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WORK MACHINE WITH A GRADING BLADE ATTACHMENT HAVING A KNOCK DOWN BLADE ASSEMBLY

Abstract

A grading blade attachment for a work machine comprising an attachment frame including an upper attachment frame portion and a rear attachment frame portion wherein the upper attachment frame portion has a frame length extending forward from the rear attachment frame portion. The attachment further includes a coupler bracket, a pivot beam, a left wheel assembly, a right wheel assembly, a grading blade, and a knock down blade. The knock down blade assembly is movably coupled to the upper attachment frame portion between an operative position and an inoperative position. The knock down blade assembly including a knock down blade positioned fore of the wheel assemblies connected to the upper attachment frame portion when in the operative position.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] N/A

TECHNICAL FIELD

[0002] The present disclosure relates generally to a work machine with a grading blade attachment having a knock down blade assembly movable between an operative position and an inoperative position.

BACKGROUND

[0003] Work machines with grade control frequently require precision in attaining the contour of the ground surface. Smaller work machines such as skid steers and compact track loaders (both hereinafter referred to as skid steers) may use a stabilizer wheel located fore of the work machine to minimize blade fluctuations and improve precision. The stabilizer wheel may further reduce grading speed performance when engaging large heaps of material. Additionally, a grading surface may not be leveled if any obstructions (e.g. poles, walls) are encountered. The obstruction would result in areas in the obstruction's immediate vicinity to require leveling by alternative attachments or manual labor which can be inefficient. Additionally, grading materials are typically delivered by truck and deposited in a heap of sufficient size as to render the distribution of the material and final grading with standard grading attachments challenging. Therein lies a need for a single attachment that can address fine grading in tight areas.

SUMMARY

[0004] According to an aspect of the present disclosure, a grading blade attachment for a work machine is disclosed. In a first embodiment, the attachment includes an attachment frame including an upper attachment frame portion, a coupler bracket, a pivot beam, wheel assemblies, a grading blade, and a knock down blade. The attachment frame includes an upper attachment frame portion and a rear attachment frame portion wherein the upper attachment frame portion has a frame length extending forward from the rear attachment frame portion. The coupler bracket includes an attachment interface for coupling the grading blade attachment to the work machine. The pivot beam extends transversely to the frame length and is coupled to the upper attachment frame portion. The left wheel assembly and the right wheel assembly is coupled to the pivot beam on opposite sides of the upper attachment frame portion. The grading blade extends transversely to the frame length. The grading blade is located aft of the wheel assemblies and is coupled to the rear attachment frame portion. The knock down blade assembly is movably coupled to the upper attachment frame portion between an operative position and an inoperative position. The knock down blade assembly includes a knock down blade positioned fore of the wheel assembles when in the operative position and is also connected to the upper attachment frame portion.

[0005] The knock down blade assembly comprises a left lift arm and a right lift pivotally coupled to the opposite sides of the upper attachment frame portion at the first lift arm ends, and coupled to the knock down blade at a second lift arm ends. The upper attachment frame support beam straddles the left beam of the upper attachment frame portion and right beam of the upper attachment frame portion. The lift arm support beam straddles the left lift arm and the right lift arm. The lift arm support beam is traverse to a longitudinal length of the upper attachment frame portion. The actuator is longitudinally oriented and pivotally couped to the lift arm support beam on a first actuator end and pivotally coupled about a lift arm pivot axis. The extension and retraction of the actuator pivots the left lift arm and the right lift arm about the pivot axis. The knock down blade is coupled to a wheel axes of the left wheel assembly and the right wheel assembly.

[0006] In a second embodiment, the upper attachment frame portion comprises a rear upper attachment frame and a fore upper attachment frame pivotally coupled to the rear attachment frame at an upper attachment frame folding axis. Rotation of the fore upper attachment frame about the upper attachment frame folding axis lift the knock down blade towards the inoperative position.

The actuator couples the first upper attachment frame portion to the second upper attachment frame portion. Extension and retraction of the actuator rotates the knock down blade about the upper attachment frame folding axis between the inoperative and the operative position. The knock down blade is no greater than a length of the grading blade in a direction transverse to the frame length.
[0007] Retraction of the actuator rotates the left lift arm and the right lift arm at least twenty degrees. The upper attachment frame portion is a single-piece component. Furthermore, the actuator is communicatively coupled to a controller wherein the controller selectively activates a portion of the hydraulic system related to movement of the actuator upon receiving a user input request from a user input interface.
[0008] Other features and aspects will become apparent by consideration of the detailed description, claims, and accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0009] The detailed description of the drawings refers to the accompanying figures.
[0010] FIG. **1** is a side view of a work machine with a grading blade attachment having a knock down blade assembly.
[0011] FIG. **2** is a side view of a first embodiment of a grading blade attachment with a knock down blade assembly.
[0012] FIG. **3** is a rear isometric view of the first embodiment with the knock down blade in the operative position.
[0013] FIG. **4** is a top view of the first embodiment shown in FIG. **3**.
[0014] FIG. **5** is a front view of the first embodiment shown in FIG. **3**.
[0015] FIG. **6** is a side view of a second embodiment of the grading blade attachment with a knock down blade assembly in the operative position.
[0016] FIG. **7** is a side view of the second embodiment of the grading blade attachment with a knock down blade assembly in the inoperative position.
[0017] Like reference numerals are used to indicate like elements throughout the several figures.
DETAILED DESCRIPTION
[0018] As used herein, “controller” is intended to be used consistent with how the term is used by a person of skill in the art, and refers to a computing component with processing, memory, and communication capabilities, which is utilized to execute instructions (i.e., stored on the memory or received via the communication capabilities) to control or communicate with one or more other components. In certain embodiments, the controller may be configured to receive input signals in various formats (e.g., hydraulic signals, voltage signals, current signals, CAN messages, optical signals, radio signals), and to output command or communication signals in various formats (e.g., hydraulic signals, voltage signals, current signals, CAN messages, optical signals, radio signals).
[0019] FIG. **1** illustrates a work machine **100**, depicted as a skid steer, with a grading blade attachment **102** operatively coupled about the front of the work machine **100**. It should be understood, however, that the work machine **100** could be one of many work machines, including, and without limitation, a compact track loader, a front loader, and other construction work machines. The work machines shown here, has a frame **104** with ground-engaging units **106** configured to support the frame **104** on a ground surface **108**. The illustrated ground-engaging units **106** comprises of wheels, but other embodiments can include tracks that engage the ground surface **108**. The work machine **100** includes an attachment **102** to allow an operator to engage the surface and cut and move material to achieve simple or complex features on the surface. As used herein, directions with regard to the work machine (e.g. fore-aft direction or longitudinal direction **120**) may be referred to from the perspective of facing towards the attachment **102** from the frame **104**

of the work machine.
[0020] The work machine **100** comprises of a boom assembly **112** pivotally coupled to the frame **104**. A grading blade attachment **102** is pivotally coupled at a forward portion of the boom assembly **112** through an attachment coupler **114**, such as Deere and Company's Quik-Tach, which is an industry standard coupler configuration universally applicable to many Deere attachments.
[0021] The boom assembly **112** comprises of a pair of boom arms **116** pivotally coupled to the frame **104** and moveable relative to the frame **104** by a pair of boom hydraulic actuators (not shown), wherein the boom hydraulic actuators may also herein be referred to throughout as lift actuators.
[0022] Now turning to FIGS. **2-7**, the grading blade attachment **102** is operable to engage the ground surface **108** and grade, cut, and/or move material to achieve simple or complex features on the ground surface **108**. When attached to and operating with a work machine **100**, the grading blade attachment **102** may experience movement in three directions, and rotation in three directions. A direction in movement of the grading blade attachment **102** may also be referred to with regard to a longitudinal direction **120**, a latitudinal or lateral direction **124**, and a vertical direction **126**. Rotation for a grading blade attachment **102** may be referred to as roll **128** or the roll direction ("tilt"), pitch **130** or the pitch direction ("lift"), and yaw **132** or the yaw direction ("angle") or heading.
[0023] The terms "distal" and "proximal" may be used herein to describe certain features of the grading blade attachment. The terms "distal" and "proximal" are used in relation to the point of view of an operator located on or within the work machine **100**. Thus, a proximal end of the grading blade attachment **102** may be the end closest to the operator and the frame **104** of the work machine **100**. A distal end of the grading blade attachment **102** may be the end furthest from the operator and the frame **104** of the work machine **100**.
[0024] The controller **228** may be in communication with other components on the work machine, such as hydraulic components, electrical components, and operator inputs within an operator station of an associated work machine. The controller **228** may be electrically connected to these other components by a wiring harness such that messages, commands, and electrical power may be transmitted between the controller **228** and the other components. Although the controller **228** is referenced in the singular, in alternative embodiments the configuration and functionality described herein can be split across multiple devices using techniques known to a person of ordinary skill in the art. The controller **228** includes the tangible, non-transitory memory **85** on which are recorded computer-executable instructions, including a predictive maintenance for a track chain undercarriage algorithm. The processor of the controller **228** is configured for executing the predictive maintenance algorithm.
[0025] The controller **228** may be embodied as one or multiple digital computers or host machines each having one or more processors, read only memory (ROM), random access memory (RAM), electrically-programmable read only memory (EPROM), optical drives, magnetic drives, etc., a high-speed clock, analog-to-digital (A/D) circuitry, digital-to-analog (D/A) circuitry, and any required input/output (I/O) circuitry, I/O devices, and communication interfaces, as well as signal conditioning and buffer electronics.
[0026] The grading blade attachment **102** includes an attachment frame that includes an upper attachment frame portion **140** and a rear attachment frame portion **142**. The upper attachment frame portion **140** has a frame length **138** coupled to and extending forward from the rear attachment frame portion **142**. A pivot beam **144** extends transversely to the frame length **138** and is pivotally coupled to the upper attachment frame portion **140** such that the pivot beam **144** is pivotable about a pivot beam axis **146** (shown in FIG. **5**) relative to the upper attachment frame portion **140**. The grading blade attachment **102** comprises of a grading blade **136** extending transversely, or substantially transversely to the length **105** of the work machine **100**. The orientation of the grading blade **136** relative to the frame **104** is contingent upon the pitch, roll, and

yaw. The grading blade assembly **102** further includes a pivot beam **144** which has a left portion **148** and a right portion **150** in opposing directions of the pivot beam axis **146**, wherein the pivot beam **144** rotates about the pivot beam axis **146** to enable the stabilizer wheels to adjust according to the tilt of the grading blade **136**.

[0027] A left wheel assembly **152** is pivotally coupled to the left portion **148** of the pivot beam **144**, or more specifically towards the end of the left portion, wherein the left wheel assembly **152** is pivotable about a left wheel axis **154**. A right wheel assembly **156** is pivotally coupled to the right portion **150** of the pivot beam **144**, or more specifically towards the end of the right portion, wherein the right stabilizer wheel assembly **156** is pivotable about right wheel axis **158**.

[0028] The grading blade attachment **102** includes a coupler bracket **160** attached to the rear attachment frame portion **142**. The coupler bracket **160** may include an attachment interface **162** for coupling the grading blade attachment **102** to the work machine **100**. Specifically, the attachment interface **162** may be operable to engage the attachment coupler **114** of the work machine **100**. The attachment's coupler bracket **160** may include a tilt plate extending transversely to the frame length **138** and positioned adjacent to the attachment coupler interface **162**. The grading blade attachment **102** also introduces a tilt actuator **180** and pitch actuator **182** as the lift and pitch actuators on the work machine are typically secured during operation of grading blade attachment **102** during a grading operation.

[0029] The grading blade assembly further comprises a knock down blade assembly coupled to the upper attachment frame portion **140** and movable between an operative position **168** and an inoperative position **170**. The knock down blade assembly **166** includes a knock down blade **172** positioned fore of the left wheel assembly **152** and the right wheel assembly **156** (collectively referred to as “wheel assemblies”) when in the operative position **168**. The operative position **168** includes engagement of the bottom edge and/or surface **174** of the knock down blade **172** with the ground surface **108**. The inoperative position **170** includes a lifting upwards of the knock down blade **172** at least twenty degrees **178** from the ground surface **108** as shown by the dotted lines **178** in FIG. **2**.

[0030] Each of the tilt actuator **180** and pitch actuators **182** are hydraulically connected to a proportional relief valve each. The proportional relief valves receive pressurized fluid from a hydraulic pump and directs such fluid to the tilt actuator **180** and the pitch actuators **182**. The proportional relief valve may meter such fluid out or control the flow rate of hydraulic fluid to each hydraulic circuit to which it is connected. Furthermore, the proportional relief valve **316** is designed to maintain a consistent pressure by releasing excess fluid when pressure in the system exceeds a certain level. A proportional relief valve may respond to changes in pressure in a linear or proportional manner wherein as the pressure in the system increases, the proportional relief valve will gradually open to release more fluid, and as the pressure decreases, the valve will gradually close to limit fluid flow, thereby advantageously improving precision. The hydraulic actuators such as the pitch actuators **182** and the tilt actuators are coupled to the outlet of the proportional relief valves to regulate fluid flow to control the speed and force of the actuator. The flow rate and thereby pressure is determined by the size of the valve opening. The inclusion of the proportional relief valve coupled to an accumulator advantageously helps keep the system stable and minimizes pressure fluctuations during sudden changes in the ground surface **108** and terrain and maintains a controlled performance of the hydraulic actuators. Contrary to this mechanism, the actuator enabling movement of the knock down blade **172** in one of two directions (i.e. upwards or downwards) comprises of an on/off valve.

[0031] In a first embodiment **200**, as shown in FIGS. **1** through **5**, the knock down blade assembly **166** comprises of a left lift arm **202** and a right lift arm **204** pivotally coupled to the opposing sides (**206***a*, **206***b*) of the upper attachment frame portion **140** at a first lift arm ends (**208***a*, **208***b*), and coupled to the knock down blade **172** at a second lift arm ends (**210***a*, **210***b*). In this embodiment, the knock down blade assembly **166** also includes an upper attachment frame support beam **212**

straddling a left beam **214** of the upper attachment frame portion **140** and a right beam **216** of the upper attachment frame portion **140**. The right beam and the left beam form a V-shaped configuration, and the upper attachment frame support beam **212** straddling the beams further provides a central coupling location for mounting an actuator **220** (hereinafter also referred to as the “knock down actuator”). In an alternative embodiment, it is conceivable that the upper attachment frame portion **140** comprises of a single beam where in a left lift arm **202** and a right lift arm **204** is coupled thereto, wherein the single beam provides a central coupling location for mounting the knock down actuator **220**. However, the single beam configuration would yield a different load distribution.

[0032] The knock down blade assembly **166** further includes a lift arm support beam **218** straddling the left lift arm **202** and the right lift arm **204** wherein the lift arm support beam **218** is traverse to the frame length **138** of the upper attachment frame portion **140**. The actuator **220** is longitudinally oriented and pivotally coupled to the lift arm support beam **218** on a first actuator end **222** and pivotally coupled to an upper attachment frame support beam **212** on a second actuator end **224**. Retraction of the knock down actuator **220** lifts the knock down blade **172** towards the inoperative position **170** (i.e. lift upwards).

[0033] The left lift arm **202** and the right lift arm **204** are pivotally coupled about a lift arm pivot axis **226**, wherein extension and retraction of the knock down actuator **220** pivots the lifts arms (**202**, **204**) about the lift arm pivot axis **226**.

[0034] Retraction of the knock down actuator **220** rotates the lift arms (**202**, **204**) preferably at least twenty degrees (as seen by the arrow **178** between the dotted lines). In this first embodiment, the upper attachment frame portion **140** is a single piece component. Having an attachment with both a grading blade assembly and a knock down assembly advantageously allows for an operator to incrementally grading an irregular surface having large piles of material to be spread. The knock down blade can perform a rough grading of the large pile by enabling the work machine to push through piles or material, thereby resulting in reduced loads on the grader blade for fine finishing using a smart grade control system. Use of the wheel assemblies for of the work machine further assists in smooth movement to improve stability and performance during fine grading.

[0035] The knock down actuator **220** is communicatively coupled to a controller **228** wherein the controller is configured to selectively activate a portion of a hydraulic system **230** related to movement of the knock down actuator **220** upon a user input request **232** from a user input interface **234**. The hydraulic coupling of the knock down actuator with the hydraulic system of the work machine advantageously allows an operator to efficiently switch the knock down blade from an operative position to an inoperative position, and vice versa without egressing the cab.

[0036] In a second embodiment **250**, as shown in FIGS. **6** and **7**, the knock down blade assembly **166** is coupled to the upper attachment frame portion between an operative position and an inoperative position. Similar to the first embodiment, the knock down blade is positioned fore of the left wheel assembly **152** and the right wheel assembly **156**. In this second embodiment **250**, the upper attachment frame portion **140** comprises of a first upper attachment frame portion and a second upper attachment frame portion pivotally coupled to the first upper attachment frame portion at the upper attachment frame folding axis. Rotating the second upper attachment frame portion about the upper attachment frame folding axis lifts the knock down blade towards the inoperative position. The upper attachment frame folding axis bi-folds the upper attachment frame. Contrary to the first embodiment, positioning the knock down blade assembly in an inoperative position also moves the left wheel assembly and right wheel assembly in an inoperative position. The extension and retraction of the knock down actuator **220** rotates the knock down blade **172** about the upper attachment frame folding axis **258** between the inoperative position **170** and the operative position **168**.

[0037] In both the first embodiment **200** and the second embodiment **250**, the knock down blade **172** is no greater than a length of the grading blade **136** in a direction transverse to the frame length

138. More loosely defined, the knock down blade **172** may be equivalent to or shorter than the grading blade **136** in a direction generally transverse to the fore-aft length of the work machine.
[0038] A technical effect of the above-mentioned embodiments enables efficient grading surfaces in small and restricted areas, in indoor areas, and surfaces with obstacles wherein a single attachment allows for rough grading, and subsequent fine grading in areas requiring grading close to obstacles.
[0039] While the above describes example embodiments of the present disclosure, these descriptions should not be viewed in a limiting sense. Rather, other variations and modifications may be made without departing from the scope and spirit of the present disclosure as defined in the appended claims.
[0040] As used herein, “e.g.” is utilized to non-exhaustively list examples and carries the same meaning as alternative illustrative phrases such as “including,” “including, but not limited to,” and “including without limitation.” Unless otherwise limited or modified, lists with elements that are separated by conjunctive terms (e.g., “and”) and that are also preceded by the phrase “one or more of” or “at least one of” indicate configurations or arrangements that potentially include individual elements of the list, or any combination thereof. For example, “at least one of A, B, and C” or “one or more of A, B, and C” indicates the possibilities of only A, only B, only C, or any combination of two or more of A, B, and C (e.g., A and B; B and C; A and C; or A, B, and C).
[0041] Those having ordinary skill in the art will recognize that terms such as “above,” “below,” “upward,” “downward,” “top,” “bottom,” etc., are used descriptively for the figures, and do not represent limitations on the scope of the disclosure, as defined by the appended claims.
[0042] Terms of degree, such as “generally”, “substantially” or “approximately” are understood by those of ordinary skill to refer to reasonable ranges outside of a given value or orientation, for example, general tolerances or positional relationships associated with manufacturing, assembly, and use of the described embodiments.

Claims

1. A grading blade attachment for a work machine, comprising: an attachment frame including an upper attachment frame portion and a rear attachment frame portion, the upper attachment frame portion having a frame length coupled to and extending forward from the rear attachment frame portion; a coupler bracket including an attachment interface for coupling the grading blade attachment to the work machine; a pivot beam extending transversely to the frame length and coupled to the upper attachment frame portion; a left wheel assembly and a right wheel assembly coupled to the pivot beam on opposing ends of the upper attachment frame portion; a grading blade extending transversely to the frame length, the grading blade aft of the wheel assemblies and coupled to the rear attachment frame portion; and a knock down blade assembly coupled to the upper attachment frame portion and movable between an operative position and an inoperative position, wherein a knock down blade is positioned fore of the wheel assemblies when in the operative position.
2. The grading blade attachment of claim 1 wherein the knock down blade assembly comprises: a left lift arm and a right lift arm pivotally coupled to the opposite sides of the upper attachment frame portion at a first lift arm ends, and coupled to the knock down blade at a second lift arm ends; an upper attachment frame support beam straddling a left beam of the upper attachment frame portion and a right beam of the upper attachment frame portion; a lift arm support beam straddling the left lift arm and the right lift arm, the lift arm support beam traverse to a longitudinal length of the upper attachment frame portion; and an actuator longitudinally oriented and pivotally coupled to the lift arm support beam on a first actuator end and pivotally coupled to the upper attachment frame support beam on a second actuator end; wherein retraction of the actuator lifts the knock down blade towards the inoperative position.

3. The grading blade attachment of claim 2, wherein the left lift arm and the right lift arm are pivotally coupled about a lift arm pivot axis, wherein extension and retraction of the actuator pivots the left lift arm and the right lift arm about the pivot axis.
4. The grading blade attachment of claim 3, wherein retraction of the actuator rotates the left lift arm and the right lift arm at least twenty degrees.
5. The grading blade attachment of claim 2, wherein the upper attachment frame portion is a single-piece component.
6. The grading blade attachment of claim 1, wherein an actuator is communicatively coupled to a controller, wherein the controller is configured to selectively activate a portion of a hydraulic system related to movement of the actuator upon receiving a user input request from a user input interface.
7. The grading blade attachment of claim 1, wherein the upper attachment frame portion comprises: a first upper attachment frame portion; a second upper attachment frame portion pivotally coupled to the first upper attachment frame portion at an upper attachment frame folding axis; wherein rotating the second upper attachment frame portion about the upper attachment frame folding axis lifts the knock down blade towards the inoperative position.
8. The grading blade attachment of claim 7, wherein an actuator couples the first upper attachment frame portion to the second upper attachment frame portion wherein extension and retraction of the actuator rotates the knock down blade about the upper attachment frame folding axis between the inoperative position and the operative position.
9. The grading blade attachment of claim 1, wherein the knock down blade is no greater than a length of the grading blade in a direction transverse to the frame length.
10. The grading blade attachment of claim 7, wherein the knock down blade is fixedly coupled to second upper attachment frame portion.
11. A work machine with a grading blade attachment, comprising: a frame supported by a plurality of ground-engaging units, the ground-engaging units configured to support the frame on a surface; a boom assembly coupled to the frame, the boom assembly having a pair of boom arms pivotally coupled to the frame and movable relative to the frame by a pair of boom hydraulic actuators; an attachment coupler coupled to a distal portion of the pair of boom arms, the attachment coupler movable relative to the frame by a pair of attachment pitch hydraulic actuators; and an attachment including an upper attachment frame portion and a rear attachment frame portion, the upper attachment frame portion having a frame length extending forward from the rear attachment frame portion; a coupler bracket including an attachment interface for coupling the grading blade attachment to the work machine; a pivot beam extending transversely to the frame length and coupled to the upper attachment frame portion; a left wheel assembly and a right wheel assembly coupled to the pivot beam on opposite sides of the upper attachment frame portion; a grading blade extending transversely to the frame length, the grading blade aft of the wheel assemblies and coupled to the rear attachment portion; and a knock down blade assembly movable coupled to the upper attachment frame portion between an operative position and an inoperative position, the knock down blade assembly including a knock down blade connected to the upper attachment frame portion and positioned fore of the wheel assemblies when in the operative position.
12. The work machine of claim 11, wherein the knock down blade assembly comprises: a left lift arm and a right lift arm pivotally coupled to the opposite sides of the upper attachment frame portion at a first lift arm ends, and coupled to the knock down blade at a second lift arm ends; an upper attachment frame support beam straddling a left beam of the upper attachment frame portion and a right beam of the attachment frame portion; a lift arm support beam straddling the left lift arm and the right lift arm, the lift arm support beam traverse to a longitudinal length of the upper attachment frame portion; and an actuator longitudinally oriented and pivotally coupled to the lift arm support beam on a first actuator end and pivotally coupled to an upper attachment frame support beam on a second actuator end, the upper attachment frame support beam straddling a left

beam of the upper attachment frame portion and a right beam of the upper attachment frame portion; wherein retraction of the actuator lifts the knock down blade towards the inoperative position.

13. The work machine of claim 12, wherein the left lift arm and the right lift arm are pivotally coupled about a lift arm pivot axis, wherein extension and retraction of the actuator pivots the left lift arm and the right lift arm about the pivot axis.

14. The work machine of claim 13, wherein retraction of the actuator rotates the left lift arm and the right lift arm at least twenty degrees.

15. The work machine of claim 12, wherein the upper attachment frame portion is a single-piece component.

16. The work machine of claim 11, wherein an actuator is communicatively coupled to a controller, the controller configured to selectively activate a portion of a hydraulic system related to movement of the actuator upon a user input request from a user input interface.

17. The work machine of claim 11, wherein the knock down blade is coupled to a wheel axes of the left wheel assembly and the right wheel assembly.

18. The work machine of claim 17, wherein the upper attachment frame portion comprises: a first upper attachment frame portion; a second upper attachment frame portion pivotally coupled to the first attachment frame portion at an upper attachment frame folding axis; wherein rotating the first upper attachment frame portion about the upper attachment frame folding axis lifts the knock down blade towards the inoperative position.

19. The work machine of claim 18, wherein an actuator couples the first upper attachment frame portion to the second upper attachment frame portion and extension and retraction of the actuator rotates the knock down blade between the inoperative position and the operative position.

20. The work machine of claim 11, wherein the knock down blade is no greater than a length of the grading blade in a direction transverse to the frame length.