

Description

Title of Invention

CRANE AND CRANE ASSEMBLING METHOD

Technical Field

[0001] The present invention relates to a crane in which a boom head, a strut, and a lower jib are integrally coupled to a distal end portion of a laid down boom main body, and a crane assembling method therefor.

Background Art

[0002] Patent Literature 1 discloses a disassembling transport method of transporting a boom head (tower cap) disassembled from a boom main body and a lower jib in a coupled state.

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent Application Laid-Open No. 2014-114101

[0004] Work of connecting a lower jib and a strut to a boom head requires much effort. Therefore, nowadays, there is a demand for a construction method for integrally assembling and disassembling a boom head, a lower jib, and a strut in consideration of efficiency in work of assembling and disassembling a crane and in transportation.

[0005] However, in a case of this construction method, depending on a posture of the boom head during transportation, it may be difficult to couple the boom head to a distal end portion of a laid down boom unless the posture of the boom head is changed. However, when the posture of the boom head is changed, if the lower jib or the strut integrated with the boom head interferes with the ground or a peripheral member, there occurs a problem of difficulty in changing the posture of the boom head.

Summary of Invention

[0006] An object of the present invention is to provide a crane capable of easily coupling a boom head to a distal end portion of a laid down boom main body, and a crane assembling method therefor.

[0007] Provided by the present invention is a crane including: a crane main body; a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal end portion of the boom main body; a jib having a lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib; a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the jib are raised, the strut supporting the jib so as to be raised and lowered; and a support portion that is mounted on the lower jib and is capable of supporting a portion of the strut closer to a

distal end side than to the second rotation center axis, in which the strut and the lower jib are mounted on the boom head and the strut is placed on the support portion, thereby configuring a coupling unit with the strut, the lower jib, and the boom head, the coupling unit being allowed to be integrally coupled to the distal end portion of the boom main body laid down with respect to the crane main body, and in a state where the boom head is disposed to face the distal end portion of the laid down boom main body, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, the strut is rotatably supported by the boom head above the lower jib, and the coupling unit is lifted up so as to be placed on the support portion, the support portion supports the strut such that the boom head is allowed to change a posture with respect to the boom main body by rotation of the lower jib around the first rotation center axis and rotation of the strut around the second rotation center axis, and relative movement of the lower jib in a front-rear direction with respect to the strut while the strut is in contact with the support portion.

[0008] Further, provided by the present invention is a method of assembling a crane, in which the crane includes: a crane main body; a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal end portion of the boom main body; a jib having a lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib; and a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the jib are raised, the strut supporting the jib so as to be raised and lowered. The assembling method includes: a preparation step of rotatably mounting the strut and the lower jib on the boom head to prepare a coupling unit configured by the boom head, the strut, and the lower jib; a first coupling step of lifting, of the coupling unit, at least the boom head and the lower jib and coupling a back surface side portion of the boom head to the distal end portion of the boom main body laid down with respect to the crane main body so as to be rotatable around a third rotation center axis parallel to the first rotation center axis such that the boom head is disposed to face the distal end portion of the boom main body laid down, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, and the strut is rotatably supported by the boom head above the lower jib and is placed on a support portion provided in the lower jib; a moving step of relatively moving the lower jib with respect to the strut toward the boom main body side while supporting, by the support portion, a portion of the strut closer to a distal end side than to the second rotation center axis, and rotating the boom head around the third rotation center axis, thereby moving a front surface side portion of the boom head to the distal end portion of the boom main body; and a second coupling step of coupling the front surface side portion of the boom head to the distal end portion of the boom main body.

Brief Description of Drawings

[0009] FIG. 1 is a side view of a crane according to an embodiment of the present invention.

FIG. 2 is an enlarged view of a main part A in FIG. 1, and is an enlarged perspective view of a part of a lower jib.

FIG. 3 is a view illustrating a posture change of the lower jib of the crane according to the embodiment of the present invention.

FIG. 4 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a coupling unit is brought close to a boom main body.

FIG. 5 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a back surface side portion of a boom head and the boom main body are coupled by a pin.

FIG. 6 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a distal end of the lower jib is grounded.

FIG. 7 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a front surface side portion of the boom head and the boom main body are coupled by a pin.

FIG. 8 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a triangular guide is raised.

FIG. 9 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where the boom main body is obliquely raised.

FIG. 10 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where the boom main body is laid down substantially horizontally.

FIG. 11 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a strut is assembled.

FIG. 12 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where the lower jib is suspended.

FIG. 13 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where the lower jib is pulled under the boom main body.

FIG. 14 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where the lower jib is turned around by approximately 180 degrees.

FIG. 15 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a connector on a back surface side of an intermediate jib and a connector on a back surface side of the lower jib are coupled.

FIG. 16 is a side view of the crane according to the embodiment of the present invention, the view illustrating a state where a connector on a front surface side of the intermediate jib and a connector on a front surface side of the lower jib are coupled.

Description of Embodiments

[0010] Hereinafter, a preferred embodiment of the present invention will be described with

reference to the drawings.

[0011] (Configuration of Tower Crane)

FIG. 1 is a side view of a tower crane 1 (crane) according to the present embodiment. As illustrated in FIG. 1, the tower crane 1 includes a lower travelling body 21 and an upper slewing body 22 (crane main body), in which the upper slewing body 22 is turnably mounted on the crawler-type lower travelling body 21. Note that the tower crane 1 may be a movable crane using a moving mechanism (e.g., a wheel) other than a crawler, or may be a fixed crane having no moving mechanism. In addition, the present invention is applied not exclusively to a tower crane but is applicable also to other crane such as a luffing crane.

[0012] The upper slewing body 22 has a turning frame 23. The tower crane 1 includes a tower (boom) 24, a jib 25, a gantry 26, a strut 27, a lower spreader 28, a jib raising-lowering lower spreader 35, a strut guy line 36, a jib raising-lowering upper spreader 37, a jib raising-lowering rope 38, a boom guy line 39, an upper spreader 40, a boom raising-lowering rope 41, a hook winch 46, a jib raising-lowering winch 47, a boom raising-lowering winch 48, a counterweight 29, a backstop 30, and a jib backstop 44.

[0013] The turning frame 23 is attached to the lower travelling body 21 via a turning bearing (not illustrated). The tower 24 is coupled to a front portion of the turning frame 23 so as to be raised and lowered with respect to the turning frame 23.

[0014] The tower 24 has a tower main body 240 (boom main body) and a tower cap 24a (boom head). The tower main body 240 includes a proximal end portion rotatably supported by the upper slewing body 22 in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion. The tower cap 24a is detachably coupled to the distal end portion of the tower main body 240. One end portion of the boom guy line 39 is connected to the tower cap 24a.

[0015] The jib 25 is rotatably coupled to the tower cap 24a on a front surface side (front side) of the tower 24. The jib 25 can be raised and lowered with respect to the tower 24. Specifically, the jib 25 includes a lower jib 25a supported by the tower cap 24a so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body 250 (FIG. 1) detachably coupled to a distal end portion of the lower jib 25a. The jib coupling body 250 includes an intermediate jib 25b and an upper jib 25c to be described later. A jib point sheave 31 is provided at a distal end of the jib 25. A hook 33 is suspended from the jib point sheave 31 via a lift-up rope 32. The lift-up rope 32 is wound around a sheave 450 (FIG. 3) pivotally supported by a triangular guide 45 coupled to a back surface side (rear side) of the tower cap 24a and around the jib point sheave 31, and then wound around the hook 33.

[0016] The gantry 26 is attached to a rear portion of the turning frame 23. The strut 27 has a triangular shape in plan view from the side, and is rotatably coupled to the tower cap 24a on a back surface side (rear side) of the tower 24. The strut 27 includes a front strut 27a, a rear strut 27b, and a coupling member 27c. A proximal end portion (lower end portion in FIG. 1) of the front strut 27a is rotatably coupled to the tower cap 24a. A proximal end portion (front end portion in FIG. 1)

of the rear strut 27b is rotatably coupled to the tower cap 24a. The coupling member 27c has one end portion coupled to a distal end portion of the rear strut 27b and the other end portion coupled to a distal end portion of the front strut 27a. The distal end portion of the front strut 27a and the distal end portion of the jib 25 are coupled by a jib guy line 34. In other words, regarding the strut 27 (the front strut 27a and the rear strut 27b), the strut 27 is supported by the tower cap 24a so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib 25a in a state where the tower 24 is raised with respect to the upper slewing body 22 and the jib 25 is raised with respect to the tower 24 (FIG. 1), and the strut supports the jib 25 so as to be raised and lowered.

[0017] The jib raising-lowering rope 38 is stretched between the jib raising-lowering lower spreader 35 attached to the back surface side in a lower portion of the tower 24 and the jib raising-lowering upper spreader 37 coupled to one end portion of the strut guy line 36. The other end portion of the strut guy line 36 is connected to the distal end portion of the rear strut 27b.

[0018] The lower spreader 28 is attached to the upper end of the gantry 26. The boom raising-lowering rope 41 is stretched between the lower spreader 28 and the upper spreader 40 which is coupled to the other end portion of the boom guy line 39.

[0019] The hook winch 46, the jib raising-lowering winch 47, and the boom raising-lowering winch 48 are disposed at a center portion of the turning frame 23. The hook winch 46 takes up or draws out the lift-up rope 32 to wind up or wind down the hook 33. The jib raising-lowering winch 47 takes up or draws out the jib raising-lowering rope 38 to raise or lower the strut 27 around a joint with a distal end portion of the tower 24. As a result, the jib 25 is raised and lowered around the joint with the tower 24. The boom raising-lowering winch 48 takes up or draws out the boom raising-lowering rope 41 to raise or lower the tower 24 around a boom foot pin 42 which is a fulcrum thereof.

[0020] The counterweight 29 is mounted on the rear portion of the turning frame 23. The backstop 30 is attached to the lower and back surface side portion of the tower 24 and extends from the back surface portion of the tower 24 toward the turning frame 23. The backstop 30 is received by a backstop receiver (not illustrated) fixed to the turning frame 23, thereby regulating rearward turn of the tower 24.

[0021] The jib backstop 44 is attached to a back surface side portion of the lower jib 25a constituting the jib 25, and extends from the back surface of the lower jib 25a toward the tower cap 24a. The jib backstop 44 is received by the tower cap 24a to regulate rearward turn of the jib 25.

[0022] FIG. 2 is an enlarged view of a main part A in FIG. 1, and is an enlarged perspective view of a part of the lower jib 25a. As illustrated in FIG. 2, the tower crane 1 further has a support portion 2S and a coupling member 12. The support portion 2S is mounted on the lower jib 25a, and is configured to support a portion of the strut 27 (the front strut 27a) closer to the distal end side than to the second rotation center axis. The support portion 2S includes a bracket 2 (frame) and a roller 11 (support roller). The bracket 2 is attached to a strut 27 side portion of the lower jib 25a (the

back surface side portion, which is an upper surface portion of the lower jib 25a in FIG. 2 and FIG. 3). FIG. 2 illustrates a state where the strut 27 is placed on the lower jib 25a (the roller 11).

[0023] The bracket 2 rotatably supports the roller 11 (support roller) which is a support member. The roller 11, which is made of resin or rubber, is rotatable with respect to the lower jib 25a, and has an outer peripheral surface capable of supporting a surface 27e (side surface), on the lower jib 25a side, of the strut 27. A rotation axis of the roller 11 is set in a left-right direction of the upper slewing body 22, that is, in parallel with the first rotation center axis. In a state where the back surface side portion of the tower cap 24a is coupled to the laid down tower main body 240 and a front surface side is not coupled, the lower jib 25a becomes relatively movable with respect to the strut 27 when the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11.

[0024] The coupling member 12 is supported by the bracket 2. The coupling member 12 is capable of coupling the strut 27 and the lower jib 25a to each other so as to prevent the strut 27 from relatively moving with respect to the lower jib 25a in a state where the support portion 2S supports the strut 27. Specifically, the strut 27 and the lower jib 25a are coupled by pin-coupling the coupling member 12 and the front strut 27a. As a result, the coupling member 12 couples the strut 27 and the lower jib 25a to each other so as to be switchable between a movement preventing state where the lower jib 25a is prevented from relatively moving in a front-rear direction with respect to the strut 27 in a state where the strut 27 is placed on the support portion 2S and a movement allowing state where the lower jib 25a is allowed to relatively move in the front-rear direction with respect to the strut 27 in a state where the strut 27 is placed on the support portion 2S. In the present embodiment, as illustrated in FIG. 2, the coupling member 12 is disposed on a side closer to the distal end of the lower jib 25a than to the roller 11. A pin hole (not illustrated) is formed in the front strut 27a.

[0025] FIG. 3 is a view illustrating a posture change of the lower jib 25a of the tower crane 1 according to the present embodiment. As illustrated in FIG. 3, in the present embodiment, an integrated article to be transported 51 (coupling unit) in which the tower cap 24a, the strut 27, the lower jib 25a, and the triangular guide 45 are integrated can be coupled to the distal end portion of the laid down tower main body 240. At this time, first, the back surface side portion (the upper part in the drawing) of the tower cap 24a and the tower main body 240 are coupled by a pin in a posture indicated by a chain double-dashed line (FIG. 5). Then, by releasing the pin-coupling between the coupling member 12 and the front strut 27a, the coupling between the strut 27 and the lower jib 25a is released. Then, as indicated by a solid line, the lower jib 25a moves, by its own weight, toward the tower 24 (rearward) while the surface 27e (FIG. 2), on the lower jib 25a side, of the strut 27 is supported by the roller 11. As a result, the posture of the tower cap 24a changes to a posture suitable for coupling the front surface side portion (the lower part in the drawing) of the tower cap 24a and the tower 24.

[0026] Returning to FIG. 2, the tower crane 1 further has guide rollers (rotating members) 3 and 4. The guide rollers 3 and 4 are provided on the strut 27 side portion (the back surface side portion) of

the lower jib 25a. The guide roller 3 is rotatably provided on a lower jib support leg 5 provided on the strut 27 side portion of the lower jib 25a. The guide roller 4 is detachably attached to a connector 6 on the back surface side (the upper part in the drawing) of the lower jib 25a. The guide rollers 3 and 4 are capable of rolling on the ground. The guide rollers 3 and 4 are rotatably mounted on a rear surface portion of the lower jib 25a in a state where the jib 25 is raised with respect to the tower 24.

[0027] (Tower Crane Assembling Method)

Next, a method of assembling the tower crane 1 will be described with reference to FIG. 4 to FIG. 16. FIG. 4 to FIG. 16 are side views of the tower crane 1 according to the present embodiment.

[0028] First, as illustrated in FIG. 4, the integrated article to be transported 51 (coupling unit) in which the tower cap 24a, the strut 27, the lower jib 25a, and the triangular guide 45 are integrated is brought near to the tower main body 240 of the tower 24 and placed on the ground. At this time, the tower main body 240 is laid down with respect to the upper slewing body 22, and the distal end portion of the tower main body 240 is placed on a boom placing stand 61. Integral transportation of the tower cap 24a, the strut 27, and the lower jib 25a eliminates the need of assembling them, so that work efficiency can be improved.

[0029] The tower main body 240 has a connector 241 (first main body coupling portion) disposed at the distal end portion of the tower main body 240 and a connector 242 (second main body coupling portion) disposed below the connector 241 at the distal end portion of the tower main body 240 in a state where the tower main body 240 is laid down with respect to the upper slewing body 22 (FIG. 4). On the other hand, the tower cap 24a has a connector 24b (first head coupling portion) coupled to the connector 241 so as to be rotatable around a third rotation center axis parallel to the first rotation center axis and a connector 24c (second head coupling portion) coupled to the connector 242 (FIG. 3 and FIG. 5).

[0030] The strut 27 and the lower jib 25a are coupled by coupling the coupling member 12 and the front strut 27a at the time of transportation of the integrated article to be transported 51. This enables relative movement of the lower jib 25a to be suppressed with respect to the strut 27 during transportation. As a result, it is possible to suppress a change in the posture of the tower cap 24a during transportation, so that a load collapse during transportation can be suppressed.

[0031] Next, as illustrated in FIG. 5, the integrated article to be transported 51 is lifted up by an auxiliary crane 100, and the connector 24b on the back surface side portion (the upper part in the drawing) of the tower cap 24a and the connector 241 of the tower main body 240 are coupled by a pin. Wires suspended from the auxiliary crane 100 are connected to the lower jib 25a and the tower cap 24a, respectively. Next, as illustrated in FIG. 6, the distal end of the lower jib 25a is grounded by the auxiliary crane 100.

[0032] Next, the wire hanging the distal end portion of the lower jib 25a in FIG. 6 is removed, and the coupling between the coupling member 12 and the front strut 27a is released. When the

coupling between the strut 27 and the lower jib 25a is released, the lower jib 25a moves, by its own weight, toward the tower 24 while the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11. As a result, as illustrated in FIG. 7, the posture of the tower cap 24a changes to a posture suitable for coupling the connector 24c on the front surface side portion (the lower part in the drawing) of the tower cap 24a and the connector 242 at the distal end portion of the tower main body 240. Thereafter, an operator couples the connector 24c in the front surface side portion of the tower cap 24a and the connector 242 of the tower main body 240 with a pin.

[0033] As described above, when the tower cap 24a is coupled to the distal end portion of the tower main body 240, the lower jib 25a is moved toward the tower main body 240 while the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11 in a state where the back surface side portion (the connector 24b) of the tower cap 24a is coupled to the tower main body 240 (the connector 241). This enables a change in the posture of the tower cap 24a in a state where the back surface side portion of the tower cap 24a is coupled to the tower main body 240. As a result, the posture of the tower cap 24a can be changed to a posture suitable for coupling the front surface side portion of the tower cap 24a and the tower main body 240. Therefore, the connector 24c of the tower cap 24a can be easily coupled to the connector 242 at the distal end portion of the laid down tower main body 240.

[0034] Further, rotation of the roller 11 supporting the surface 27e, on the lower jib 25a side, of the strut 27 enables the lower jib 25a to be suitably relatively moved, i.e., to be slid, with respect to the strut 27.

[0035] Next, as illustrated in FIG. 8, the triangular guide 45 laid on the strut 27 is raised around a fulcrum 451 (FIG. 3), and a coupling portion 452 of the triangular guide 45 is coupled to a coupling portion 24d (FIG. 3) of the tower cap 24a. Additionally, the boom guy line 39 is connected to the tower cap 24a (FIG. 9).

[0036] Next, as illustrated in FIG. 9, the boom raising-lowering rope 41 is wound up to raise the tower 24 obliquely, and the lower jib 25a is lifted up by the auxiliary crane 100. Then, the upper slewing body 22 is turned, and the boom placing stand 61 is removed.

[0037] Next, as illustrated in FIG. 10, the boom raising-lowering rope 41 is drawn out to lay down the tower 24 substantially horizontally, and the jib guy line 36 hung on the sheave 450 and the jib raising-lowering upper spreader 37 are connected. Then, as illustrated in FIG. 11, the jib raising-lowering rope 38 is wound up to lift up the rear strut 27b, and a prop 27d is attached between the rear strut 27b and the front strut 27a to assemble the strut 27.

[0038] Next, as illustrated in FIG. 12, the boom raising-lowering rope 41 is wound up to raise the tower 24 and the jib raising-lowering rope 38 is wound up to raise the strut 27 and suspend the lower jib 25a from the tower cap 24a. Then, a tip of a wire W drawn out from a leaving winch (not illustrated) provided at the proximal end portion of the tower 24 is connected to a connector 8 on the back surface side (the left part in the drawing) of the lower jib 25a.

[0039] Next, as illustrated in FIG. 13, the lower jib 25a is drawn under the tower 24 as indicated by

an arrow by taking up the wire with a leaving winch. At this time, the guide roller 4 attached to the connector 6 is grounded to roll on the ground (see FIG. 2). Then, as illustrated in FIG. 14, the boom raising-lowering rope 41 is drawn out to lower the tower 24 while the lower jib 25a is turned around about a fulcrum 25S (FIG. 3) (the first rotation center axis) by approximately 180 degrees. At this time, instead of the guide roller 4, the guide roller 3 provided on the lower jib support leg 5 is grounded to roll on the ground (see FIG. 2). This makes it easy to change the orientation of the lower jib 25a by approximately 180 degrees. The guide rollers 3 and 4 are desirably disposed at a distal end portion of the back surface portion (the rear surface portion) of the lower jib 25a in the working posture of the crane 1.

[0040] Next, as illustrated in FIG. 15, a connector 251 on a back surface side (the upper part in the drawing) of the intermediate jib 25b to which the upper jib 25c is connected in advance and the connector 8 on the back surface side (the upper part in the drawing) of the lower jib 25a are coupled by a pin. Then, as illustrated in FIG. 16, the intermediate jib 25b is lifted up by the auxiliary crane 100, and a connector 252 on a front surface side (the lower part in the drawing) of the intermediate jib 25b and the connector 6 on a front surface side (the lower part in the drawing) of the lower jib 25a are coupled by a pin.

[0041] As described above, in the present embodiment, in a state where the tower cap 24a is disposed to face the distal end portion of the laid down tower main body 240, the lower jib 25a is rotatably supported by the tower cap 24a on the opposite side of the tower main body 240 with the tower cap 24a interposed therebetween, the strut 27 is rotatably supported by the tower cap 24a above the lower jib 25a, and the integrated article to be transported 51 (the coupling unit) is lifted so as to be placed on the support portion 2S, the lower jib 25a rotates around the fulcrum 25S (the first rotation center axis), the strut 27 rotates around a fulcrum 27as (the second rotation center axis), and the lower jib 25a relatively moves in the front-rear direction with respect to the strut 27 while the strut 27 is in contact with the support portion 2S, whereby the support portion 2S supports the strut 27 so as to allow the tower cap 24a to change the posture with respect to the tower main body 240.

[0042] More specifically, the support portion 2S supports the strut 27 so as to allow the lower jib 25a to rotate around the first rotation center axis, the strut 27 to rotate around the second rotation center axis, and the lower jib 25a to relatively move with respect to the strut 27 to approach the laid down tower main body 240 (the connector 242) in response to the tower cap 24a rotating around the third rotation center axis so that the connector 24c approaches the connector 242 and changing the posture with respect to the tower main body 240 as illustrated in FIG. 7 in a state (FIG. 6) where the connector 24b is rotatably coupled to the connector 241 such that the connector 24c of the tower cap 24a of the suspended integrated article to be transported 51 is disposed apart from the connector 242 of the tower main body 240 in the front-rear direction.

[0043] The above assembling method includes a preparation step, a first coupling step, a moving step, and a second coupling step.

[0044] In the preparation step, the strut 27 and the lower jib 25a are rotatably mounted on the tower

cap 24a to prepare the integrated article to be transported 51 (the coupling unit) configured by the tower cap 24a, the strut 27, and the lower jib 25a. The preparation step may include integral transportation of the tower cap 24a, the strut 27, and the lower jib 25a as the integrated article to be transported 51 to a work site.

[0045] In the first coupling step, of the integrated article to be transported 51, at least the tower cap 24a and the lower jib 25a are lifted and the back surface side portion (the connector 24b) of the tower cap 24a is coupled to the distal end portion (the connector 241) of the tower main body 240 laid down with respect to the upper slewing body 22 so as to be rotatable around the third rotation center axis parallel to the first rotation center axis such that the tower cap 24a is disposed to face the distal end portion of the laid down tower main body 240, the lower jib 25a is rotatably supported by the tower cap 24a on the opposite side of the tower main body 240 with the tower cap 24a interposed therebetween, and the strut 27 is rotatably supported by the tower cap 24a above the lower jib 25a.

[0046] In addition, in the moving step, while a portion of the strut 27 closer to the distal end side than to the second rotation center axis is supported by the support portion 2S provided in the lower jib 25a, the lower jib 25a is relatively moved to the tower main body 240 side with respect to the strut 27 and the tower cap 24a is rotated around the third rotation center axis, so that the front surface side portion (the connector 24c) of the tower cap 24a is moved to the distal end portion (the connector 242) of the tower main body 240.

[0047] Furthermore, in the second coupling step, the front surface side portion (the connector 24c) of the tower cap 24a is coupled to the distal end portion (the connector 242) of the tower main body 240.

[0048] (Tower Crane Disassembling Method)

Next, a method of disassembling the tower crane 1 will be described with reference to FIG. 4 to FIG. 16.

[0049] First, the jib 25 is bent with respect to the tower 24 in the state illustrated in FIG. 1, and as illustrated in FIG. 16, the boom raising-lowering rope 41 is drawn out to lay down the tower 24. As a result, the jib 25 is disposed below the tower 24. Then, the intermediate jib 25b is lifted up by the auxiliary crane 100 to release the coupling between the connector 252 on the front surface side (the lower part in the drawing) of the intermediate jib 25b and the connector 6 on the front surface side (the lower part in the drawing) of the lower jib 25a.

[0050] Next, as illustrated in FIG. 15, the intermediate jib 25b is lowered to the ground to release the coupling between the connector 251 on the back surface side (the upper part in the drawing) of the intermediate jib 25b and the connector 8 on the back surface side (the upper part in the drawing) of the lower jib 25a. Then, as illustrated in FIG. 14, parts of the jib 25 other than the lower jib 25a are removed.

[0051] Next, as illustrated in FIG. 13, FIG. 12, and FIG. 11, the lower jib 25a is turned around by approximately 180 degrees, and the boom raising-lowering rope 41 is drawn out to cause the tower

24 to lay down almost horizontally. Then, the prop 27d attached between the rear strut 27b and the front strut 27a is removed.

[0052] Next, as illustrated in FIG. 10, by drawing out the jib raising-lowering rope 38, the rear strut 27b is laid down on the front strut 27a to release the connection between the jib guy line 36 and the jib raising-lowering upper spreader 37. Then, as illustrated in FIG. 9, the boom raising-lowering rope 41 is wound up to raise the tower 24 obliquely, and the lower jib 25a is lifted up by the auxiliary crane 100. Then, the boom placing stand 61 is disposed below the tower main body 240 of the tower 24.

[0053] Next, as illustrated in FIG. 8, the upper slewing body 22 is turned, and the boom raising-lowering rope 41 is drawn out to lay down the tower 24, so that the distal end portion of the tower main body 240 is placed on the boom placing stand 61. Then, the connection between the tower cap 24a and the boom guy line 39 is released.

[0054] Next, as illustrated in FIG. 7, the triangular guide 45 is laid down onto the strut 27. Then, the distal end side of the lower jib 25a is hung by the auxiliary crane 100 to release the coupling between the connector 24c at the front surface side portion (the lower part in the drawing) of the tower cap 24a and the connector 242 of the tower main body 240. Thereafter, as illustrated in FIG. 6, while the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11, the lower jib 25a is moved forward until the distal end of the lower jib 25a is positioned at the distal end of the front strut 27a. Then, by coupling the coupling member 12 and the front strut 27a by a pin, the strut 27 and the lower jib 25a are coupled.

[0055] Next, as illustrated in FIG. 5, the integrated article to be transported 51 is lifted up by the auxiliary crane 100 to release the coupling between the connector 24b at the back surface side portion (the upper part in the drawing) of the tower cap 24a and the connector 241 of the tower main body 240. Then, as illustrated in FIG. 4, the integrated article to be transported 51 is moved to a position away from the tower main body 240. Integral transportation of the tower cap 24a, the strut 27, and the lower jib 25a eliminates the need of disassembling them, so that work efficiency can be improved. Further, by coupling the strut 27 and the lower jib 25a by the coupling member 12 at the time of transportation, it is possible to suppress the relative movement of the lower jib 25a with respect to the strut 27 during transportation. As a result, it is possible to suppress a change in the posture of the tower cap 24a during transportation, so that a load collapse during transportation can be suppressed.

[0056] As described above, according to the tower crane 1 and the method for assembling the tower crane 1 of the present embodiment, when the tower cap 24a is coupled to the distal end portion of the tower main body 240 of the tower 24, the posture of the tower cap 24a can be changed without greatly changing the posture of the lifted integrated article to be transported 51 as a whole. Therefore, it is possible to couple the tower cap 24a to the tower main body 240 while suppressing the integrated article to be transported 51 from interfering with surrounding members. In particular, in a state where the back surface side portion of the tower cap 24a is coupled to the tower

main body 240, the lower jib 25a is moved toward the tower main body 240 while the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11. This enables a change in the posture of the tower cap 24a in a state where the back surface side portion of the tower cap 24a is coupled to the tower main body 240. As a result, the posture of the tower cap 24a can be changed to a posture suitable for coupling the front surface side portion of the tower cap 24a and the tower main body 240. Therefore, the tower cap 24a can be easily coupled to the distal end portion of the laid down tower main body 240.

[0057] According to the tower crane 1 of the present embodiment, the strut 27 and the lower jib 25a can be coupled by the coupling member 12. Therefore, when the strut 27 and the lower jib 25a are coupled at the time of transportation, it is possible to suppress the relative movement of the lower jib 25a with respect to the strut 27 during transportation. As a result, since it is possible to suppress a change in the posture of the tower cap 24a during transportation, a load collapse during transportation can be suppressed, so that damage to each member is suppressed.

[0058] According to the tower crane 1 of the present embodiment, the surface 27e, on the lower jib 25a side, of the strut 27 is supported by the roller 11 rotatable with respect to the lower jib 25a. The rotation of the roller 11 supporting the surface 27e, on the lower jib 25a side, of the strut 27, enables the lower jib 25a to be suitably relatively moved (slid) with respect to the strut 27.

[0059] In addition, the tower crane 1 according to the present embodiment has the guide rollers 3 and 4 which are provided in the strut 27 side portion of the lower jib 25a (the upper surface portion of the lower jib 25a in FIG. 2) and are capable of rolling on the ground. By rolling the guide rollers 3 and 4 on the ground, it is easy to change the orientation of the lower jib 25a by approximately 180 degrees.

[0060] In addition, according to the method for assembling the tower crane 1 according to the present embodiment, the tower cap 24a, the strut 27, and the lower jib 25a are transported integrally. Since this eliminates the need of assembling or disassembling the tower cap 24a, the strut 27, and the lower jib 25a, the work efficiency can be improved.

[0061] Although the embodiment of the present invention has been described in the foregoing, it is merely an example and does not particularly limit the present invention, and the specific configuration and the like can be modified in design as appropriate. In addition, the actions and effects described in the embodiment of the present invention are a mere enumeration of the most suitable action and effect resulting from the present invention, and the actions and effects obtained by the present invention are not limited to those described in the embodiment of the present invention. The above-described integrated article to be transported 51 (the coupling unit) may not include the triangular guide 45.

[0062] Provided by the present invention is a crane including: a crane main body; a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal end portion of the boom main body; a jib having a

lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib; a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the jib are raised, the strut supporting the jib so as to be raised and lowered; and a support portion that is mounted on the lower jib and is capable of supporting a portion of the strut closer to a distal end side than to the second rotation center axis. The strut and the lower jib are mounted on the boom head and the strut is placed on the support portion, thereby configuring a coupling unit with the strut, the lower jib, and the boom head, the coupling unit being allowed to be integrally coupled to the distal end portion of the boom main body laid down with respect to the crane main body, and in a state where the boom head is disposed to face the distal end portion of the laid down boom main body, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, the strut is rotatably supported by the boom head above the lower jib, and the coupling unit is lifted up so as to be placed on the support portion, the support portion supports the strut such that the boom head is allowed to change a posture with respect to the boom main body by rotation of the lower jib around the first rotation center axis and rotation of the strut around the second rotation center axis, and relative movement of the lower jib in a front-rear direction with respect to the strut while the strut is in contact with the support portion.

[0063] According to this configuration, when the posture of the boom head is changed with respect to the boom main body in a state where the boom head, the strut, and the lower jib are integrally lifted up as the coupling unit, the lower jib and the strut are rotatable, and the lower jib can relatively move forward and backward with respect to the strut. Therefore, the posture of the boom head can be changed without greatly changing the posture of the coupling unit as a whole. This enables the boom head to be coupled to the boom main body while suppressing the coupling unit from interfering with surrounding members.

[0064] In the above configuration, it is desirable that the boom main body includes a first main body coupling portion arranged at a distal end portion of the boom main body and a second main body coupling portion arranged below the first main body coupling portion at the distal end portion of the boom main body in a state where the boom main body is laid down with respect to the crane main body, that the boom head includes a first head coupling portion coupled to the first main body coupling portion so as to be rotatable around a third rotation center axis parallel to the first rotation center axis and a second head coupling portion coupled to the second main body coupling portion, and, that the support portion supports the strut so as to allow the lower jib to rotate around the first rotation center axis, the strut to rotate around the second rotation center axis, and the lower jib to relatively move with respect to the strut to approach the second main body coupling portion in response to the boom head rotating around the third rotation center axis so that the second head coupling portion approaches the second main body coupling portion and changing the posture with

respect to the boom main body in a state where the first head coupling portion is rotatably coupled to the first main body coupling portion such that the second head coupling portion of the boom head of the coupling unit suspended is disposed apart in the front-rear direction from the second main body coupling portion of the boom main body laid down.

[0065] According to this configuration, when the boom head is coupled to the distal end portion of the boom main body, the lower jib is moved toward the boom main body while the strut is supported by the support portion in a state where the first head coupling portion (the back surface side portion) of the boom head is coupled to the first main body coupling portion of the boom main body. This enables the boom head in a state where the first head coupling portion is coupled to the boom main body to change the posture. As a result, the posture of the boom head can be changed to a posture suitable for coupling the second head coupling portion (the front surface side portion) of the boom head and the second main body coupling portion of the boom main body. Therefore, the boom head can be easily coupled to the distal end portion of the laid down boom main body.

[0066] In the above configuration, it is desirable that the crane further includes a coupling member capable of coupling the strut and the lower jib to each other so as to be switchable between a movement preventing state where the lower jib is prevented from relatively moving in the front-rear direction with respect to the strut in a state where the strut is placed on the support portion and a movement allowing state where the lower jib is allowed to relatively move in the front-rear direction with respect to the strut in a state where the strut is placed on the support portion.

[0067] According to this configuration, since the lower jib can be suppressed from relatively moving with respect to the strut during transportation, it is possible to suppress a load collapse during transportation.

[0068] In the above configuration, it is desirable that the support portion includes a support roller having an outer peripheral surface capable of supporting the strut, and rotatable around a rotation axis parallel to the first rotation center axis such that the strut supported by the outer peripheral surface relatively moves in the front-rear direction with respect to the lower jib.

[0069] According to this configuration, the lower jib can be stably relatively moved (slid) with respect to the strut by the rotation of the support roller.

[0070] In the above configuration, it is desirable that the crane further includes a rotating member mounted on the lower jib so as to be capable of rolling on the ground in a state where the boom is laid down with respect to the crane main body and the lower jib is disposed below the boom.

[0071] According to this configuration, by rolling the rotating member on the ground, the orientation of the lower jib can be easily changed below the boom at the time of assembly and disassembly.

[0072] Provided by the present invention is a method of assembling a crane, in which the crane includes: a crane main body; a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal

end portion of the boom main body; a jib having a lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib; and a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the jib are raised, the strut serving as a support for the jib to be raised and lowered. The assembling method includes: a preparation step of rotatably mounting the strut and the lower jib on the boom head to prepare a coupling unit configured by the boom head, the strut, and the lower jib; a first coupling step of lifting, of the coupling unit, at least the boom head and the lower jib and coupling a back surface side portion of the boom head to the distal end portion of the boom main body laid down with respect to the crane main body so as to be rotatable around a third rotation center axis parallel to the first rotation center axis such that the boom head is disposed to face the distal end portion of the boom main body laid down, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, and the strut is rotatably supported by the boom head above the lower jib and is placed on a support portion provided in the lower jib; a moving step of relatively moving the lower jib with respect to the strut toward the boom main body side while supporting, by the support portion, a portion of the strut closer to a distal end side than to the second rotation center axis, and rotating the boom head around the third rotation center axis, thereby moving a front surface side portion of the boom head to the distal end portion of the boom main body; and a second coupling step of coupling the front surface side portion of the boom head to the distal end portion of the boom main body.

[0073] According to the present method, when the boom head is coupled to the boom main body in a state where the boom head, the strut, and the lower jib are integrally lifted up as the coupling unit, since the lower jib and the strut are rotatable, and the lower jib can relatively move with respect to the strut, the posture of the boom head can be changed without largely changing the posture of the coupling unit as a whole, and the boom head can be easily coupled to the boom main body.

[0074] In the above method, it is desirable that the preparation step includes integrally transporting the boom head, the strut, and the lower jib as the coupling unit before the first coupling step.

[0075] According to the this method, it is not necessary to assemble or disassemble the boom head, the strut, and the lower jib at the time of transportation, so that work efficiency in the preparation step can be improved.

Claims

1. A crane comprising:

a crane main body;

a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal end portion of the boom main body;

a jib having a lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib;

a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the jib are raised, the strut supporting the jib so as to be raised and lowered; and

a support portion that is mounted on the lower jib and is capable of supporting a portion of the strut closer to a distal end side than to the second rotation center axis,

wherein

the strut and the lower jib are mounted on the boom head and the strut is placed on the support portion, thereby configuring a coupling unit with the strut, the lower jib, and the boom head, the coupling unit being allowed to be integrally coupled to the distal end portion of the boom main body laid down with respect to the crane main body, and

in a state where the boom head is disposed to face the distal end portion of the laid down boom main body, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, the strut is rotatably supported by the boom head above the lower jib, and the coupling unit is lifted up so as to be placed on the support portion, the support portion supports the strut such that the boom head is allowed to change a posture with respect to the boom main body by rotation of the lower jib around the first rotation center axis and rotation of the strut around the second rotation center axis, and relative movement of the lower jib in a front-rear direction with respect to the strut while the strut is in contact with the support portion.

2. The crane according to claim 1, wherein

the boom main body includes a first main body coupling portion arranged at a distal end portion of the boom main body and a second main body coupling portion arranged below the first main body coupling portion at the distal end portion of the boom main body in a state where the boom main body is laid down with respect to the crane main body,

the boom head includes a first head coupling portion coupled to the first main body coupling portion so as to be rotatable around a third rotation center axis parallel to the first rotation center axis and a second head coupling portion coupled to the second main body coupling portion,

and

the support portion supports the strut so as to allow the lower jib to rotate around the first rotation center axis, the strut to rotate around the second rotation center axis, and the lower jib to relatively move with respect to the strut to approach the second main body coupling portion in response to the boom head rotating around the third rotation center axis so that the second head coupling portion approaches the second main body coupling portion and changing the posture with respect to the boom main body in a state where the first head coupling portion is rotatably coupled to the first main body coupling portion such that the second head coupling portion of the boom head of the coupling unit suspended is disposed apart in the front-rear direction from the second main body coupling portion of the boom main body laid down.

3. The crane according to claim 1, further comprising a coupling member capable of coupling the strut and the lower jib to each other so as to be switchable between a movement preventing state where the lower jib is prevented from relatively moving in the front-rear direction with respect to the strut in a state where the strut is placed on the support portion and a movement allowing state where the lower jib is allowed to relatively move in the front-rear direction with respect to the strut in a state where the strut is placed on the support portion.

4. The crane according to any one of claims 1 to 3, wherein the support portion includes a support roller having an outer peripheral surface capable of supporting the strut, and rotatable around a rotation axis parallel to the first rotation center axis such that the strut supported by the outer peripheral surface relatively moves in the front-rear direction with respect to the lower jib.

5. The crane according to any one of claims 1 to 4, further comprising a rotating member mounted on the lower jib so as to be capable of rolling on the ground in a state where the boom is laid down with respect to the crane main body and the lower jib is disposed below the boom.

6. A method of assembling a crane, wherein the crane includes:
a crane main body;

a boom having a boom main body including a proximal end portion rotatably supported by the crane main body in a raising-lowering direction and a distal end portion on a side opposite to the proximal end portion, and a boom head detachably coupled to the distal end portion of the boom main body;

a jib having a lower jib supported by the boom head so as to be rotatable in the raising-lowering direction around a horizontal first rotation center axis, and a jib coupling body detachably coupled to a distal end portion of the lower jib; and

a strut supported by the boom head so as to be rotatable around a second rotation center axis parallel to the first rotation center axis behind the lower jib in a state where the boom and the

jib are raised, the strut supporting the jib so as to be raised and lowered, the method of assembling a crane comprising:

- a preparation step of rotatably mounting the strut and the lower jib on the boom head to prepare a coupling unit configured by the boom head, the strut, and the lower jib;

- a first coupling step of lifting, of the coupling unit, at least the boom head and the lower jib and coupling a back surface side portion of the boom head to the distal end portion of the boom main body laid down with respect to the crane main body so as to be rotatable around a third rotation center axis parallel to the first rotation center axis such that the boom head is disposed to face the distal end portion of the boom main body laid down, the lower jib is rotatably supported by the boom head on the opposite side of the boom main body with the boom head interposed therebetween, and the strut is rotatably supported by the boom head above the lower jib and is placed on a support portion provided in the lower jib;

- a moving step of relatively moving the lower jib with respect to the strut toward the boom main body side while supporting, by the support portion, a portion of the strut closer to a distal end side than to the second rotation center axis, and rotating the boom head around the third rotation center axis, thereby moving a front surface side portion of the boom head to the distal end portion of the boom main body; and

- a second coupling step of coupling the front surface side portion of the boom head to the distal end portion of the boom main body.

7. The method of assembling a crane according to claim 6, wherein the preparation step includes integrally transporting the boom head, the strut, and the lower jib as the coupling unit before the first coupling step.