FOLDING BOOM AND ENGINEERING MACHINERY

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Chinese Patent Application No. 202010471249.6 entitled “foldable boom and engineering machinery”, filed on May 28, 2020 and Chinese Patent Application No. 202110003363.0 entitled “foldable boom and engineering machinery”, filed on January 4, 2021. All of the aforementioned patent applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of engineering machines, and particularly to a foldable boom and an engineering machine.

BACKGROUND

[0003] Currently in the field of engineering machines, a crawler crane and the like can be used for material lifting, transportation, loading and unloading, and installation, etc. The crawler crane has many advantages, such as high craning ability, low ground specific pressure, small turning radius, high climbing ability, unnecessity for leg support, driving with load, excellent operation stability, and adaptive adjustment for truss combination height, and is widely used in construction areas of electric power, municipal infrastructure, bridges, petroleum chemical engineering, water conservancy and hydropower, etc.

[0004] Currently, when the crawler crane is transferred, a boom thereon needs to be detached into segments and transported separately from the main machine. The detaching and mounting operation is time-wasting and labor-wasting, transferring efficiency is low, a transportation cost is high, and a construction period is significantly affected.

SUMMARY

[0005] A purpose of the present disclosure is to provide a foldable boom and an engineering machine, to solve technical problems that booms of a crawler crane need to be detached into segments during transferring, which is time-wasting and labor-wasting for detaching, inefficient and costly in transferring, and to realize an effect of unnecessity for detaching booms, which is

convenient for transportation and saving assembly time.

[0006] According to an aspect, a foldable boom as provided by the present disclosure includes a lower-section arm and an intermediate arm, where

[0007] the lower-section arm and the intermediate arm are rotatably connected to enable the lower-section arm and the intermediate arm to be folded and unfolded;

[0008] a detachable structure provided at a joint between the lower-section arm and the intermediate arm, used for locking rotation between the lower-section arm and the intermediate arm in an unfolded state; and

[0009] the foldable boom further includes a connection arm provided between the lower-section arm and the intermediate arm, where

[0010] the lower-section arm and the connection arm are rotatably connected, a first detachable structure is provided at a joint between the lower-section arm and the connection arm to lock rotation between the lower-section arm and the connection arm;

[0011] the intermediate arm and the connection arm are rotatably connected, a second detachable structure is provided at a joint between the intermediate arm and the connection arm to lock rotation between the intermediate arm and the connection arm, and the connection arm is a trapezoid structure; and

[0012] the connection arm includes a first lateral part and a second lateral part parallel to each other; an end of the first lateral part is rotatably connected to a side of the lower-section arm; another end of the first lateral part is rotatably connected to a side of the intermediate arm; and the first detachable structure is provided at a joint between an end of the second lateral part and the lower-section arm, and the second detachable structure is provided at a joint between another end of the second lateral part and the intermediate arm.

[0013] According to an embodiment, the foldable boom further includes an upper-section arm, the upper-section arm including an upper-section arm body and an upper-section arm goose head, where

[0014] an end of the upper-section arm body is connected to an end of the intermediate arm away from the connection arm, the upper-section arm goose head and the upper-section arm body are rotatably connected, the upper-section arm goose head and the upper-section arm body are connected through a third detachable structure, and the third detachable structure is used for locking rotation between the upper-section arm goose head and the upper-section arm body.

[0015] According to an embodiment, the foldable boom further includes a first driving mechanism, a second driving mechanism and a third driving mechanism, where

[0016] the first driving mechanism is provided at the joint between the lower-section arm and the connection arm to drive the connection arm to rotate relative to the lower-section arm;

[0017] the second driving mechanism is provided at the joint between the intermediate arm and the connection arm to drive the connection arm to rotate relative to the intermediate arm; and

[0018] the third driving mechanism is provided at the joint between the upper-section arm body and the upper-section arm goose head to drive the upper-section arm goose head to rotate relative to the upper-section arm body.

[0019] According to an embodiment, the first driving mechanism, the second driving mechanism and the third driving mechanism are telescopic drivers.

[0020] According to an embodiment, a fixed end of the first driving mechanism is mounted at the lower-section arm and a movable end of the first driving mechanism is hinged with the connection arm;

[0021] a fixed end of the second driving mechanism is mounted at the intermediate arm and a movable end is hinged with the connection arm; and

[0022] a fixed end of the third driving mechanism is mounted at the upper-section arm body and a movable end of the third driving mechanism is hinged with the upper-section arm goose head.

[0023] According to an embodiment, the telescopic driver is a hydraulic cylinder.

[0024] According to an embodiment, the foldable boom further includes an extension arm, where an end of the extension arm is connected to the intermediate arm and another end of the extension arm is connected to the upper-section arm.

[0025] According to the folding boom provided by the present disclosure provides an engineering machine, including a machine body and a foldable boom as described in the above description, where the lower-section arm of the foldable boom is pivotably connected to the machine body.

[0026] The foldable boom provided by the present disclosure includes a lower-section arm and an intermediate arm, where the lower-section arm and the intermediate arm are rotatably connected to enable the lower-section arm and the intermediate arm to be folded and unfolded; and a detachable structure provided at a joint between the lower-section arm and the intermediate arm to lock rotation between the lower-section arm and the intermediate arm in an unfolded state. When the foldable boom is in use, the lower-section arm and the intermediate arm are unfolded and the detachable structure is used for locking rotation between the lower-

section arm and the intermediate arm; when the foldable boom is to be transported, the detachable structure is opened to enable the lower-section arm to rotate relative to the intermediate arm, thereby the foldable boom may be folded without detaching booms into segments, thus facilitating use, improving transferring efficiency and reducing transportation cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] In order to explain technical solutions of specific embodiments of the present disclosure or technical solutions in the prior art more clearly, accompanying drawings which are necessary to be used in the description of the specific embodiments or the prior art will be briefly introduced hereinafter. Obviously, the accompanying drawings used in the description as below are for some embodiments of the present disclosure, and based on these accompanying drawings, those skilled in the art may obtain other accompanying drawings without any inventive work.

[0028] FIG. 1 is a structural diagram of a foldable boom provided by embodiment 1 of the present disclosure.

[0029] FIG. 2 is a schematic diagram of a foldable boom which is folded for transportation provided by embodiment 1 of the present disclosure.

[0030] FIG. 3 is a schematic diagram of a connection arm of a foldable boom provided by embodiment 1 of the present disclosure.

[0031] FIG. 4 is a schematic diagram of a first detachable structure of a foldable boom provided by embodiment 1 of the present disclosure.

[0032] FIG. 5 is an exploded view of a first detachable structure of a foldable boom provided by embodiment 1 of the present disclosure.

[0033] FIG. 6 is a structural diagram of a foldable boom provided by embodiment 2 of the present disclosure.

[0034] FIG. 7 is a schematic diagram of a foldable boom which is folded for transportation provided by embodiment 2 of the present disclosure.

[0035] FIG. 8 is a structural schematic diagram of an engineering machine with a foldable boom in a completely unfolded state as provided by the present disclosure.

[0036] FIG. 8A is a partially enlarged view for A1 in the embodiment shown in FIG. 8.

[0037] FIG. 9 is another structural schematic diagram of an engineering machine with an

intermediate arm of a foldable boom pivoting in a direction of an arrow to a folded state as provided by the present disclosure.

[0038] FIG. 10 is a top view of the embodiment shown in FIG. 9, showing a foldable boom in a folded state.

[0039] FIG. 10A is a partially enlarged view for A2 in the embodiment shown in FIG. 10.

[0040] FIG. 11 is a still another structural diagram of an engineering machine with an intermediate arm of a foldable boom rotated to a position above a lower-section arm provided by the present disclosure.

[0041] FIG. 12 is a top view of the embodiment shown in FIG. 11, showing a foldable boom in a turn-over state.

[0042] FIG. 13 is a structural schematic diagram of an engineering machine in a transportation state provided by the present disclosure.

[0043] Reference numerals:

[0044] 1, 102-1: lower-section arm; 2, 104: intermediate arm; 3: upper-section arm body; 4: upper-section arm goose head; 5, 122: connection arm; 6, 124: first driving mechanism; 7, 126: second driving mechanism; 8: third driving mechanism; 9: extension arm; 10: connection pin; 11: second sleeve; 12: third sleeve; 51: first sleeve; 52, 128: first lateral part; 53, 130: second lateral part; 101: stopping portion; 102: stopping hole; 103: stopping pin; 100: foldable boom; 106: hinge device; 108: first arm segment portion; 110: second arm segment portion; 112: first arm segment; 114: second arm segment; 116: third boom segment; 118: fourth boom segment; 120: upper-section arm; 200: engineering machine; 202: machine body.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0045] Hereinafter, technical solutions of the present disclosure will be described clearly and completely in combination with embodiments. Obviously, described embodiments are some embodiments of the present disclosure, rather than all embodiments. Any other embodiments obtained by those skilled in the art, based on the embodiments in the present disclosure and without any inventive work, will fall within a protection scope of the present disclosure.

[0046] Embodiment 1

[0047] As shown in FIG. 1 to FIG. 5, a foldable boom provided by the present disclosure includes a lower-section arm 1 and an intermediate arm 2, where the lower-section arm 1 and the intermediate arm 2 are rotatably connected to enable the lower-section arm 1 and the

intermediate arm 2 to be folded and unfolded; and a detachable structure provided at a joint between the lower-section arm 1 and the intermediate arm 2 to lock rotation between the unfolded lower-section arm 1 and the intermediate arm 2.

[0048] When the foldable boom is in use, the lower-section arm 1 and the intermediate arm 2 are unfolded, and the detachable structure is used for locking rotation between the lower-section arm 1 and the intermediate arm 2; and when the foldable boom is to be transported, the detachable structure is opened to enable the lower-section arm 1 to rotate relative to the intermediate arm 2, and thereby the foldable boom may be folded without detaching booms into segments, thus facilitating use, improving transferring efficiency and reducing transportation cost.

[0049] Furthermore, the foldable boom includes a connection arm 5 provided between the lower-section arm 1 and the intermediate arm 2.

[0050] The lower-section arm 1 and the connection arm 5 are rotatably connected, and a first detachable structure is provided at a joint between the lower-section arm 1 and the connection arm 5 and is used for locking rotation between the lower-section arm 1 and the connection arm 5.

[0051] The intermediate arm 2 and the connection arm 5 are rotatably connected, and a second detachable structure is provided at a joint between the intermediate arm 2 and the connection arm 5 and is used for locking rotation between the intermediate arm 2 and the connection arm 5.

[0052] Specifically, according to the foldable boom provided by the present disclosure, an end of the lower-section arm 1 is rotatably connected to the connection arm 5 to enable the lower-section arm 1 to rotate relative to the connection arm 5, and the first detachable structure is provided at a joint between another end of the lower-section arm 1 and the connection arm 5. When the foldable boom is in use, the first detachable structure is closed for locking rotation between the lower-section arm 1 and the connection arm 5; and when the foldable boom is to be transported, the first detachable structure is opened to enable the lower-section arm 1 to rotate relative to connection arm 5, thus enabling folding.

[0053] An end the intermediate arm 2 is rotatably connected to the connection arm 5 to enable the intermediate arm 2 to rotate relative to the connection arm 5, and the second detachable structure is provided at a joint between another end of the intermediate arm 2 and the connection arm 5. When the foldable boom is in use, the second detachable structure is closed for locking rotation between the intermediate arm 2 and the connection arm 5; and when the foldable boom

is to be transported, the second detachable structure is opened to enable the intermediate arm 2 to rotate relative to connection arm 5, thus enabling folding.

[0054] In actual transportation, as lower-section arm 1 may rotate relative to connection arm 5 when the first detachable structure is opened and the intermediate arm 2 may rotate relative to connection arm 5 when the second detachable structure is opened, the connection arm 5 is rotatably connected to the lower-section arm 1 and with the intermediate arm 2. Accordingly, the folding and unfolding of the foldable boom may be achieved, without need for detaching booms into segments, thus facilitating use, improving transferring efficiency and reducing transportation cost.

[0055] Furthermore, the foldable boom includes an upper-section arm, and the upper-section arm includes an upper-section arm body 3 and an upper-section arm goose head 4.

[0056] An end of the upper-section arm body 3 is connected to an end of the intermediate arm 2 away from the connection arm 5, the upper-section arm goose head 4 and the upper-section arm body 3 are rotatably connected, and the upper-section arm goose head 4 is detachably connected to the upper-section arm body 3 through a third detachable structure, which is used for locking rotation between the upper-section arm goose head 4 and the upper-section arm body 3.

[0057] Specifically, the foldable boom further includes the upper-section arm which includes the upper-section arm body 3 and the upper-section arm goose head 4. An end of the upper-section arm goose head 4 is connected to the upper-section arm body 3, and a third detachable structure is provided at a joint between another end of the upper-section arm goose head 4 and the upper-section arm body 3. When the foldable boom is in use, the third detachable structure is closed, thus locking rotation between the upper-section arm goose head 4 and the upper-section arm body 3. When the foldable boom is to be transported, the third detachable structure may be opened to enable the upper-section arm goose head 4 to rotate relative to the upper-section arm body 3, thus enabling folding.

[0058] When the foldable boom is to be transported, the foldable boom may fall down. The third detachable structure may be opened, and the upper-section arm goose head 4 may be rotated relative to upper-section arm body 3 for a certain angle so that it may be fixed on a rear structure of transportation vehicle. When the foldable boom is used for craning goods, the upper-section arm goose head 4 is rotated in a reversed direction, and the third detachable structure is closed, achieving connection between the upper-section arm goose head 4 and the upper-section arm body 3.

[0059] The first detachable structure includes a connection pin 10, a first sleeve 51 provided at the lower-section arm 1, a second sleeve 11 provided at the connection arm 5, and a third sleeve 12 provided at the connection arm 5. The second sleeve 11 and the third sleeve 12 are set in interval with each other, the first sleeve 51 may be rotated to a position between the second sleeve 11 and the third sleeve 12, and the connection pin 10 may be inserted to pass through the second sleeve 11, the first sleeve 51 and the third sleeve 12 in sequence, thus achieving detachable connection between the lower-section arm 1 and the connection arm 5.

[0060] An end of the connection pin 10 may be provided with a stopping portion 101, and another end of the connection pin 10 may be provided with a stopping hole 102. A stopping pin 103 is used to insert into the stopping hole 102, to prevent disengagement of the connection pin 10.

[0061] It should be noted that the connection pin 10 may also be substituted by a bolt assembly as long as it may achieve the same function.

[0062] The second detachable structure and the third detachable structure may be same as the above-described detachable structure. Those skilled in the art may also select a detachable structure in another form as long as a convenient and quick detachable connection may be achieved.

[0063] Furthermore, the connection arm 5 is a trapezoid structure, and includes a first lateral part 52 and a second lateral part 53 parallel to each other; an end of the first lateral part 52 is rotatably connected to a side of the lower-section arm 1, and another end of the first lateral part 52 is rotatably connected to a side of the intermediate arm 2; and the first detachable structure is provided at a joint between an end of the second lateral part 53 and the lower-section arm 1, and the second detachable structure is provided at a joint between another end of the second lateral part 53 and the intermediate arm 2.

[0064] Specifically, the connection arm 5 may be the trapezoid structure. The joint between the lower-section arm 1 and the connection arm 5 and the joint between the intermediate arm 2 and the connection arm 5 are in shapes corresponding to the unparallel sides of the trapezoid structure, facilitating connection with the lower-section arm 1 and connection with the intermediate arm 2.

[0065] According to the connection arm 5 in the trapezoid structure, the first lateral part 52 and the second lateral part 53 are parallel to each other and perpendicular to a length direction of the foldable boom, and a length of the first lateral part 52 is less than that of the second lateral part 53.

[0066] The lower-section arm 1 is rotatably connected to an end of the first lateral part 52 and the first detachable structure is provided at a joint between the lower-section arm 1 and the corresponding second lateral part 53.

[0067] The intermediate arm 2 is rotatably connected to another end of the first lateral part 52 and the second detachable structure is provided at a joint between the intermediate arm 2 and the corresponding second lateral part 53.

[0068] During an actual folding process, the first detachable structure and the second detachable structure are opened so that the second lateral part 53 of the connection arm 5 may be rotated in a direction away from the intermediate arm 2 and the upper-section arm may be rotated in a direction away from the connection arm 5, respectively, and then the lower-section arm 1 and the intermediate arm 2 are folded. An end of the upper-section arm away from the connection arm 5 is fixed to the crane, and the upper-section arm and the intermediate arm 2 are fixed to the connection arm 5 by means of ropes or the like.

[0069] Furthermore, the foldable boom includes a first driving mechanism 6, a second driving mechanism 7 and a third driving mechanism 8.

[0070] The first driving mechanism 6 is provided at the joint between the lower-section arm 1 and the connection arm 5 to drive the connection arm 5 to rotate relative to the lower-section arm 1.

[0071] The second driving mechanism 7 is provided at the joint between the intermediate arm 2 and the connection arm 5 to drive the connection arm 5 to rotate relative to the intermediate arm 2.

[0072] The third driving mechanism 8 is provided at the joint between the upper-section arm body 3 and the upper-section arm goose head 4 to drive the upper-section arm goose head 4 to rotate relative to the upper-section arm body 3.

[0073] Optionally, the first driving mechanism 6, the second driving mechanism 7 and the third driving mechanism 8 are telescopic drivers.

[0074] Optionally, a fixed end of the first driving mechanism 6 is mounted at the lower-section arm 1 and a movable end of the first driving mechanism 6 is hinged with the connection arm 5.

[0075] A fixed end of the second driving mechanism 7 is mounted at the intermediate arm 2 and a movable end of the second driving mechanism 7 is hinged with the connection arm 5.

[0076] A fixed end of the third driving mechanism 8 is mounted at the upper-section arm body 3 and a movable end of the third driving mechanism 8 is hinged with the upper-section arm goose head 4.

[0077] In the present embodiment, the first driving mechanism 6 is provided at the joint between the lower-section arm 1 and the connection arm 5, for enabling automatic folding of the lower-section arm 1 and the connection arm 5. The second driving mechanism 7 is provided at the joint between the intermediate arm 2 and the connection arm 5, for enabling automatic folding of the intermediate arm 2 and the connection arm 5.

[0078] Specifically, a fixed end of the first driving mechanism 6 is mounted at the lower-section arm 1 and a movable end of the first driving mechanism 6 is connected to the connection arm 5; and a fixed end of the second driving mechanism 7 is mounted at the intermediate arm 2 and a movable end of the second driving mechanism 7 is connected to the connection arm 5.

[0079] The third driving mechanism 8 is provided at the joint between the upper-section arm goose head 4 and the upper-section arm body 3. A fixed end of the third driving mechanism 8 is connected to the upper-section arm body 3 and a movable end of the third driving mechanism 8 is connected to the upper-section arm goose head 4, for enabling automatic folding of the lower-section arm 1 and the connection arm 5.

[0080] A fixed end of the first driving mechanism 6 is connected to the lower-section arm 1 and a movable end of the first driving mechanism 6 is hinged with the connection arm 5; a fixed end of the second driving mechanism 7 is connected to the intermediate arm 2 and a movable end of the second driving mechanism 7 is hinged with the connection arm 5; and a fixed end of the third driving mechanism 8 is connected to the upper-section arm body 3 and a movable end of the third driving mechanism 8 is hinged with the upper-section arm goose head 4. When the first driving mechanism 6 and the second driving mechanism 7 drive the connection arm 5 and when the third driving mechanism 8 drives the upper-section arm goose head 4, it is more convenient to fold the foldable boom.

[0081] It should be noted that the fixed end of the first driving mechanism 6 may be also hinged with the lower-section arm 1, the second driving mechanism 7 may be also hinged with the intermediate arm 2, and the third driving mechanism 8 may be also hinged with the upper-section arm body 3.

[0082] Optionally, the telescopic driver is a hydraulic cylinder.

[0083] Embodiment 2

[0084] As shown in FIG. 6 and FIG. 7, there is a difference between Embodiment 1 and Embodiment 2 that the foldable boom of Embodiment 2 further includes an extension arm 9, of which an end is connected to the intermediate arm 2 and another end is connected to the upper-section arm.

[0085] Specifically, the extension arm 9 is provided between the intermediate arm 2 and the upper-section arm. An end of the extension arm 9 is detachably connected to the intermediate arm 2 and another end of the extension arm 9 is detachably connected to an end of the upper-section arm body 3 away from the upper-section arm goose head 4.

[0086] When the foldable boom is to be transported, it is possible to detach only the extension arm 9, without detaching other portions of the foldable boom or detaching the foldable boom from the main machine, thus saving transferring time for the crane.

[0087] It should be noted that the quantity of the extension arm 9 may be one or more. When there are a plurality of the extension arms 9, the extension arms 9 may be connected in sequence between the intermediate arm 2 and the upper-section arm.

[0088] Embodiment 3

[0089] Referring to FIG. 8 to FIG. 13, embodiments of a foldable boom and an engineering machine as provided in the present disclosure will be described. It should be understood that the description below is only for exemplary embodiments of the present disclosure, rather than providing any specific limitation to the present disclosure.

[0090] As shown in FIG. 8 to FIG. 13, embodiments of the present disclosure provide a foldable boom 100 and an engineering machine 200 with the foldable boom 100. In the embodiments as shown in the figures, the engineering machine 200 may be a crawler crane and the like. In the present disclosure, the embodiments of the present disclosure will be described hereinafter, taking the crawler crane as an example. However, it should be understood that it is also possible for the foldable boom 100 in the present disclosure to be applied to other similar engineering machines, such as piling machines, excavators, etc., without departing from the scope of the present disclosure.

[0091] As shown in FIG. 8 to FIG. 13, in an embodiment of the present disclosure, the foldable boom 100 may include a lower-section arm 102-1 and an intermediate arm 104. Specifically, the lower-section arm 102-1 may be pivotably connected to a machine body 202 of the engineering machine 200 so that the lower-section arm 102-1 may rotate relative to the machine body 202 of the engineering machine 200. Furthermore, the intermediate arm 104 may be pivotably connected to the lower-section arm 102-1, and may pivot between a folded position above the lower-section arm 102-1 and an unfolded position where the intermediate arm 104 unfolds with respect to the lower-section arm 102-1.

[0092] As shown in FIG. 8 to FIG. 10, the intermediate arm 104 is in the unfolded position with respect to the lower-section arm 102-1. As shown in FIG. 11 to FIG. 13, the intermediate

arm 104 is in the folded position above the lower-section arm 102-1. It can be seen from the embodiments as shown in FIG. 8 to FIG. 13 that as the intermediate arm 104 may rotate to the folded position above the lower-section arm 102-1, when the intermediate arm 104 pivots with respect to the lower-section arm 102-1, it may be understood that the pivoting axis is extending in a width direction of the foldable boom 100, i.e. extending in a width direction of the engineering machine 200.

[0093] Furthermore, in an embodiment of the present disclosure, a hinge device 106 may be provided at the intermediate arm 104. Specifically, the intermediate arm 104 may be folded around the hinge device 106, where the intermediate arm 104 has a turning direction different from its folding direction. That is, the intermediate arm 104 not only may rotate with respect to the lower-section arm 102-1, but also may rotate around the hinge device 106, thus a size of the intermediate arm 104 may be effectively reduced in an unused state.

[0094] As shown in FIG. 8, the intermediate arm 104 in the unfolded state is shown, where the intermediate arm 104 is not folded. As shown in FIG. 9 and FIG. 10, the intermediate arm 104 in the folded state is shown. In this case, from the state shown in FIG. 8, the intermediate arm is folded in the direction of the arrow shown in FIG. 10 to form the structure shown in FIG. 9 and FIG. 10.

[0095] In the above-described embodiments, the turning direction of the intermediate arm 104 during turning is different from its folding direction during folding. For example, when the intermediate arm 104 is being folded, it may be folded within a horizontal plane (pivoting for 180°, for example) from the completely unfolded state shown in FIG. 8, in the direction of the arrow shown in FIG. 10, to the folded state shown in FIG. 9 and FIG. 10. Then, the intermediate arm 104 in the folded state shown in FIG. 9 and FIG. 10, may be turned (turning for 180°, for example), i.e. turned upward from the state shown in FIG. 9 and FIG. 10 to a position above the lower-section arm 102-1, as shown in FIG. 11 and FIG. 12.

[0096] When the folding and turning operations are both completed, the foldable boom 100 is changed from the completely unfolded state shown in FIG. 8 to the completely folded state shown in FIG. 11. In this state, as shown in FIG. 13, during transportation of the foldable boom 100 and the engineering machine 200, the size of the booms of the long boom type may be effectively reduced so that it may be carried on the machine body of the engineering machine. Therefore, the foldable boom as provided in the present disclosure may be transported only after simple folding, without detaching, thus saving time and labor. Moreover, in the present disclosure, by the method of foldable booms, the transportation of a single machine, such as a

crawler crane with a long boom, is achieved, reducing the transportation cost.

[0097] Furthermore, as shown in FIG. 8 to FIG. 10, according to the embodiments of the present disclosure, the intermediate arm 104 generally may include a first arm segment portion 108 and a second arm segment portion 110.

[0098] Specifically, the first arm segment portion 108 and the second arm segment portion 110 may be pivotably connected by the above-described hinge device 106. In the present embodiment, as described above, the pivoting axis of the hinge device 106 may extend in a direction of thickness of the intermediate arm 104. That is, when the foldable boom 100 is mounted on the machine body 202 of the engineering machine 200, the pivoting axis of the hinge device 106 is extending in a direction of height of the engineering machine 200. Thus, when the intermediate arm 104 is in the folded state, the first arm segment portion 108 and the second arm segment portion 110 are disposed side by side, as shown in FIG. 10.

[0099] Furthermore, as shown in FIG. 10, according to the embodiment of the present disclosure, for the first arm segment portion 108 and the second arm segment portion 110, one side edge of the first arm segment portion 108 and one side edge of the second arm segment portion 110 may be pivotably connected by the hinge device 106; and the other side edge of the first arm segment portion 108 and the other side edge of the second arm segment portion 110 may be detachably connected. Specifically, it should be understood herein that the above-described edges refer to those of the first arm segment portion 108 and the second arm segment 110 extending in a direction of thickness of the foldable boom portion 100. As shown in FIG. 10A, it can be seen from the top view that the one side edge of the first arm segment portion 108 and the one side edge of the second arm segment portion 110 are pivotably connected by the hinge device 106 such that the intermediate arm 104 may be folded around the hinge device 106. The other side edge of the first arm segment portion 108 and the other side edge of the second arm segment 110 are detachably connected. Thus, when the intermediate arm 104 is folded, the above-described edges of another end are in the detached state. When the intermediate arm 104 is unfolded to perform various operation tasks, the above-described edges of another end may be connected together by a fastener, thus forming an integrated structure.

[00100] Furthermore, as shown in FIG. 8, according to the embodiment of the present disclosure, the first arm segment portion 108 may include a first arm segment 112 and at least one second arm segment 114. Similarly, the second arm segment portion 110 may include a third boom segment 116 and at least one fourth boom segment 118.

[00101] Specifically, the first arm segment 112 and the third boom segment 116 may be

pivotably connected by the hinge device 106 as described above. The second arm segment 114 may be connected between the first arm segment 112 and the lower-section arm 102-1, and the third boom segment 116 and the fourth boom segment 118 may be connected. Furthermore, the fourth boom segment 118 may be connected between the third boom segment 116 and the upper-section arm 120 of the foldable boom 100. Thus, a complete structure of the intermediate arm 104 is formed.

[00102] In an embodiment of the present disclosure, the first arm segment 108 may include a plurality of the second arm segments 114 as described above, and adjacent second arm segment 114 are connected together in a manner of detachable connection. Thus, for the foldable boom 100 in the present disclosure, it is possible to appropriately select the quantity of the second arm segment 114 according to requirements such that the total length of the foldable boom 100 after unfolding can meet engineering requirements. Similar to the above, according to the embodiments of the present disclosure, the second arm segment portion 110 may also include a plurality of the fourth boom segments 118 as described above, and adjacent fourth boom segment 118 may also be connected together in a manner of detachable connection, thus enabling length adjustment.

[00103] Referring to FIG. 8 in combination with FIG. 8A, according to the embodiments of the present disclosure, the foldable boom 100 may further include a connection arm 122. Specifically, the lower-section arm 102-1 may include a first end pivotably connected to the machine body 202 of the engineering machine 200, and a second end opposite to the first end.

[00104] As shown in FIG. 8A, in the embodiment, a top of the second end of the lower-section arm 102-1 may be pivotably connected to the connection arm 122. Furthermore, a top of an end of the intermediate arm 104 may be pivotably connected to the connection arm 122. In contrast to the above, a bottom of the second end of the lower-section arm 102-1 may be detachably connected to a bottom of the above-described one end of the intermediate arm 104.

[00105] Specifically, the top of the second end of the lower-section arm 102-1 is pivotably connected to the connection arm 122 so that the connection arm 122 may pivot with respect to the lower-section arm 102-1; and the connection arm 122 is in turn pivotably connected to the top of an end of the intermediate arm 104 so that the intermediate arm 104 may pivot with respect to the connection arm 122. Thus, by the configuration of the connection arm 122, the intermediate arm 104 may pivot with respect to the lower-section arm 102-1.

[00106] Furthermore, the bottom of the second end of the lower-section arm 102-1 is detachably connected to the bottom of the above-described one end of the intermediate arm 104.

When the intermediate arm 104 turns to the folded position above the lower-section arm 102-1, the above-described two ends are detached from each other; and when the intermediate arm 104 is in the unfolded position with respect to lower-section arm 102-1, the above-described two ends are connected together. Thus, when the foldable boom 100 is unfolded to perform various operation tasks, the lower-section arm 102-1 is securely connected via the connection arm 122 with the intermediate arm 104 on one hand, and is directly connected together with the intermediate arm 104 on the other hand so as to make the foldable boom 100 more stable in use.

[00107] Furthermore, as shown in FIG. 8A, according to the embodiment of the present disclosure, the foldable boom 100 further includes a first driving mechanism 124 and a second driving mechanism 126.

[00108] Specifically, an end of the first driving mechanism 124 may be connected to the lower-section arm 102-1 and another end of the first driving mechanism 124 may be connected to the connection arm 122. In this way, it is possible to use the first driving mechanism 124 to drive the connection arm 122 to move such that the connection arm 122 rotates with respect to lower-section arm 102-1. Similar to the above, an end of the second driving mechanism 126 may be connected to the intermediate arm 104 and another end of the second driving mechanism 126 may be connected to the connection arm 122. In this way, it is possible to use the second driving mechanism 126 to drive the intermediate arm 104 to move such that the intermediate arm 104 can rotate relative to connection arm 122.

[00109] Herein, it should be understood that any appropriate structure may be adopted for the above-described first driving mechanism 124 and second driving mechanism 126, such as a hydraulic oil cylinder, a pneumatic oil cylinder, etc. That is, there is no limitation to the present disclosure for the selected types of the first driving mechanism 124 and the second driving mechanism 126, and any appropriate structure may be used in the present disclosure and may depend on specific use conditions.

[00110] According to the embodiment of the present disclosure, the connection arm 122 may include a first lateral part 128 and a second lateral part 130 opposite to each other. In practical mounting, a top of the second end of the lower-section arm 102-1 may be pivotably connected to an end of the first lateral part 128, a top of an end of the above-described intermediate arm 104 may be pivotably connected to another end of the first lateral part 128. In addition, the above-described another end of the first driving mechanism 124 may be pivotably connected to an end of the second lateral part 130, and the above-described another end of the second driving mechanism 126 may be pivotably connected to another end of the second lateral part 130. Thus,

a complete connection structure is formed as shown in FIG. 8A.

[00111] According to another aspect, an engineering machine 200 is further provided in an embodiment of the present disclosure. The engineering machine 200 includes a machine body 202 and the foldable boom 100 as described above. Specifically, the lower-section arm 102-1 of the foldable boom 100 may be pivotably connected to the machine body 202, thus forming a structure as shown in the figures. As the engineering machine 200 includes the above-described foldable boom 100, it will also possess all the advantages as described above.

[00112] In summary, the foldable boom as provided in the present disclosure includes a lower-section arm 1 and an intermediate arm 2, where the lower-section arm 1 and the intermediate arm 2 are rotatably connected so that the lower-section arm 1 and the intermediate arm 2 may be folded and unfolded; and a detachable structure provided at a joint between the lower-section arm 1 and the intermediate arm 2 to lock rotation between the unfolded lower-section arm 1 and the intermediate arm 2. When the foldable boom is in use, lower-section arm 1 and the intermediate arm 2 are unfolded, the detachable structure is used for locking rotation between the lower-section arm 1 and the intermediate arm 2; and when it is to be transported, the detachable structure is opened and the lower-section arm 1 can rotate relative to the intermediate arm 2, so that the foldable boom can be folded, without need for detaching the boom support into pieces, thus facilitating use, improving transferring efficiency and reducing transportation cost.

[00113] Finally, it should be noted that the above embodiments are only used for explaining, rather than limiting, the technical solutions of the present disclosure. Though the present disclosure has been explained in detail in combination with the above embodiments, it should be understood by those skilled in the art that the technical solutions as recorded in the above embodiments can be modified or some or all technical features therein can be substituted equivalently. For such modification or substitution, the technical solutions corresponding thereto will not substantially depart from the scope of the technical solutions of the embodiments in the present disclosure.

CLAIM

1. A foldable boom, comprising:

a lower-section arm and an intermediate arm, wherein the lower-section arm and the intermediate arm are rotatably connected to enable the lower-section arm and the intermediate arm to be folded and unfolded, wherein a detachable structure is provided at a joint between the lower-section arm and the intermediate arm to lock rotation between the lower-section arm and the intermediate arm;

a connection arm provided between the lower-section arm and the intermediate arm, wherein the lower-section arm and the connection arm are rotatably connected, a first detachable structure is provided at a joint between the lower-section arm and the connection arm to lock rotation between the lower-section arm and the connection arm, and the intermediate arm and the connection arm are rotatably connected, a second detachable structure is provided at a joint between the intermediate arm and the connection arm to lock rotation between the intermediate arm and the connection arm; and the connection arm is a trapezoid structure; and

the connection arm comprises a first lateral part and a second lateral part parallel to each other; an end of the first lateral part is rotatably connected to a side of the lower-section arm; another end of the first lateral part is rotatably connected to a side of the intermediate arm; and the first detachable structure is provided at a joint between an end of the second lateral part and the lower-section arm, and the second detachable structure is provided at a joint between another end of the second lateral part and the intermediate arm.

2. The foldable boom according to claim 1, further comprising an upper-section arm, the upper-section arm comprising an upper-section arm body and an upper-section arm goose head, wherein

an end of the upper-section arm body is connected to an end of the intermediate arm away from the connection arm, the upper-section arm goose head and the upper-section arm body are rotatably connected, the upper-section arm goose head and the upper-section arm body are connected through a third detachable structure, and the third detachable structure is used for locking rotation between the upper-section arm goose head and the upper-section arm body.

3. The foldable boom according to claim 2, further comprising: a first driving mechanism,

a second driving mechanism and a third driving mechanism, wherein

the first driving mechanism is provided at the joint between the lower-section arm and the connection arm to drive the connection arm to rotate relative to the lower-section arm;

the second driving mechanism is provided at the joint between the intermediate arm and the connection arm to drive the connection arm to rotate relative to the intermediate arm; and

the third driving mechanism is provided at the joint between the upper-section arm body and the upper-section arm goose head to drive the upper-section arm goose head to rotate relative to the upper-section arm body.

4. The foldable boom according to claim 3, wherein the first driving mechanism, the second driving mechanism and the third driving mechanism are telescopic drivers.

5. The foldable boom according to claim 4, wherein

a fixed end of the first driving mechanism is mounted at the lower-section arm and a movable end of the first driving mechanism is hinged with the connection arm;

a fixed end of the second driving mechanism is mounted at the intermediate arm and a movable end of the second driving mechanism is hinged with the connection arm; and

a fixed end of the third driving mechanism is mounted at the upper-section arm body and a movable end of the third driving mechanism is hinged with the upper-section arm goose head.

6. The foldable boom according to claim 5, wherein the telescopic driver is a hydraulic cylinder.

7. The foldable boom according to claim 2, further comprising an extension arm, wherein an end of the extension arm is connected to the intermediate arm and another end of the extension arm is connected to the upper-section arm.

8. An engineering machine, comprising a machine body and the foldable boom according to any one of claims 1 to 7, wherein the lower-section arm of the foldable boom is pivotably connected to the machine body.