DEVICE FOR EXTENDING AND STORING HORIZONTAL BOOM

A horizontal boom setting/unsetting apparatus turns a horizontal boom to a position where the horizontal boom is laid along a side surface of a vertical boom, thus enabling easy accommodation of the horizontal boom, while facilitating also setting up of the horizontal boom which has been accommodated. To this end, the apparatus includes a bracket (5) fixed to the free end of the vertical boom (2) and having a pin-receiving hole (6), a bracket (11) fixed to a supporting frame (10) connected to the horizontal boom (3) and having a pin-receiving hole (12), the pin-receiving hole (6) and the pin-receiving hole (12) receiving a connecting pin (14) so as to be rotatable relative to each other, and a rotary actuator (16) disposed on the axis of the connecting pin (14).
Description

Technical Field

The present invention relates to a horizontal boom setting/unsetting apparatus and, more particularly, to an apparatus for setting up a horizontal boom of a mobile crane and for unsetting the same such that the horizontal boom is accommodated by being laid along one side of a vertical boom.

Background Art

Hitherto, foldable booms for use on mobile cranes have been known such as that disclosed in Japanese Utility Model Laid-Open No. 63-41092. This known foldable boom includes a vertical boom pivotally secured to a chassis for swinging up and down between an erecting position and lay-down position, and a horizontal boom connected to the vertical boom so as to be swingable up and down. During running of the mobile crane, the vertical boom is held in laid-down position and the horizontal boom is accommodated by being laid along the vertical boom. During operation of the crane, the vertical boom is held in vertical posture and the horizontal boom is swung up and down at an end of the vertical boom.

In the known foldable boom of the kind described, the horizontal boom is accommodated such that it overlaps the vertical boom, so that the overall height of the booms in folded state increases to hamper the sight of the operator during running of the mobile crane.

A solution to this problem is proposed in Japanese Utility Model Application No. 4-091512 which has not yet been laid-open to public inspection. In this proposal, brackets are provided on an end of the vertical boom so as to project in the breadthwise direction, and pin-receiving holes are formed in these brackets such that their axes extend in the longitudinal direction of the vertical boom. Brackets also are provided on a supporting frame on which the horizontal boom is vertically swingably mounted, the brackets projecting in the breadthwise direction and having pin-receiving holes formed therein such that their axes extend in the longitudinal direction. Pins are inserted to extend through the pin-receiving holes in the brackets of the vertical boom and to the supporting frame, respectively, so as to project in the breadthwise direction, and the pin-receiving holes are aligned with each other when the axes extend in the longitudinal direction. Pins are inserted to extend through the pin-receiving holes in the brackets of the vertical boom and the supporting frame, whereby the supporting frame is rotatable in the breadthwise direction of the supporting frame. When accommodating the booms, the horizontal boom is fully laid-down and then the supporting frame is rotated 180°, so that the horizontal boom is accommodated by being laid along the side face of the vertical boom. The overall height of the boom assembly in the accommodated state is therefore reduced so that the sight of the operator is not hampered during running of the mobile crane.

The above-described known apparatus, however, has a drawback that no power means is used to set up the horizontal boom and to unset and accommodate the same, and the work for setting up and unsetting the horizontal boom entirely owes to manual effort. Such work is not only laborious but also is dangerous. Another problem is that unsetting and accommodation of the horizontal boom causes a winch wire to be unnaturally flexed in a U-like form between the vertical boom and the horizontal boom, posing a risk of damaging of the wire.

Disclosure of the Invention

The present invention has been accomplished to eliminate the above-described problems of the known arts. Thus, an object of the present invention is to provide an apparatus which enables an operator to set up a horizontal arm and to unset and accommodate the same remotely at an operator's seat, without the risk of damaging of wire.

According to the present invention, a horizontal boom setting/unsetting apparatus comprises: horizontal boom setting/unsetting means; and fixing means for fixing the horizontal boom to the vertical boom and to the supporting frame, respectively, so as to be swingable up and down. The fixing means may include: a bracket fixed to the free end of the vertical boom so as to extend in the breadthwise direction, the bracket having a pin-receiving hole having axis extending in the longitudinal direction; a bracket fixed to a supporting frame so as to extend in the breadthwise direction, the horizontal boom being vertically swingably connected to the supporting frame, the bracket on the supporting frame having a pin-receiving hole having axis extending in the longitudinal direction, the pin-receiving hole of the vertical boom and the pin-receiving hole of the supporting frame receiving a connecting pin so that the supporting frame being connected to the vertical boom for rotation in the breadthwise direction; and a rotary actuator disposed on the axis of the connecting pin. The fixing means may include: brackets fixed to the free end of the vertical boom and to the supporting frame, respectively, so as to extend in the breadthwise direction, the bracket on the vertical boom and the bracket on the supporting frame being provided with pin-receiving holes such that the pin-receiving holes are aligned with each other when the horizontal boom is in the set-up position; and a hydraulic cylinder disposed on the axis of the pin-receiving holes and having connecting pins adapted to be received in the pin-receiving holes. The fixing means may include: a connecting shaft fixed to the supporting frame; a hook provided on the vertical boom and engageable with the connecting shaft when the horizontal boom is in the set-up position; and an actuator provided on the vertical boom and operable to bring the hook into and out of engagement with the connecting shaft. A guide for guiding a winch wire may be provided on the free end of the vertical boom or on the base end portion of the horizontal boom. In this arrangement, wire guides may be provided between the guide and a winch wire sheave mounted on the free end of the vertical boom.
boom and between the guide and a winch wire sheave provided on the base end portion of the horizontal boom. It is possible to employ springs for adjusting positions of the guide and the wire guide. The wire guide may be disposed at a position where the wire guide does not contact with the wire straightened between the sheave on the free end of the vertical boom and the sheave on the base end of the horizontal boom when the horizontal boom is in the set-up position. The horizontal boom setting/unsetting means may include hydraulic cylinders mounted on a supporting frame and adapted for vertically swinging the vertical boom and the horizontal boom; a parallelogram link mounted on the free end of the vertical boom so as to enable the supporting frame to translationally move in the breadthwise direction; and a hydraulic cylinder mounted on the free end of the vertical boom so as to actuate the parallelogram link.

According to the features set forth above, various actuators such as hydraulic cylinders are controllable from the operator’s seat. Namely, the operator seated on the operator’s seat can control these actuators so as to horizontally turn the horizontal boom in the breadthwise direction of the vertical arm thereby setting up the horizontal arm and to fix the supporting frame of the horizontal boom to the vertical boom. When the apparatus incorporates winch wire guide sheaves and the wire guides such that their positions are adjustable by means of springs, there is no risk that the wire is unnaturally bent when the horizontal boom has been set up. Since the wire guide is positioned such that it does never contact with the wire which is straightened due to setting up of the horizontal boom, wear of the wire due to abrasion is suppressed. The parallelogram link and the associated hydraulic cylinder enables the horizontal boom to be translationally moved and laid down, whereby the horizontal boom can be accommodated along one side surface of the vertical boom in parallel therewith.

Brief Description of the Drawings

Fig. 1 is a perspective view of a wheeled mobile crane in which a horizontal boom is accommodated by being laid along a side face of a vertical boom, in accordance with an embodiment of the present invention;
Fig. 2 is a right-side elevational view of the wheeled mobile crane as shown in Fig. 1;
Fig. 3 is a plan view of the wheeled mobile crane as shown in Fig. 1;
Fig. 4 is a side elevational view of the wheeled mobile crane in a state in which a horizontal boom has been set up in accordance with an embodiment of the present invention;
Fig. 5 is a perspective view of a first embodiment of the horizontal boom setting/unsetting apparatus in accordance with the present invention, showing particularly a structure for connecting vertical and horizontal booms to each other.
Figs. 6A and 6B are illustrations of an example of fixing means employed in the embodiment, wherein Fig. 6A illustrates a state in which a hydraulic cylinder has been extended, while Fig. 6B shows a state in which the hydraulic cylinder has been contracted; Fig. 7 is a side elevational view of a second example of the fixing means employed in the embodiment;
Fig. 8 is a sectional view taken along the line VIII-VIII of Fig. 7;
Fig. 9 is a detailed perspective view of a bracket shown in Fig. 7;
Figs. 10A to 10C are illustrations of operation of the second example of the fixing means, wherein Fig. 10A is an illustration of the fixing means in a state in which the horizontal boom has been set up, Fig. 10B is an illustration of the fixing means in a state in which a supporting frame is going to be disconnected from the vertical boom, and Fig. 10C is an illustration of the fixing means in a state in which a connecting shaft has been removed;
Fig. 11 is an illustration of a second embodiment of the horizontal boom setting/unsetting apparatus of the present invention in a state in which the horizontal boom has been set up;
Fig. 12 is an illustration of the second embodiment of the horizontal boom setting/unsetting apparatus of the present invention in a state in which the horizontal boom has been unset and accommodated;
Fig. 13 is a perspective view of components of the second embodiment of the setting/unsetting apparatus;
Fig. 14 is a front elevational view of ends of vertical and horizontal booms in a third embodiment of the horizontal boom setting/unsetting apparatus of the present invention, in a state in which the horizontal boom has been unset and accommodated;
Fig. 15 is a front elevational view of ends of vertical and horizontal booms in a third embodiment of the horizontal boom setting/unsetting apparatus of the present invention, in a state in which the horizontal boom is being set up;
Fig. 16 is a front elevational view of ends of vertical and horizontal booms in a third embodiment of the horizontal boom setting/unsetting apparatus of the present invention, in a state in which the horizontal boom has been set up; and
Fig. 17 is an illustration of a guide sheave and a guide position adjusting spring which are incorporated in the third embodiment of the horizontal boom setting/unsetting apparatus.

The Best Mode for Carrying Out the Invention

Preferred embodiments of the horizontal boom setting/unsetting apparatus of the present invention will be described in detail with reference to the accompanying
drawings.

Referring to Figs. 1 to 3, there is shown a wheeled mobile crane with an accommodated boom structure in which a vertical boom 2 which is vertically swingably secured to a chassis 1 has been laid down and a horizontal boom 3 has been accommodated by being laid along one side face of the vertical boom 2. Fig. 4 shows the state in which the vertical boom 2 has been erected and the horizontal boom 3 has been set up and fully swung down.

Referring now to Fig. 5 which shows a first embodiment of the setting/unsetting apparatus, the horizontal boom 3 and a hydraulic cylinder 4 for actuating the horizontal boom 3 to swing it up and down are vertically swingably attached to a supporting frame 10. A bracket 5 fixed to the vertical boom 2 projects in both breadthwise directions and thus has two laterally projecting wings one of which has a pin-receiving hole 6 while the other has a pin-receiving hole 7, the holes having axes extending on longitudinal direction. A bracket 11 fixed to a supporting frame 10 projects in both breadthwise directions and thus has two laterally projecting wings one of which has a pin-receiving hole 12 while the other has a pin-receiving holes 13, the holes having axes extending on longitudinal direction. The pin-receiving hole 6 and the pin receiving hole 12 in the wings of the same side of the vertical boom commonly receive a connecting pin 14 so that the wing having the pin-receiving hole 6 and the wing having the pin-receiving hole 12 are rotatable relative to each other. A bracket 8 is fixed to one side of the vertical boom 2 at a position which is on the extension of the pin-receiving hole 6, while a bracket 15 is fixed to one side of the supporting frame 10 at a position which is on the extension of the pin-receiving hole 12. These brackets 8 and 15 are connected to each other through a hydraulic cylinder 34 operation of the rotary actuator motor 16 which is controllable remotely from the operator's seat. Thus, the arrangement is such that the supporting frame 10 is rotated in the direction of breadth of the vertical boom 2 about the axis of the connector pin 14 as a result of operation of the rotary actuator motor 16.

A description will now be given of a first example of the fixing means for fixing the vertical boom 2 and the horizontal boom 3 to each other. Referring to Figs. 5, 6A and 6B, when the horizontal boom 3 has been set up, the pin-receiving hole 7 in the other wind of the bracket 5 on the vertical boom and the pin-receiving hole 13 in the bracket 11 on the supporting frame 10 are aligned with each other. A hydraulic cylinder 17 having connecting pins 18 is fixed to the vertical boom 2 so as to be located on the extension of the pin-receiving hole 7 of the vertical boom 2. The hydraulic cylinder 17 is controllable remotely from the operator's seat. As shown in Fig. 6A, when the hydraulic cylinder 17 is activated to extend the connecting pins 18, these pins are inserted into the pin-receiving hole 7 in the vertical boom 2 and the pin-receiving hole 13 in the supporting frame 10, whereby the supporting frame 10 is fixed to the vertical boom 2 with the horizontal boom held in the set-up condition. Conversely, when the hydraulic cylinder 17 is actuated to retract the connecting pins 18, the connecting pin 18 is withdrawn from the pin-receiving hole 13 in the supporting frame 10, whereby the supporting frame is freed.

The operation of the described first example of the fixing means is as follows. In order to set up the boom which has been in unset condition as shown in Figs. 1 and 2, the vertical boom is operated to erect and the rotary actuator motor 16 is operated from the operator's seat so that the supporting frame 10 is rotated in the direction of breadth of the vertical frame 2, whereby the horizontal boom is set up in the posture as shown in Fig. 4. After bringing the pin-receiving hole 13 in the supporting frame 10 into alignment with the pin-receiving hole 7 in the vertical boom 2, the hydraulic cylinder 17 which has been in the contracted state is activated to extend the connecting pins 18 into the pin-receiving holes 7 and 13, thereby fixing the supporting frame 10 to the vertical frame 2. Unsetting and accommodation of the horizontal boom in the operative state can be done by following the above-described steps in reverse order.

Figs. 7 to 10C show a second example of the fixing means. A connecting shaft 21 is fixed to the supporting frame 10 by means of a bracket 20. A bracket 22 having a recess 24 is fixed to the vertical boom 2. Unsetting and accommodation of the boom structure in accordance with contracting and extending operations of the hydraulic cylinder 34. When the horizontal boom has been set up, the connecting shaft 21 is engageable with both the shaft receiving portion 25 in the bracket 22 and the shaft receiving portion 32 of the rotor 30.

The operation of the second example of the fixing means is as follows. When the horizontal boom 3 has been in the set-up condition, the connecting shaft 21 is in engagement with the shaft receiving portion 25 of the bracket 22 and the shaft receiving portion 32 of the rotor 30, as shown in Fig. 10A. In this state, the hydraulic cylinder 34 is operated to extend (see Fig. 7) so as to rotate the rotor 30, so that the recess 31 and the recess 24 in the bracket are offset to fix the connecting shaft 21, thereby connecting the supporting frame 10 to the vertical boom 2. To disconnect the supporting frame 10 from the vertical boom 2 the hydraulic cylinder 34 is operated in contracting direction, so that the rotor 30 is rotated in the direction of the arrow, thereby bringing the recess 31 in the rotor 30 into alignment with the recess 24 in the bracket 22, as shown in Fig. 10B. Then, the connecting shaft 21 is disengaged from the bracket 22 and the rotor 30, as shown in Fig. 10C.

Figs. 11 to 13 show a second embodiment of the horizontal boom setting/unsetting apparatus in accord-
ance with the present invention. Brackets 40 and 41 are fixed to the end of the vertical boom 2 so as to extend in the breadthwise direction. Pin-receiving holes 42 are formed to formed in one side portion of the bracket 40, while pin-receiving holes 43 are formed in the bracket 41. Pin-receiving holes 44 are formed in the other side portion of the bracket 40. A horizontal boom 3 and a hydraulic cylinder 4 for horizontally boom are vertically swingably connected to a supporting frame 50 by means of pins 51 and 52. Pin-receiving holes 53, 54 and 55 for receiving connecting pins are formed in the supporting frame 50. The pin-receiving holes 42, 43 in the vertical boom 2 and the pin-receiving hole 53 of the supporting frame 50 are connected through a first link 60 having pin-receiving holes 61 at its both ends, by means of pins 45, 56, while the pin-receiving holes 44 of the vertical boom 2 and the pin-receiving holes 54 of the supporting frame 50 are connected to each other through a second link 62 which is provided at its both ends with pin-receiving holes 63, whereby a parallelogram link is formed as shown in Fig. 11.

A bracket 64 having a pin-receiving hole 65 is provided on a side surface of the first link 60. The pin-receiving holes 55 in the supporting frame 50 and the pin-receiving hole 65 of the first link 60 are connected to each other through a hydraulic cylinder 66 by means of pins 67. According to this arrangement, the horizontal boom 3 is translationally moved in the breadthwise direction in accordance with extending/contracting operations of the hydraulic cylinder 66.

The operation of the apparatus having the described construction is as follows. As shown in Fig. 11, the vertical boom 2 and the horizontal boom 3 are extended along a straight line when the hydraulic cylinder 66 is operated to extend, whereby the horizontal boom 3 is set up. When the hydraulic cylinder 66 is operated to contract, the supporting frame 50 is translationally moved in the breadthwise direction and then the horizontal boom is swung to extend along one side of the vertical boom 2 in parallel therewith, so as to be accommodated in this position.

A description will now be given of a third embodiment of the horizontal boom setting/unsetting apparatus of the present invention, with specific reference to Figs. 14 to 17. Referring to Fig. 14, numerals 70 and 71 denote winch wire sheaves which are mounted on the free end of the vertical boom 2, while numerals 72 and 73 denote winch wire sheaves attached to the base end portion of the horizontal boom 3. A wire 74 is extended through the sheaves 70, 72, while a wire 75 is extended through sheaves 71, 73. A bracket 75 on the free end of the vertical boom 2 and a supporting frame 10 of the horizontal boom 3 are connected to each other for pivot motion about the center of a hole 6. A guide sheave 80 is disposed on the extension of the axis of the hole 6. The guide sheave 80 serves to guide the wires 74, 75 which are bent in U-like form when the horizontal boom 3 has been unset and accommodated. A guide 81 is provided between the guide sheave 80 and the sheaves 70, 71. Similarly, a guide 82 is disposed between the guide sheave 80 and the sheaves 72, 73. These guides 81 and 82 serve to guide the wires 74, 75 so as to prevent any extraordinary bending force from acting on these wires 74, 75. It is not essential that the guide sheave 80 is rotatable. Thus, the guide sheave 80 may be substituted by a member which can guide the wire.

Fig. 15 shows a state in which the horizontal boom 3 which has been accommodated is being set up, while Fig. 16 shows the state in which the horizontal boom has been set up. As will be seen from Fig. 16, the guides 81 and 82 are disposed at positions where they do not contact the wires 74 and 75 straightened between the sheaves 70 and 72 and between the sheaves 71 and 73, respectively, thus avoiding abrasion of the wires. The wires 74, 75 are therefore usable for longer period of time.

Fig. 17 illustrates a modification in which the guide sheaves 80 and 81 are provided with position adjusting springs. The guide sheave 80 is carried by a rockable lever 83 which is urged by a spring 84. Likewise, the guide 81 is mounted on a rockable lever 85 which is urged by a spring 86. These springs 84, 86 serve to automatically adjust the positions of the guides when large forces are applied to the wires.

Industrial Applicability

The horizontal boom setting/unsetting apparatus of the present invention enables setting up of a horizontal boom, as well as accommodation and fixing of the same, to be performed safely and easily by the control of actuators from the operator's seat, while suppressing wear of wires attributable to suppression. Furthermore, accommodation of the horizontal boom along one side surface of the vertical boom, as well as setting up of the same, can be executed simply through transnational motion and vertical swinging motion of the horizontal boom.

Claims

1. A horizontal boom setting/unsetting apparatus for a mobile crane of the type having a vertically swingable vertical boom, and a horizontal boom vertically swingably connected to the free end of said vertical boom and adapted to be accommodated by being laid along one side surface of said vertical boom in parallel therewith, said apparatus comprising: horizontal boom setting/unsetting means; and fixing means and said fixing means being controllable from an operator's seat.

2. A horizontal boom setting/unsetting apparatus according to Claim 1, wherein said setting/unsetting means includes: a bracket fixed to the free end of said vertical boom so as to extend in the breadth-
wise direction, said bracket having a pin-receiving
hold having axis extending in the longitudinal direc-
tion; a bracket fixed to a supporting frame so as to
extend in the breadthwise direction, said horizontal
boom being vertically swingably connected to the
supporting frame, said bracket on said supporting
frame having a pin-receiving hole having axis extend-
ing in the longitudinal direction, said pin-
receiving hole of said vertical boom and said pin-
receiving hole of said supporting frame receiving a
connecting pin so that said supporting frame being
connected to said vertical boom for rotation in the
breadthwise direction; and a rotary actuator dis-
posed on the axis of said connecting pin.

3. A horizontal arm setting/unsetting apparatus
according to one of Claims 1 and 2, wherein said
fixing means includes: brackets fixed to the free end
of said vertical boom and to said supporting frame,
respectively, so as to extend in the breadthwise
direction, said bracket on said vertical boom and
said bracket on said supporting frame being pro-
vided with pin-receiving holes such that said pin-
receiving holes are aligned with each other when
said horizontal boom is in the set-up position; and a
hydraulic cylinder disposed on the axis of said pin-
receiving holes and having connecting pins
adapted to be received in said pin-receiving holes.

4. A horizontal boom setting/unsetting apparatus
according to one of Claims 1 and 2, wherein said
fixing means includes: a connecting shaft fixed to
said supporting frame; a hook provided on said ver-
tical boom and engageable with said connecting
shaft when said horizontal boom is in the set-up
position; and an actuator provided on said vertical
boom and operable to bring said hook into and out
of engagement with said connecting shaft.

5. A horizontal boom setting/unsetting apparatus
according to Claim 2, wherein a guide for guiding a
winch wire is provided on the free end of said verti-
cal boom or on the base end portion of said hori-
zontal boom.

6. A horizontal boom setting/unsetting apparatus
according to Claim 5, wherein a wire guides are
provided between said guide and a winch wire
sheave mounted on the free end of said vertical
boom and between said guide and a winch wire
sheave provided on the base end portion of said
horizontal boom.

7. A horizontal boom setting/unsetting apparatus
according to Claim 6, further comprising springs for
adjusting positions of said guide and said wire
guide.

8. A horizontal boom setting/unsetting apparatus
according to Claim 6 or 7, wherein said wire guide
is disposed at a position where said wire guide
does not contact with the wire straightened
between said sheave on the free end of said verti-
cal boom and said sheave on the base end of a hori-
zontal boom when said horizontal boom is in the
set-up position.

9. A horizontal boom setting/unsetting apparatus
according to Claim 1, wherein said horizontal boom
setting/unsetting means includes a hydraulic cylin-
der mounted on a supporting frame and adapted for
vertically swinging said vertical boom and said hor-
zontal boom; a parallelogram link mounted on the
free end of said vertical boom so as to enable said
supporting frame to translationally move in the
breadthwise direction; and a hydraulic cylinder
mounted on the free end of said vertical boom so as
to actuate said parallelogram link.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl6 B66C 23/26, 23/42, 23/68, 23/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl6 B66C 23/26, 23/42, 23/68, 23/70

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Kokai Jitsuyo Shinan Koho 1971 - 1995

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
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Date of the actual completion of the international search
January 26, 1995 (26. 01. 95)

Date of mailing of the international search report
February 7, 1995 (07. 02. 95)

Name and mailing address of the ISA/Authorized officer
Japanese Patent Office
Facsimile No.
Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)