Title: WORK MACHINE WITH BOOM STOP

Abstract: A work machine (10) has a lift arm assembly (28) pivotally coupled to a frame assembly (12) at a forward frame pivot (14). The lift arm assembly (28) includes a pair of spaced-apart lift arms (62) and an extensible lift cylinder (58). The lift cylinder (58) is pivotally coupled to the lift arms (28,62) at a lift cylinder connection pivot (66). The lift cylinder (58) is pivotally coupled to the frame assembly (12) such that extension of the lift cylinder (58) moves the lift arms (28,62) with respect to the frame assembly (12) about the frame pivot (64). A boom stop (80) is pivotally coupled to the lift cylinder connection pivot (66). The boom stop (80) is movable from an inoperable position with a remote end (80A) adjacent the lift arms (28,62) to an operable position wherein the boom stop (80) engages the frame assembly (12) and prevents lowering movement of the lift arms (28,62) with respect to the frame assembly (12). The lift arm assembly (28) also includes a latch assembly (82) coupled to one of the lift arms (62) for holding the boom stop (80) in the inoperable position.


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WORK MACHINE WITH BOOM STOP

BACKGROUND OF THE INVENTION

The present invention relates to a self-propelled vehicle having a front lift arm assembly. More particularly, the present invention relates to a work machine with a lift arm assembly having a boom stop thereon.

A wheeled work machine includes a frame attached to an operator compartment such as a cab. A cargo support is attached to the frame behind the cab. A lift arm assembly is attached to the frame generally in front of the cab and centered on a longitudinal center line of the work machine. The lift arm assembly is movable with respect to the frame and can be attached to one or more work tools such as a bucket. The wheeled work machine is suited for use as a utility vehicle for various tasks.

Many loaders include boom stops to render a raised lift arm assembly inoperable. One example of a boom stop is disclosed in United States Patent No. 5,009,566. The lift arm includes a hydraulic cylinder having a cylinder body attached to the frame of the skid steer loader and an extensible rod attached to the lift arm assembly. When the rod is fully extended from the cylinder body, the boom stop is positioned between the cylinder body and the lift arm assembly, thus preventing the rod from retracting into the cylinder body.
SUMMARY OF THE INVENTION

The present invention is directed to a self-propelled, wheeled work machine having a lift arm assembly pivotally coupled to a front of a frame assembly at a frame pivot. The lift arm assembly includes a pair of spaced-apart lift arms and an extensible lift cylinder. The lift arms are relatively close together so the lift arm assembly is positioned in center portions of the frame. The lift cylinder is pivotally coupled to the lift arms at a lift cylinder connection pivot, and is pivotally coupled to the frame assembly such that extension of the lift cylinder moves the lift arms with respect to the frame assembly about the frame pivot.

A boom stop is pivotally coupled to the lift cylinder connection pivot. The boom stop is movable from an inoperable position adjacent to and retained with the lift arms, to an operable position wherein an end of the boom stop engages the frame assembly and prevents lowering the lift arms with respect to the frame assembly. The boom stop is releasably held with a latch coupled to one of the lift arms. The latch includes a bracket on the boom stop having a retractable pin resiliently urged into an engaged position. In the engaged position, the pin engages a bracket on the one lift arm to hold the boom stop in the inoperable position.
BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevation view of a work machine constructed in accordance with the present invention;

Figure 2 is a fragmentary side elevation view of a portion of a work machine frame with a lift arm assembly in a lowered position with respect to the frame;

Figure 3 is a side elevation view of the lift arm assembly in a raised position with respect to the portion of the frame shown in Figure 2;

Figure 4 is a perspective view of a portion of the lift arm assembly shown in Figures 2 and 3;

Figure 5 is a plan view of the lift arm assembly shown in Figure 4;

Figure 6 is a plan view of a portion of the lift arm assembly shown in Figure 5; and

Figure 7 is an enlarged side view of a portion of the side view of Figure 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is side elevation view of an exemplary work machine 10. The work machine 10 includes a frame 12 supported with front and rear wheel assemblies 14, 16 respectively. The frame 12 is attached to a cab 18 that defines an operator compartment 20 having an operator platform, and a seat 22, and operator controls 24. The work machine also includes an engine, not shown, typically disposed between the seat 22 and the rear wheel
assembly 16 and attached to the frame 12. The frame 12 also is connected to a cargo support 26, which is disposed behind the seat 22 in the example. A lift arm assembly 28 is positioned in front of the seat 22 and attached to the front portion of frame 12. The lift arm assembly 28 is adapted to receive a removable tool 30, such as a bucket 32 shown in Figure 1.

In a typical example, the frame 12 is a rigid frame assembly that provides generally no frame articulation between the front and rear wheel assemblies 14, 16. The frame 12 is illustrated as including longitudinal members 34 extending from the front wheel assembly 14 toward the rear wheel assembly 16. The frame includes a cargo support portion 36, a middle portion 38, and a lift arm support portion 40. The lift arm support portion 40 is particularly strengthened to resist bending or twisting from loads carried with lift arm assembly 28. The middle portion 38 is adapted to provide a stable mount for the cab 18 and can be suited to accommodate a transverse mounted engine.

The engine can power either or both of the wheel assemblies 14, 16 to move the work machine 10. The engine is connected to one or both of the wheel assemblies 14, 16, with mechanical drives, hydraulic motors or other suitable devices for power transmission. In the illustrated embodiment, hydraulic drive motors are used to drive the wheels.
The wheel assemblies 14, 16 can include suspension systems coupled to the frame 12. A steering linkage can be coupled to the front wheels, rear wheels, or both. In the illustrated embodiment, the wheels are steered using hydraulic cylinders. Controls 24 for the operation of the work machine 10 are mounted in the operator compartment 20.

The cab 18 defines the operator compartment 20. The cab 18 in the example includes a canopy 42 and lights 44. A windshield, windows and doors can also be provided, if desired. The operator compartment 20 includes an instrument cluster and dash 46 generally disposed in front of the seat 22, and includes gauges, controls and the like useful for comfort of the operator and operation of the work machine 10. The seat 22 can include one or more bucket seats or a common bench seat for two or more riders.

More detailed descriptions of a work machine, such as the exemplary work machine 10, are found in United States Patent Application Publication No. 2003073400; and also in United States Patent No. 6,729,830.

Figure 1 also shows the lift arm assembly 28 connected to the lift arm support portion 40 of the frame 12. The remote end of the lift arm 28 can be connected to an interface 48 that provides attachments to various tools 30. Such tools 30 can include buckets, grapples, brooms, augers or other tools. The lift arm assembly 28 is coupled to the
frame 12 in such a manner that it can be moved with respect to the frame 12. Movement of the lift arm assembly 28 is effected through the use of hydraulic actuators that receive power from the engine.

Figure 2 is a more detailed view of the lift arm assembly 28 as coupled to the frame 12. The lift arm assembly 28 is coupled to a mast assembly 50 that is included in the lift arm support portion 40 of the frame 12. The mast assembly 50 includes a pair of opposing side mast plates 52A and 52B (shown in the elevation view of Figures 3, 4 and 7). A cross member 54 is attached to and extends between the side mast plates 52A and 52B, and a pair of spaced brace plates 56A and 56B (Figure 7) that are positioned to the inside of the side mast plates 52A and 52B. The brace plates 56A and 56B are suitably braced to support a tilt cylinder 72 at upper end portions 57A and 57B of the brace plates 56A and 56B.

The lift arm assembly 28 is pivotally movable with respect to the mast assembly 50. The lift arm assembly 28 includes a lift cylinder indicated generally at 58 positioned between the brace plates 56A and 56B, with the cylinder base supported at a pivot 60. Lift arms 62, which are joined together with cross members, are pivoted between the mast plates 52A and 52B at pivot 64. The lift arms 62 are also pivotably coupled to the rod end of lift cylinder 58 at a connection 66. The remote or outer ends of the lift arms 62 have a tilt link 68
connected thereto at pivot 70. Tilt cylinder 72 is coupled to upper ends 57A and 57B of the spaced brace plates 56A and 56B at tilt cylinder pivot 74, the rod end of tilt cylinder 72 is connected to the tilt link 68 at tilt cylinder connection pivot 76. The tilt link 68 is pivotably coupled to a connector link 78.

The connector link 78 and the remote ends of the lift arms are adapted to be coupled to a tool. In one example as described above, the lift arms 62 and links 78 are coupled to an attachment plate 48 that can be used to support one of several tools. Other examples include the lift arms and links being connected to quick exchange brackets or the lift arms and links may be connected directly to the tool with pin connections.

In the example shown, the lift cylinder 58 and tilt cylinder 72 are hydraulic cylinders and each includes a body or cylinder portion and an extensible rod. The lift cylinder body portion 86 is shown in Figure 2 coupled to the mast frame assembly 50 and the extensible rod 84 is coupled to the lift cylinder connection 66. The tilt cylinder body portion is shown in Figures coupled to the mast frame assembly 50 and the extensible rod 84 coupled to the link 68.

Other configurations are possible. The cylinders 58 and 72 are actuated with operator controls and are powered by the engine.

Figures 2, 3 and 7 also show a lift arm or boom stop 80 having one end pivotably coupled to the rod
end pivot 66 of 58. A latch assembly 82 retains the remote or outer end 80A of the boom stop 80 relative to one lift arm. The lift arm or boom stop 80 is held by the latch assembly 82 in a first, stored or inoperative position, with the boom stop 80 generally extending along the length of the lift arm assembly 28. The lift arm or boom stop 80 is shown coupled to the latch assembly 82. The boom stop 80 in the first stored position does not interfere with the operation of the lift arm assembly 28 and the tool 30.

Figures 3 and 7 show the lift arms 62 (and thus lift arm assembly) in a raised position with respect to the frame assembly 50 lift cylinder. Rod 84 is extended from the body 86 of the lift cylinder 58 to place the lift arms 62 in the raised position. The lift cylinder 58 can be controlled to extend the rod 84 from the body 86 and thus vary the height of the lift arms 62. Figures 3 and 7, however, show the lift arms 62 in a generally fully raised position.

The lift arm or boom stop 80 is also shown disposed in a second, or operative, position in Figures 3 and 7, positioned to prevent downward movement of the lift arm assembly 28. In the second position, the latch assembly 82 is released and the outer or remote end 80A of the boom stop moves down as the boom stop pivots about the lift cylinder connection pivot 66. The remote end 80A of the boom stop 80 seats against the offset portion 55 of cross member 54 between the side plates 52A and 52B, or
other sturdy member or portion of the frame assembly 50. If the lift cylinder 58 is slightly retracted, the boom stop 80 becomes wedged or otherwise secured in the offset portion 55, and this prevents further retraction of the lift cylinder 58 or downward movement of the lift arm assembly until the lift arm assembly is raised.

The boom stop is stopped right on the vehicle frame, so the boom stop has a large area to rest upon, and the boom stop does not extend along the lift cylinder rod. The boom stop is independent from the lift cylinder. The offset portion 55 also tilts upwardly slightly to retain the boom stop 80 positively. The remote end of the boom stop is trimmed at a mating angle.

Extension of the lift cylinder 58 permits manual removal of the remote end of the boom stop 80 from the raised outer edge of the offset frame portion 55. The lift arm assembly is raised sufficiently to provide clearance. The boom stop 80 then can be manually placed in the first stored or inoperative position again and latched in place with latch assembly 82.

Figures 4 and 5 show additional views of the pair of lift arms 62, boom stop 80, and latch assembly 82. In the example shown, the boom stop 80 is mounted between the pair of lift arms 62 and is formed out of a U-shaped bar or strut for strength. The boom stop 80 includes a connection plate 88 that
is a portion of the latch assembly 82. The latch assembly 82 in the example includes an S-shaped bracket 90 attached to one of the lift arms 62 and containing a spring-loaded pin 92. The spring-loaded pin 92 includes a spring 93, a handle 94 that extends through slot 96 in the S-shaped bracket 90, and a tip or end 95 that projects from an end wall of bracket 90 and will fit into a hole 102 provided in the connection plate 88 to retain the boom stop 80 in the first inoperative or stored position.

The pin 92 is resiliently urged to an engaged position 98, and is movable from the engaged position 98 of the handle to a disengaged position 100. In the engaged position 98, also shown in Figure 6, the tip 95 of the pin 92 extends through hole 102 on the connection plate 88. The spring 93 holds the pin 92 in place and secures the boom stop 80 in the first position and along the lift arms 62. The pin 92 also carries a keeper 104 for the spring 93 to retain the spring 93 in position on the pin 92. In one example, the keeper 93 is a snap ring. When the handle 94 is pulled toward the disengaged position 100, the spring 93 is compressed between the keeper 104 and a middle bar 106 of the S-shaped bracket 90. The pin 92 slides out of the hole 102 of the connection plate 88, and the boom stop 80 is decoupled from the bracket 90 of the latch assembly 82.

When the handle 94 is released the spring 93 urges the tip 95 away from the bracket 90 and the
latch assembly 82 is ready for coupling to the boom stop 80. The connection plate 88 includes an angled lip portion 108 that guides the tip 95 of the pin 92 back into the hole 102 as the boom stop 80 is moved into the first position. The tip 95 slides along the lip 108 and then extends through the hole 102 to lock the boom stop 80 into the first position. The connection plate 88 in the example also includes a resilient bumper 110 that mates with a resilient button 112 attached to the bracket 90. The resilient material for the bumper 110 and button 112, such as rubber or another elastomeric material serves to prevent the boom stop 80 from rattling during operation of the machine 10. In another example, the connection plate 88 can be attached to one of the lift arms and the bracket 90 and spring would be attached to the boom stop.

The boom stop latch assembly 82 can be released to drop the remote end down and the boom stop will pivot as the lift arm assembly is raised. The remote end of the boom stop 80 will slide along the raised front edge of offset portion 55 until the edge of the tapered end 80A of the boom stop 80 is over the front edge of the offset section 55. The remote end then swings to the position of Figures 3 and 7 under gravity against a vertical frame section 55A as the lift arms are raised. When the lift arms are lowered, the cooperating tapered end 80A will seat securely on the tilted upper surface of offset frame
portion 55. The boom stop cannot be manually moved back to its stored or inoperative position until the lift arms are raised again sufficiently to provide clearance for pivoting the boom stop upwardly.

Although the present invention has now been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.
WHAT IS CLAIMED IS:

1. A work machine, comprising:
   a lift arm assembly pivotally coupled to a frame assembly at a frame pivot;
   the lift arm assembly including at least one lift arm and an extensible lift cylinder,
   wherein the lift cylinder is pivotally coupled to the lift arm assembly at a lift cylinder connection pivot and the lift cylinder is pivotally coupled to the frame assembly such that extension of the lift cylinder raises an outer end of the lift arm with respect to the frame assembly about the frame pivot; and
   a boom stop pivotally coupled to the lift arm and pivotally movable from an inoperable position adjacent the lift arm to an operable position wherein an end of the boom stop engages the frame assembly after the lift arm has been raised with respect to the frame assembly.

2. The work machine of claim 1, wherein the lift arm assembly is pivotally coupled to the frame assembly between a pair of spaced-apart side plates having a frame cross member between the side plates, and wherein the end of the boom stop engages the frame cross member when moved into the operable position.
3. The work machine of either of claims 1 or 2, wherein the boom stop is movable into the operable position when the lift cylinder is extended a selected amount.

4. The work machine of any one of the preceding claims, wherein the boom stop is coupled to the lift arm with a releasable latch assembly in the inoperable position.

5. The work machine of claim 4, wherein the latch assembly is attached to the lift arm and includes a retractable pin, and the boom stop includes a connection plate that is engaged by the retractable pin to couple the boom stop to the lift arm.

6. The work machine of claim 4, wherein the latch assembly includes at least one resilient member engaging the connection plate when the boom stop is coupled to the lift arm.

7. The work machine of any of claims 1-3, wherein the lift arm assembly comprises a pair of lift arms spaced laterally apart and joined together, and wherein the boom stop is pivotally mounted between the pair of spaced lift arms.

8. A lift arm assembly for a wheeled work machine having a frame wherein the lift arm assembly is movable with respect to the frame, the lift arm assembly, comprising:

an extensible lift cylinder coupled to the lift arm assembly at a lift cylinder connection
pivot, and operable to raise an outer end of the lift arm assembly;

a lift arm stop having one end coupled to the lift arm assembly, the lift arm stop having a second end movable between a stored position adjacent to the lift arm assembly and an operable position wherein the second end of the lift arm stop engages a portion of the frame with the lift arm assembly raised.

9. The lift arm assembly of claim 8, wherein the lift arm stop and lift arm assembly have cooperative latch elements to releasably hold the lift arm stop in its stored position.

10. The lift arm assembly of claim 8 and a latch bracket coupled to the lift arm assembly, the latch bracket carrying a retractable pin and a spring, wherein the spring resiliently urges the retractable pin into an engaged position, and wherein the pin in the engaged position mates with a connection plate on the lift arm stop and couples the lift arm stop to the lift arm assembly when the lift arm stop is in the stored position.

11. The lift arm assembly of claim 15, wherein the latch bracket includes at least one resilient button that engages the connection plate when the lift arm stop is coupled to the lift arm assembly.

12. The lift arm assembly of any one of claims 8-11, wherein the portion of the frame comprises a surface
upwardly sloped in a forward direction, and the second end of the lift arm stop has an end configuration that mates with the upwardly sloped surface, such that once the end configuration engages the upwardly sloped surface, the lift arm stop is prevented from moving to its stored position until the lift arm assembly is raised.
### INTERNATIONAL SEARCH REPORT

#### A. CLASSIFICATION OF SUBJECT MATTER

- E02F9/24
- E02F3/38

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)

- E02F
- E05C
- E21B

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

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

- EPO-Internal

#### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 4 522 554 A (WILLIAMS ET AL) 11 June 1985 (1985-06-11) column 2, line 49 - column 3, line 25; figure 1</td>
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<td>Y</td>
<td>US 4 033 469 A (FRANK ET AL) 5 July 1977 (1977-07-05) figures</td>
<td>6, 10, 11</td>
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<tr>
<td>X</td>
<td>US 4 218 094 A (LEAVER, JOHN Y) 19 August 1980 (1980-08-19) column 2, line 58 - column 3, line 40; figures column 5, line 12 - line 24</td>
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| X        | Further documents are listed in the continuation of box C. |
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<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>US 3 223 251 A (ROTHE ARTHUR ET AL) 14 December 1965 (1965-12-14) figures</td>
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<tr>
<td>Y</td>
<td>column 2, line 39 - column 3, line 26; figures</td>
<td>7</td>
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<tr>
<td>A</td>
<td>US 4 189 278 A (DEWEY, RONALD A) 19 February 1980 (1980-02-19) figures</td>
<td>1-12</td>
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<tr>
<td>X</td>
<td>US 3 805 463 A (LANG D,US ET AL) 23 April 1974 (1974-04-23) figures</td>
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<td>US 3223251</td>
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