive unit, or by setting the power transmission mechanism to a de-energized state, and allowing the lock switching member to move from the lock permissible position to the lock release position by the pulling member so as to release, from

the boom, the jib anchored to the boom.

[0064]

In the above configuration, preferably, the lock switching member may include a protrusion protruding from the locking portion in a direction orthogonal to an axis direction of the boom in such a way that an operator is allowed to view the protrusion from an operation room of the crane, when the lock switching member is located at the lock permissible position.

[0065]

In the above configuration, the jib anchoring device may further include: a detection unit operative to detect at least that the lock switching member has moved from the lock permissible position to the lock release position; and a drive control unit operative to control driving and stopping of the drive unit, based on a detection result of the detection unit.

CLAIMS

1. A jib anchoring device provided on a crane including a boom, and a jib mounted on a distal end of the boom to be raised and lowered, the jib being foldable with respect to the boom, the jib anchoring device being operative to anchor the jib to the boom, comprising:

a locking portion provided on the boom;

a locked portion provided on the jib, and operative to be locked by the locking portion, when the jib is folded with respect to the boom;

a lock switching member movable between a lock permissible position and a lock release position, operative to switch a locking state of the locked portion by the locking portion, configured to allow the locking portion to lock the locked portion when located at the lock permissible position, and configured to release locking of the locked portion by the locking portion when located at the lock release position;

a biasing portion for biasing the lock switching member in such a way that the lock switching member is located at the lock permissible position;

a drive unit mounted on the locking portion, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion;

a power transmission mechanism mounted on the locking portion, configured to allow power of the drive unit to be transmitted to the lock switching member when being in an energized state, and configured to prevent power of the drive unit from being transmitted to the lock switching member when being in a de-energized state; and

a pulling member connected to the lock switching member, and operative to move the lock switching member from the lock permissible position to the lock release position against a biasing force of the biasing portion by being pulled by an operator, when the power transmission mechanism is in the de-energized state.

2. The jib anchoring device according to claim 1, further comprising

a transmission control unit operative to switch the power transmission mechanism between the energized state and the de-energized state, wherein

the transmission control unit locks the locked portion by the locking portion by setting the power transmission mechanism to a de-energized state, and allowing the lock switching member to move from the lock release position to the lock permissible position by a biasing force of the biasing portion so as to anchor, to the boom, the jib in a folded state with respect to the boom, and

the transmission control unit releases locking of the locked portion by the locking portion by setting the power transmission mechanism to an energized state, and allowing the lock switching member to move from the lock permissible position to the lock release position by power of the drive unit, or by setting the power transmission mechanism to a de-energized state, and allowing the lock switching member to move from the lock permissible position to the lock release position by the pulling member so as to release, from the boom, the jib anchored to the boom.

3. The jib anchoring device according to claim 1 or 2, wherein

the lock switching member includes a protrusion protruding from the locking portion in a direction orthogonal to an axis direction of the boom in such a way that an operator is allowed to view the protrusion from an operation room of the crane, when the lock switching member is located at the lock permissible position.

4. The jib anchoring device according to any one of claims 1 to 3, further comprising:

a detection unit operative to detect at least that the lock switching member has moved from the lock permissible position to the lock release position; and

a drive control unit operative to control driving and stopping of the drive unit, based on a detection result of the detection unit.