A machine is disclosed. The machine includes a lift arm attached to a frame of the machine. The machine also includes a cylinder assembly. The cylinder assembly includes a first end and a second end, wherein the first end of the cylinder assembly is coupled to the lift arm. The machine further includes a work implement coupled to the second end of the cylinder assembly and the lift arm.
FIG. 1
LINKAGE ASSEMBLY FOR MACHINE

TECHNICAL FIELD

[0001] The present disclosure relates to a linkage assembly; and more particularly, to a connection structure associated with the linkage assembly for machines, such as those used in construction.

BACKGROUND

[0002] Machines, for example, wheel loaders are used for moving material, such as earth, clay, sand, and gravel, from one place to another at a worksite. The machines generally include an implement, such as a bucket, provided at a front or rear end of the machine. A linkage assembly is provided on the machine in connection with the implement for manipulating the implement of the machine.

[0003] The linkage assembly structure may vary in design. For example, in a construction machine, such as a wheel loader, the linkage assembly may include a pair of lift arms raised and lowered by lift cylinders. The linkage assembly may also include Z-bar linkages in order to rack the implement during digging and dumping operations. The Z-bar linkages include a lift cylinder, a lift lever, and a tilt link coupled between the frame and the implement, such that the tilt lever and the tilt link are driven by the tilt cylinder. Further, one end of the tilt cylinder is pivotally connected to the frame of the wheel loader.

[0004] U.S. Pat. No. 5,879,126 describes a working unit of a construction equipment with an attachment self leveling function. The working unit includes an attachment self leveling linkage. The linkage automatically maintains the desired angle of the attachment relative to the reference or ground surface, thereby maintaining the horizontal position of the attachment without any motion for controlling the bucket cylinder while lifting up the attachment from the initial position to the uppermost position by the arm-up motion during the operations of the construction equipment.

SUMMARY OF THE DISCLOSURE

[0005] In one aspect of the present disclosure, a machine is disclosed. The machine includes a lift arm attached to a frame of the machine. The machine also includes a cylinder assembly. The cylinder assembly includes a first end and a second end, wherein the first end of the cylinder assembly is coupled to the lift arm. The machine further includes a work implement coupled to the second end of the cylinder assembly and the lift arm.

[0006] In another aspect of the present disclosure, a linkage assembly is disclosed. The linkage assembly includes a lift arm including a first lift arm member and a second lift arm member. The first lift arm member and the second lift arm members of the lift arm are configured to be attached to a frame. The linkage assembly also includes a horizontal support member connected between the first lift arm member and the second lift arm member. The linkage assembly further includes a cylinder assembly including a first cylinder and a second cylinder. Further, one end of each of the first cylinder and the second cylinder respectively is coupled to the horizontal support member and another end of each of the first cylinder and the second cylinder respectively is configured to be coupled to a work implement.

[0007] In yet another aspect of the present disclosure, a construction machine is disclosed. The construction machine includes a power source. The construction machine also includes a frame. The construction machine further includes a linkage assembly coupled to the frame. The linkage assembly includes a lift arm. The linkage assembly also includes a cylinder assembly. The cylinder assembly includes a first end and a second end, wherein the first end of the cylinder assembly is coupled to the lift arm. The construction machine further includes a work implement coupled to the second end of the cylinder assembly and the lift arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a perspective view of an exemplary machine, according to one embodiment of the present disclosure;

[0010] FIG. 2 is a perspective view illustrating an implement of the machine in a groundline position;

[0011] FIG. 3 is a perspective view illustrating the implement of the machine in a level position; and

[0012] FIG. 4 is a perspective view illustrating the implement of the machine in a dump position.

DETAILED DESCRIPTION

[0013] Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or the like parts. FIG. 1 represents an exemplary machine 100, according to one embodiment of the present disclosure. More specifically, the machine 100 may embody a wheel loader as shown in the illustrated embodiment. Alternatively, the machine 100 may include, but is not limited to, a backhoe loader, a skid steer loader, a motor grader, a load haul dumper and the like. It should be understood that the machine 100 may alternatively include other mining, transportation, forestry or any other industrial, agricultural or construction machinery.

[0014] Referring to FIG. 1, the machine 100 may include a chassis and/or a frame 102. A powertrain or a drivetrain (not shown) may be provided on the machine 100 for the production and transmission of motive power. The powertrain may include a power source such as, one or more engines, power plants or other power delivery systems like batteries, hybrid engines, and the like. It should be noted that the power source could also be external to the machine 100. A set of ground engaging members 104, such as wheels, may also be provided on the machine 100 for the purpose of mobility. The powertrain may further include a torque converter, transmission inclusive of gearing, drive shaft and other known drive links provided between the power source and the set of ground engaging members 104 for the transmission of motive power. Further, the machine 100 may include an operator cabin 106 which houses controls for operating the machine 100.

[0015] The machine 100 may include an implement 108. In the illustrated embodiment, the implement 108 is embodied as a bucket. The implement 108 is mounted at a front end 110 of the machine 100. The implement 108 may include a plurality of blades 109 provided at a front end of the implement 108. The implement 108 is connected to the frame 102 of the machine 100 by a linkage assembly 112.

[0016] The linkage assembly 112 includes a lift arm 114. The lift arm 114 includes a first lift arm member 116 and a second lift arm member 118. A first end 120 of each of the first
and second lift arm members 116, 118 is pivotally connected to the frame 102 of the machine 100 by a pivot pin A. Further, a second end 122 of each of the first and second lift arm members 116, 118 is pivotally connected to the implement 108 by a pivot pin B (see FIGS. 2-4). In the following discussion, a length of the elements will be designated by their pivot pins. With this convention, the first and second lift arm members 116, 118 have a length AB.

Each of the first and second lift arm members 116, 118 has a corresponding lift cylinder 124. The rotation of the first and second lift arm members 116, 118 is controlled by the lift cylinders 124 associated with the machine 100. Alternatively, a single lift arm member and lift cylinder, a pair of lift arm members driven by a single lift cylinder, or other arrangements of the lift arm and the lift cylinders providing similar functionality as kinematic elements may be implemented. One end of the lift cylinders 124 is pivotally connected to the frame 102 by a pivot pin Y (see FIGS. 2-4). Whereas, other end of the lift cylinders 124 is pivotally connected to the lift arm 114 by a pivot pin K, such that the lift cylinders 124 define a length KY of the lift cylinder 124. Further, the lift cylinders 124 may be extended to raise the lift arm 114 or retracted to lower the lift arm 114.

The linkage assembly 112 also includes a horizontal support member 126. The horizontal support member 126 is connected between the first and second lift arm members 116, 118. The linkage assembly 112 further includes a cylinder assembly 128. The rotation of the implement 108 may be controlled by the cylinder assembly 128. In one example, the cylinder assembly 128 may include a single cylinder provided between the horizontal frame member 126 and the implement 108. In another example, as illustrated in the accompanying figures, the cylinder assembly 128 includes a pair of cylinders, namely a first cylinder 130 and a second cylinder 132. The first and second cylinders 130, 132 are embodied as tilt cylinders. The first and second cylinders 130, 132 are configured to rack the implement 108 of the machine 100, for example, during digging and dumping operations. A first end 134 of each of the first and second cylinders 130, 132 is connected to the horizontal support member 126 by pivot pins F. Further, a second end 136 of each of the first and second cylinders 130, 132 is pivotally connected to the implement 108 of the machine 100 by pivot pins C (see FIGS. 2-4), such that FC defines the length of the first and second cylinders 130, 132.

It should be noted that the cylinders 124, 130, 132 may include a known single acting or double acting cylinder. In the illustrated embodiment, the cylinder 124, 130, 132 is a double acting cylinder serving the purpose of both, an extension and a retraction of components connected thereto. Referring to FIGS. 1-4, the cylinders 124, 130, 132 may each include a cylinder barrel 138, 140 and a piston (not shown), wherein the piston is slidable received within the cylinder barrel 138, 140. Further, a piston rod 142, 144 may be connected to the piston of each of the cylinders 124, 130, 132. In the illustrated embodiment, the piston rod 142 of the lift cylinders 124 is connected to the lift arm 114 by the pivot pin K. Whereas, the piston rods 144 of the first and second cylinders 130, 132 are connected to the implement 108 by the pivot pins C. It should be noted that the lift cylinders 124 and the first and second cylinders 130, 132 of the cylinder assembly 128 may be actuated pneumatically or hydraulically.

On receiving a signal from the operator cabin 106 of the machine 100, the lengths KY and FC associated with the lift cylinders 124 and the first and second cylinders 130, 132 respectively may vary as the corresponding piston rods 142, 144 extend and retract, thereby effectuating a movement of the lift arm 114 and the implement 108. Accordingly, the length KY of the lift cylinder 124 is minimal in a fully retracted position of the piston rod 142 and the length KY is maximal when the piston rod 142 is in a fully extended position. Similarly, the length FC of the first and second cylinders 130, 132 is minimal in a fully retracted position of the piston rods 144 and the length FC is maximal when the piston rods 144 of the first and second cylinders 130, 132 are in a fully extended position. Based on the varying lengths KY and FC of the cylinders 124, 130, 132 the machine 100 may perform different operations such as loading, dumping, excavating, leveling, and the like.

FIGS. 2-4 are perspective views of the front end 110 of the machine 100, wherein the lift arm 114 and the implement 108 are shown in different positions while performing various machine tasks. Referring to FIGS. 1 and 2, the implement 108 is at a groundline position with the lift arm 114 lowered. In this position, the lift cylinders 124 and the first and second cylinders 130, 132 are in the retracted position. In the illustrated embodiment, in the groundline position the implement 108 of the machine 100 may scoop up material from the ground, such as sand, dirt, or gravel, for transportation from one place to another.

In another example, the implement 108 may also perform the ground leveling or excavating operation. In one example, while powering the machine 100 onto a pile of material, the first and second cylinders 130, 132 are actuated and retracted, such that the implement 108 rolls back or pivots about the pivot pins B, C towards the frame 102 of the machine 100, in order to fill the implement 108 with such material. One of ordinary skill in the art will appreciate that the implement 108 may be rolled back in any position of the lift arm 114. It should be noted that the implement 108 may be rolled back up to a certain angle with respect to the ground. In exemplary embodiment, the implement 108 may roll back to an angle between 35 to 45 degrees with respect to the ground.

After loading of the material within the implement 108, the implement 108 may be raised out of the pile by the lift arm 114 for transport of the material to a dumping site. A distance or elevation by which the lift arm 114 is lifted may depend on an elevation of an awaiting dump truck or an open trench. FIGS. 3 and 4 show the lift arm 114 in the raised position. The lift arm 114 may be raised by actuating and extending the lift cylinders 124. On receiving the control signal from the operator cabin 106, the piston rod 142 attached to the lift arm 114 may extend and raise the lift arm 114, such that the first and second lift arm members 116, 118 pivot about the pivot pins A. Further, the first and second cylinders 130, 132 of the cylinder assembly 128 also pivot about the pivot pin F, such that the pivoting action of the lift arm 114 and the first and second cylinders 130, 132 further lift the implement 108 of the machine 100.

Referring to FIG. 3, the implement 108 is in a level position; with the lift arm 114 raised approximately midway of a total rotational travel of the lift arm 114. The lift arm 114 may be in the level position during a travel of the machine 100 from a loading site to the dumping site. In this situation, the implement 108 may be rolled back about the pivot pins B, C so that the material present within the implement 108 does not fall off therefrom.
FIG. 4 illustrates the dump operation of the machine 100. In the accompanying figures, the lift arms 114 are shown in the raised position, with the lift cylinders 124 being actuated and extended to a maximum length KY of the lift cylinders 124. Further, the implement 108 is shown in a dumped position. The dumped position of the implement 108 is realized by actuating and extending the first and second cylinders 130, 132 of the cylinder assembly 128, such that the implement 108 pivots about the pivot pins B, C. The dumped position of the implement 108 may be accomplished at any position of the lift arm 114 which may be high enough to permit the implement 108 to pivot downwardly about the pivot pin B, C, without engaging an obstacle or the ground therebeneath. In one exemplary embodiment, when in the dumped position, the implement 108 may form an angle of approximately 40 to 45 DEG with respect to the ground. However, this angle may vary based on various factors, for example, the length of the first and second cylinders 130, 132 or the position of the lift arm 114.

INDUSTRIAL APPLICABILITY

Machines, such as the wheel loader, include tilt cylinders. The tilt cylinders rack the implement while performing tasks, such as digging and dumping, on a worksite. The tilt cylinders are pinned between the frame of the machine and a tilt lever. Further, a tilt link is pinned between the implement and the tilt lever. However, the tilt links and tilt levers are heavy components. The tilt links and tilt levers add to an overall weight of the machine. Further, the tilt links and tilt levers also add to an overall manufacturing cost of the machine.

In the present disclosure, the first and second cylinders 130, 132 are pivotally connected between the lift arm 114 and the horizontal support member 126 and the implement 108. This eliminates the requirement of the tilt links and tilt levers, thereby reducing the overall weight of the machine 100. In one example, the weight of the machine 100 may be reduced by approximately 9000 kg. This arrangement of the first and second cylinders 130, 132 also reduces the overall cost associated with the manufacturing of the machine 100. Further, the linkage assembly 112 of the present disclosure has a simplified construction, such that it may be easily manufactured and installed on the machine 100. The linkage assembly 112 therefore improves an operational efficiency of the machine 100. One of ordinary skill in the art will appreciate that the linkage assembly may be utilized in connection with a variety of machines and is not limited to that of the application disclosed herein.

While aspects of the present disclosure have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present disclosure as determined based upon the claims and any equivalents thereof.

What is claimed is:

1. A machine comprising:
a lift arm attached to a frame of the machine;
a cylinder assembly having a first end and a second end, wherein the first end of the cylinder assembly is coupled to the lift arm; and

- a work implement coupled to the second end of the cylinder assembly and the lift arm.

2. The machine of claim 1, wherein the lift arm includes a first lift arm member and a second lift arm member.

3. The machine of claim 2, wherein one end of each of the first lift arm member and the second arm member respectively, are connected to the work implement.

4. The machine of claim 2 further comprising:
a horizontal support member connected between the first lift arm member and the second lift arm member.

5. The machine of claim 4, wherein the cylinder assembly includes a first cylinder and a second cylinder.

6. The machine of claim 5, wherein a first end of the first cylinder and a first end of the second cylinder respectively, are connected to the lift arm via the horizontal support member.

7. The machine of claim 1, wherein the cylinder assembly is actuated pneumatically or hydraulically.

8. A linkage assembly comprising:
a lift arm including a first lift arm member and a second lift arm member, the first lift arm member and the second lift arm member configured to be attached to a frame;
a horizontal support member connected between the first lift arm member and the second lift arm member; and
a cylinder assembly including a first cylinder and a second cylinder, wherein one end of each of the first cylinder and the second cylinder respectively, is coupled to the horizontal support member and another end of each of the first cylinder and the second cylinder respectively, is configured to be coupled to a work implement.

9. The linkage assembly of claim 8, wherein the cylinder assembly is actuated pneumatically or hydraulically.

10. A construction machine comprising:
a power source;
a frame;
a linkage assembly coupled to the frame, the linkage assembly comprising:
a lift arm; and
a cylinder assembly having a first end and a second end, wherein the first end of the cylinder assembly is coupled to the lift arm; and
a work implement coupled to the second end of the cylinder assembly and the lift arm.

11. The construction machine of claim 10, wherein the lift arm includes a first lift arm member and a second lift arm member.

12. The construction machine of claim 11, wherein one end of each of the first lift arm member and the second lift arm member respectively, are connected to the work implement.

13. The construction machine of claim 11 further comprising:
a horizontal support member connected between the first lift arm member and the second lift arm member.

14. The construction machine of claim 13, wherein the cylinder assembly includes a first cylinder and a second cylinder.

15. The construction machine of claim 14, wherein a first end of the first cylinder and a first end of the second cylinder respectively, are connected to the lift arm via the horizontal support member.

16. The construction machine of claim 10, wherein the cylinder assembly is actuated pneumatically or hydraulically.

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