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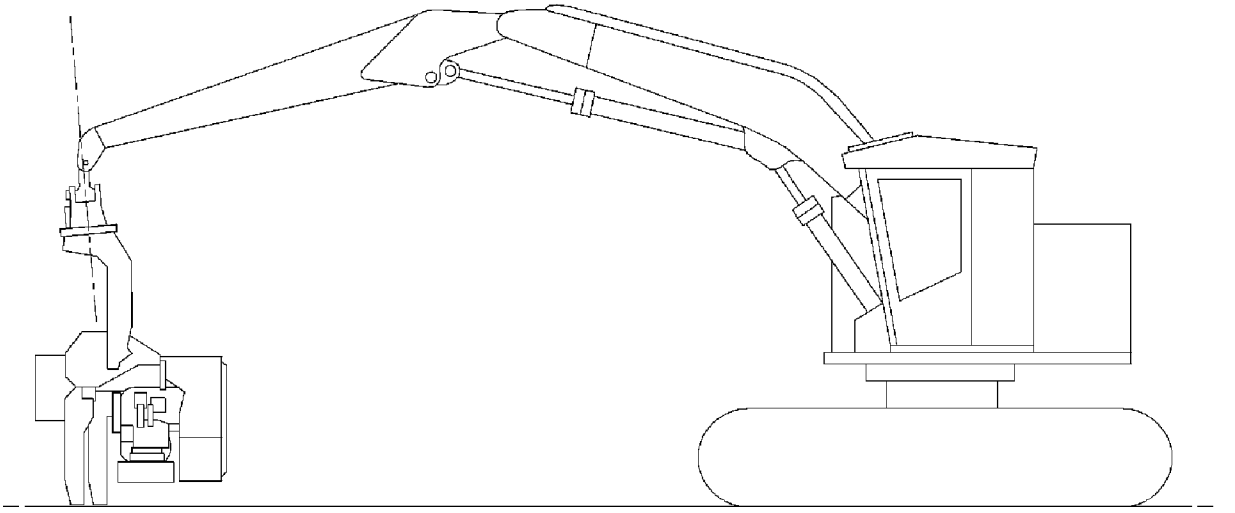
(54) Title: A TIMBER WORKING DEVICE AND A METHOD FOR A TIMBER WORKING DEVICE



(57) Abrégé/Abstract:
A timber working device, comprising a frame, having a feed axis, a drive system, configured to feed at least one stem along the feed axis, a pair of upper knives movably attached to the frame, at least a lower knife, movable attached to the frame, wherein the upper and lower knives are configured to be controllable each by an actuator to open and close around a stem, a tilt mechanism comprising a tilt bracket pivotably attached to the frame, at least two hydraulic tilt actuators acting between the frame and the tilt bracket to control a tilt position of the frame in relation to the tilt bracket.

Abstract

A timber working device, comprising a frame, having a feed axis, a drive system, configured to feed at least one stem along the feed axis, a pair of upper knives movably attached to the frame, at least a lower knife, movable attached to the frame, wherein the upper and lower knives are configured to be controllable each by an actuator to open and close around a stem, a tilt mechanism comprising a tilt bracket pivotably attached to the frame, at least two hydraulic tilt actuators acting between the frame and the tilt bracket to control a tilt position of the frame in relation to the tilt bracket.

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A TIMBER WORKING DEVICE AND A METHOD FOR A TIMBER WORKING DEVICE

FIELD OF THE INVENTION

The present invention concerns a timber working device for felling and/or processing logs and a method for a timber working device.

BACKGROUND OF THE INVENTION

Mobile work machines, in particular, forestry equipment and forestry machines, e.g. harvesters and forwarders, have an articulated boom and a tree stem processing tool at the tip of the boom. The tool can be e.g. a harvester head, a felling head, a harvesting and processing head, or a log grapple equipped with a sawing apparatus. The tool can be used e.g. to cut standing trees, to process felled trees or to grab objects, such as logs or tree stems. When using such a tool with power-driven operations, it is operated under the control of an operator of the work machine.

The mobile work machines comprise an articulated crane with the tool attached to a boom tip of the crane. Such tools handle heavy load, that may comprise a load of soil or logs or raw material. Usually such cranes are controlled by hydraulic actuators that are driven by hydraulic pressure from one or more pumps. The pumps are usually powered by the primary power source of the vehicle.

The stem processing tool or harvester tool comprises several movable knives that are used to grab the log/tree with the harvester tool. These knives are hydraulically actuated and controlled by the controller mounted on the harvester tool. Once the tree is grabbed with the harvester tool, a saw blade, usually at a bottom side of the harvester tool, is activated to cut the tree/stem. After the cutting process the tree will fall over, only being fixated in the harvester tool by the knives closed around the stem. Usually, within the harvester tool, feeding wheels are activated to pull/push the stem through the harvester tool and the knives, so that bark/branches are removed, and the log/stem is cut up into log pieces of determined size.

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When the log/tree is cut and rests on the ground it represents a resistance to the feeding wheels and additional torque and shear forces on the knives of the harvester head. The forces act on the knives in an opening direction, so that the hydraulic control of the knives needs to be adjusted to ensure a correct grip and position on the log to remove bark or branches. At the same time, due to a higher gripping force of the knives, the feeding wheel hydraulic motors also need a higher torque due to the higher gripping force of the knives.
US 7,296,602 discloses tree processing equipment with a two-position pivot point for an actuator end. The equipment comprises two tilt actuators mounted on two sides which can actuate a tilt movement of the equipment/tool to enable a horizontal feeding direction of the log/tree.

This results not only in a higher work load for the machine operator but also in a higher wear on the log and a loss of quality of the product. Due to the higher forces required, the machines fuel consumption is also increased as well as the production and maintenance costs.

SUMMARY OF THE INVENTION

The invention discloses a timber working device, which comprises a frame, having a feed axis, a drive system, configured to feed at least one stem along the feed axis, a pair of upper knives movably attached to the frame, at least a lower knife, movable attached to the frame, wherein the upper and lower knives are configured to be controllable each by an actuator to open and close around a stem. Further, it comprises a tilt mechanism comprising a tilt bracket pivotably attached to the frame, at least two hydraulic tilt actuators acting between the frame and the tilt bracket to control a tilt position of the frame in relation to the tilt bracket, wherein the two tilt actuators are opposed, so that during a tilt movement, one tilt actuator is extending while the other tilt actuator is retracting at the same time.

The timber working device according to the invention has thus at least two hydraulic tilt actuators, wherein when one tilt actuator extends, the other tilt actuator retracts. Depending on the tilt position of the timber working device the tilt actuators have a different length of extension. Accordingly, the tilt forces acting on the hydraulic tilt actuators are harmonized, so that sufficient hydraulic force is provided by the timber working device at all tilt angles. This

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reduces the necessary hydraulic force provided by the pumps and accelerates the working procedure.

In another embodiment of the timber working device, the tilt actuators are mounted on opposite sides of the tilt bracket.

The hydraulic tilt actuators can thus work in opposite directions. As one tilt actuator is extending, the other tilt actuator being mounted on the opposite site must retract. The available high tilt torque combined with the wide tilt angle provides ability to eliminate the effect of the skidding force.

The tilt actuators may be mounted on the same side of the tilt bracket.

This can provide additional design space as one side of the tilt bracket is not used. There can be provided some additional control devices or hydraulic lines. Also, the hydraulic tilt actuators may be accessed for maintenance with less effort.

The tilt actuators may comprise double acting hydraulic cylinders.

The tilt forces can be applied in any angled position of the tilt bracket. The hydraulic actuators may act in both directions increasing the possible usable hydraulic efficiency.

The hydraulic tilt actuators may have a different size.

The tilt actuators can have different sizes. The hydraulic force able to be used by the hydraulic actuators can be adapted depending on the work load and the usage of the timber working device. Also, necessary design space can be reduced and thus leaving room for additional devices on the timber working machine.

The hydraulic tilt actuators may have a different length.
Reducing or extending the base length setup of the tilt actuators may save design space. The lever arms can be adapted so that always the highest usable hydraulic force can be used.

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This further ensures an effective use of hydraulic power, so that all knives of the timber working device can be supplied and the forces are adjusted accordingly.

The hydraulic tilt actuators may have a different power level.

This allows an additional adaption of the tilt actuators depending on their position between the frame and the tilt bracket. It may also be the case that the power of the tilt actuators is dynamically adjusted depending on the control model in regard to the log/stem weight and the necessary forces to tilt.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a side view of the timber working device according to the invention;

Figure 2 displays a top view of the timer working device according to the invention;

Figure 3 shows an isometric view of the timber working device according to the invention where the tilt bracket is in a 90 degrees angle to the frame;

Figure 4 depicts an isometric view of the timber working device according to the invention where the tils bracket is in an angle of more than 90 degrees to the frame;

Figure 5 displays the available tilt torque of the timber working device according to the invention which is provided by two hydraulic actuators over the angle range.

Figure 6 shows a standard timber working device which is state of the art.

DETAILED DESCRIPTION

Figure 6 discloses a state-of-the-art harvester head for felling and processing trees. It comprises a frame 12 on which all components are mounted. The harvester head has a feed axis 14 which is oriented with the center line of a tree or stem when the harvester head is attached to the tree. The tree is grabbed by an upper knife 22 which is closed around the tree

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along with the feeding wheels of the drive system 20. Once the tree is cut with a saw blade provided in the harvester head, the tree falls over and is feed through the harvester head by the feeding wheels. In predetermined distances the tree is cut into logs.

Especially when the tree is suspended in the harvester head after the felling with one end of the tree being pulled on the ground. When the feeding process is started, the feeding wheels must work against the skidding force of the tree. The skidding force causes also a torque load on the upper 22 and lower knives 24 of the harvester head. The torque momentum is acting in an opening direction of the knifes so that the grip would become weaker. In order to prevent such a loss of gripping force, the actuators 26 controlling the knives are used with a higher hydraulic force to keep the knives in a gripping position. The higher closing force on the knives also increases the friction of the knives on the tree surface. The higher friction requires thus a higher feeding force from the drive system 20 so that the motors driving the feeding wheels require a power increase to pull the tree through the knives. The skidding force leads to a higher workload on the harvester head and a higher fuel consumption.

Figure 1 discloses a timber working device 10 of the present invention. It comprises a frame 12 with provided spaces and fix points for at least a saw blade, feeding wheels, hydraulic lines, hydraulic actuators and controllers.

The frame 12 surrounds a feed axis 14, where a tree or log will be feed through the harvester head during use. On a rear side of the frame 12 a tilt bracket 32 is movably attached to the frame 12 by at least two hinges which allow an angled movement of the tilt bracket 32 in relation to the frame 12. The tilt bracket 32 is later attached to a crane of a forest working machine and enables relative movement of the frame 12 and the crane.

At least one hydraulic tilt actuator 34 is attached to the tilt bracket 32 and to the frame 12 in a manner that allows to adjust the angle of the tilt bracket 32 and the frame 12 by extending or reducing the tilt actuator. The tilt actuator can be connected to the frame 12 directly or by using an additional fixture which is attached to the frame 12.

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Figure 2 shows the timber working device 10 in a rear view. On a bottom side the frame 12 comprises a saw box for installing a saw blade. The feed axis 14 of the harvester head is positioned about the middle of the frame 12. The tilt bracket 32 is held in position by two tilt actuators 34 wherein one tilt actuator is in an extended position while the other tilt actuator is in a retracted position. The tilt bracket 32 is held in the same position as in Figure 1.

Figure 3 depicts the timber working device 10 in a horizontal position. This position reflects the state when the tree is held by the harvester head after cutting. The tilt actuators 34 are used to pull or push the harvester head in a horizontal position. The tilt bracket 32 is positioned in a 90-degree angle to the frame 12. Both tilt actuators 34 are used to hold the position whereby both tilt actuators 34 are fixed to the tilt bracket 32 and the frame 12 in a way that their forces applied on the tilt bracket 32 are opposed to each other.

Figure 4 discloses another angle position of the tilt bracket 32. One tilt actuator is fully extended while the other is fully retracted. This leads to an equalized strain on the hydraulic power system and on the tilt actuators 34. The tilt force can be maximized while the skidding forces of the tree are reduced and torque resulting in an opening force on the knives are reduced.

Figure 5 shows a diagram displaying the modulation of the tilt torque during a movement of the tilt bracket 32 and the frame 12. The angle ranges from -100 degrees to + 100 degrees wherein a center position reflects a 90 degree position of the tilt bracket 32 and the frame 12, displaying a horizontal arrangement of the harvester head when supported by a crane. The curve 42 depicting triangles represents the right actuator and the curve 44 showing horizontal oriented squares represents the left actuator. The top curve 40 represents the resulting tilt torque of the timber working device 10 or harvester head. In about the horizontal position, shown as 15 degrees, both actuators are delivering the same amount of torque, resulting in an even strain on both actuators. At angles of +100 and -100 degrees only one actuator is working under full torque conditions and when the angle is further adjusted towards the 0 degree angle, the other actuator adds more torque. This leads to the fact that at angles of -30 degrees to +30 degrees the tilt torque is maximized, offering the maximum torque when the harvester head is in a horizontal position.

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CLAIMS:

1. A timber working device, comprising:

a frame, having a feed axis;

a drive system, configured to feed at least one stem along the feed axis;

a pair of upper knives movably attached to the frame;

at least a lower knife, movable attached to the frame;

wherein the upper and lower knives are configured to be controllable each by an actuator to open and close around a stem; and

a tilt mechanism comprising:

a tilt bracket pivotably attached to the frame; and

at least two hydraulic tilt actuators acting between the frame and the tilt bracket to control a tilt position of the frame in relation to the tilt bracket;

wherein the at least two tilt actuators are opposed, so that during a tilt movement, one tilt actuator is extending while the other tilt actuator is retracting at the same time.

2. The timber working device according to claim 1, wherein the tilt actuators are mounted on opposite sides of the tilt bracket.

3. The timber working device according to claim 1, wherein the tilt actuators are mounted on the same side of the tilt bracket.

4. The timber working device according to any one of claims 1 to 3, wherein the tilt actuators comprise double acting hydraulic cylinders.

5. The timber working device according to any one of claims 1 to 4, wherein the tilt actuators have a different size.

6. The timber working device according to any one of claims 1 to 5, wherein the tilt actuators have a different length.

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7. The timber looking device according to any one of claims 1 to 6, wherein the tilt actuators have a different power level.

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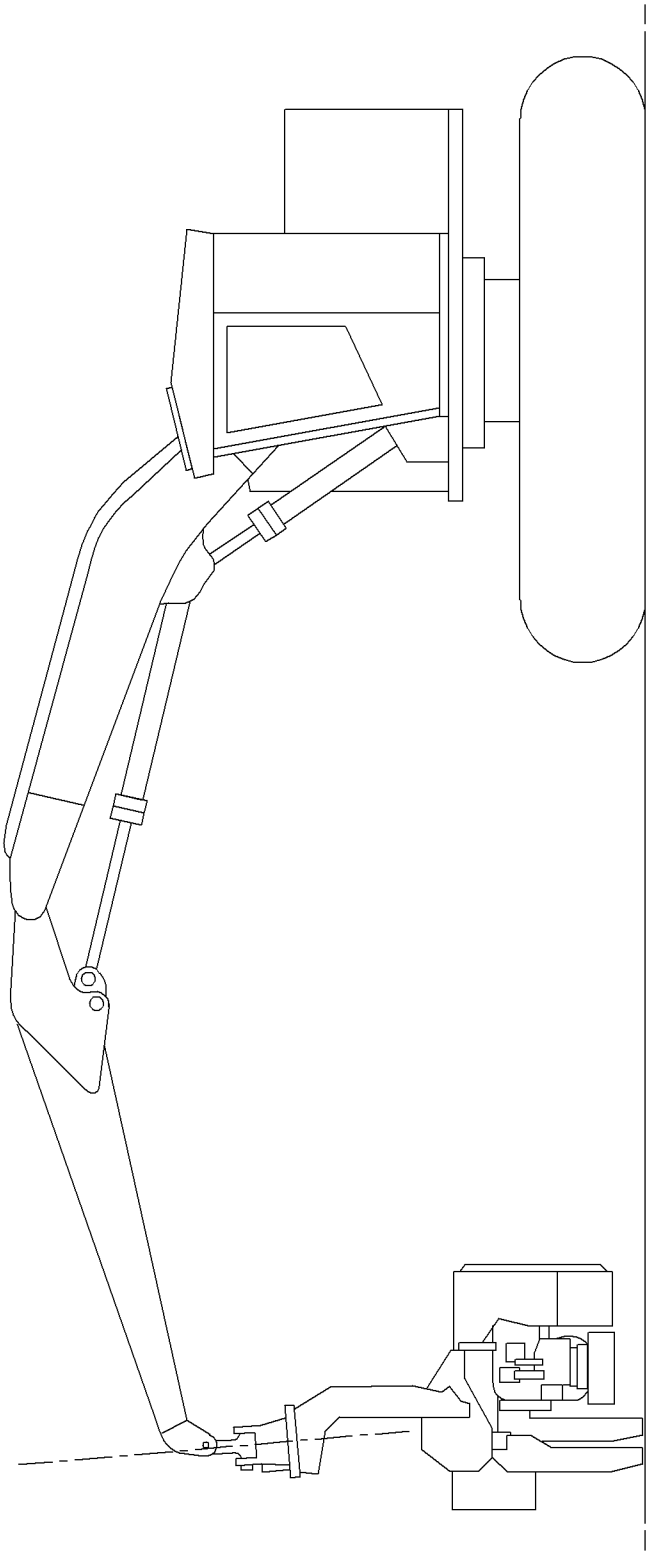

FIG. 1

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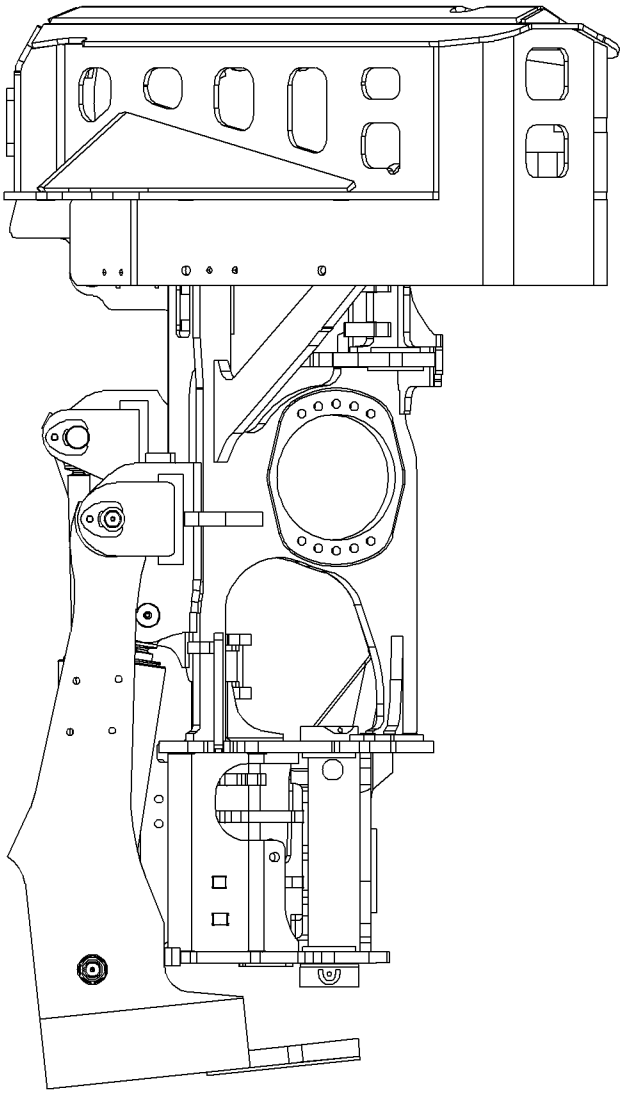

FIG. 2

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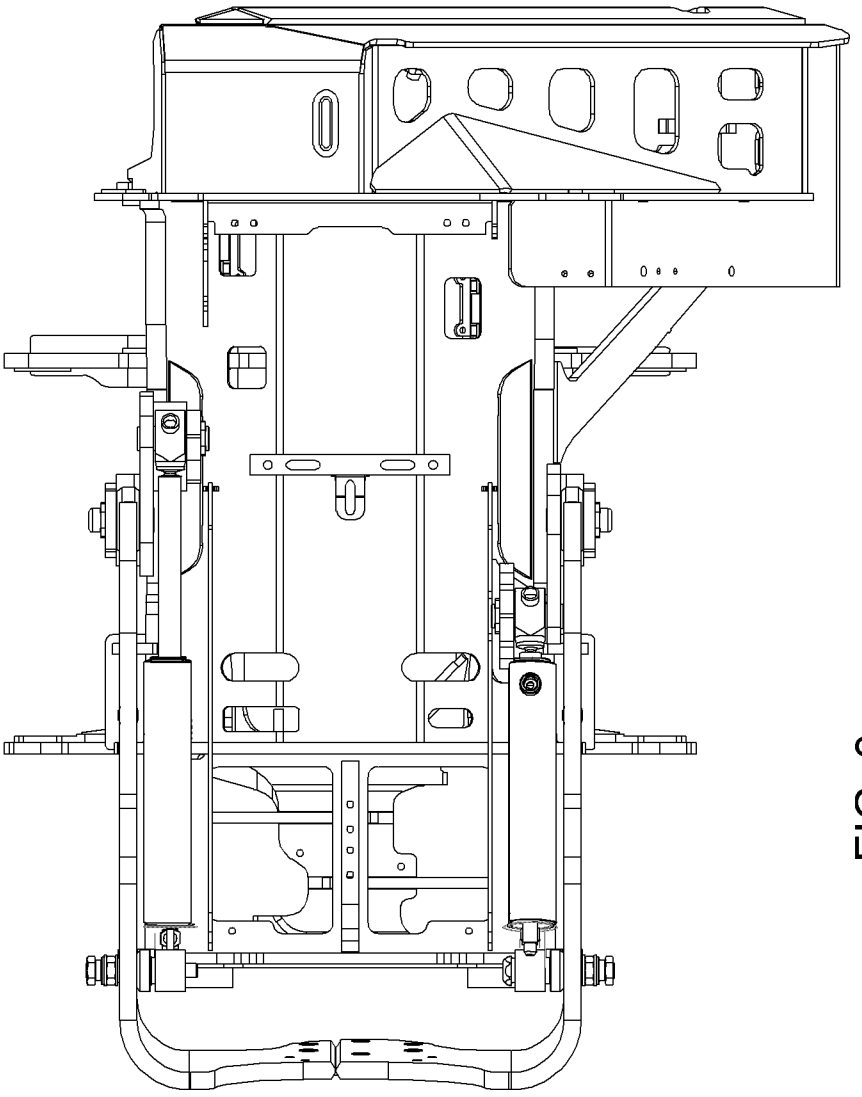

FIG. 3

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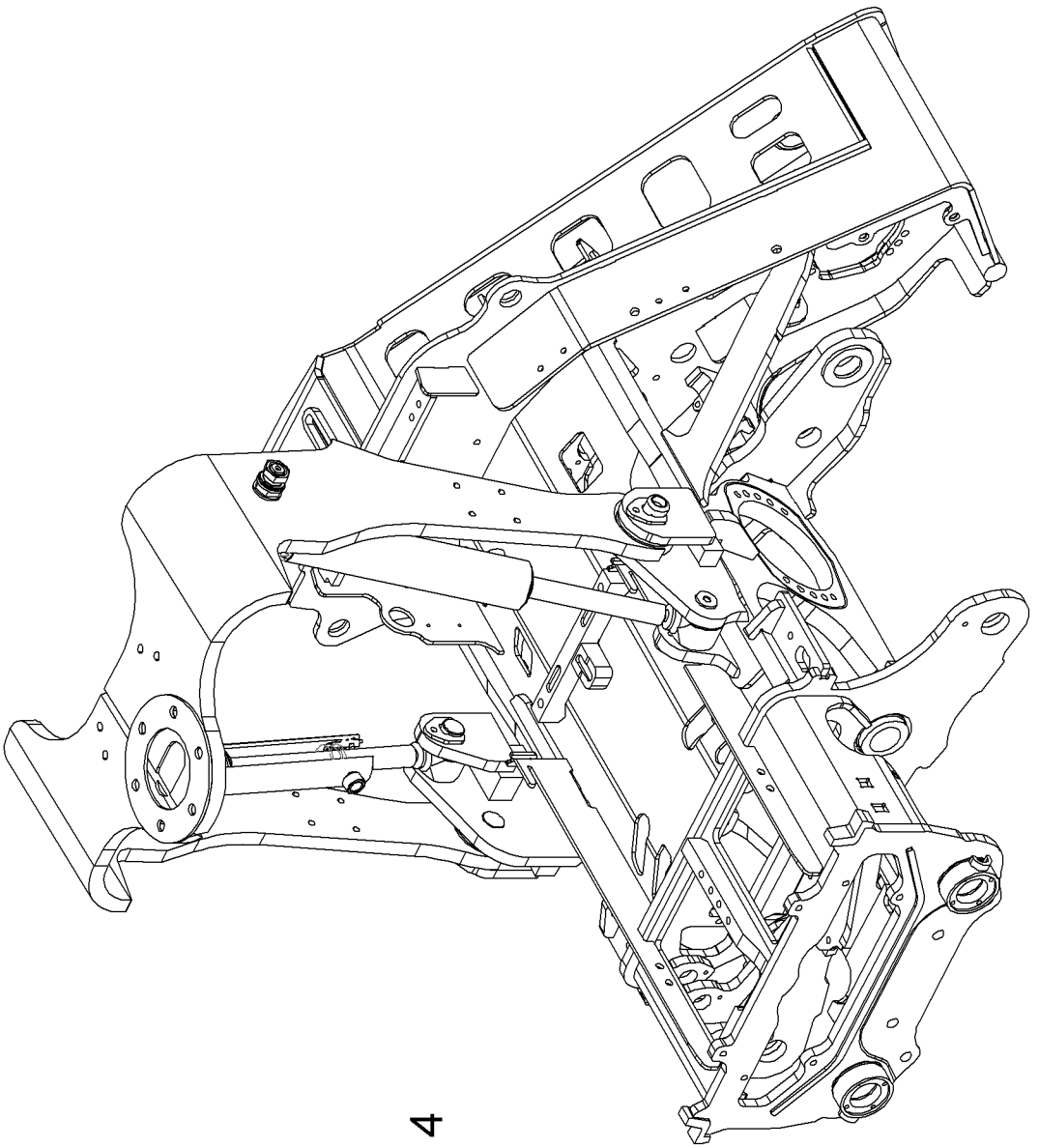

FIG. 4

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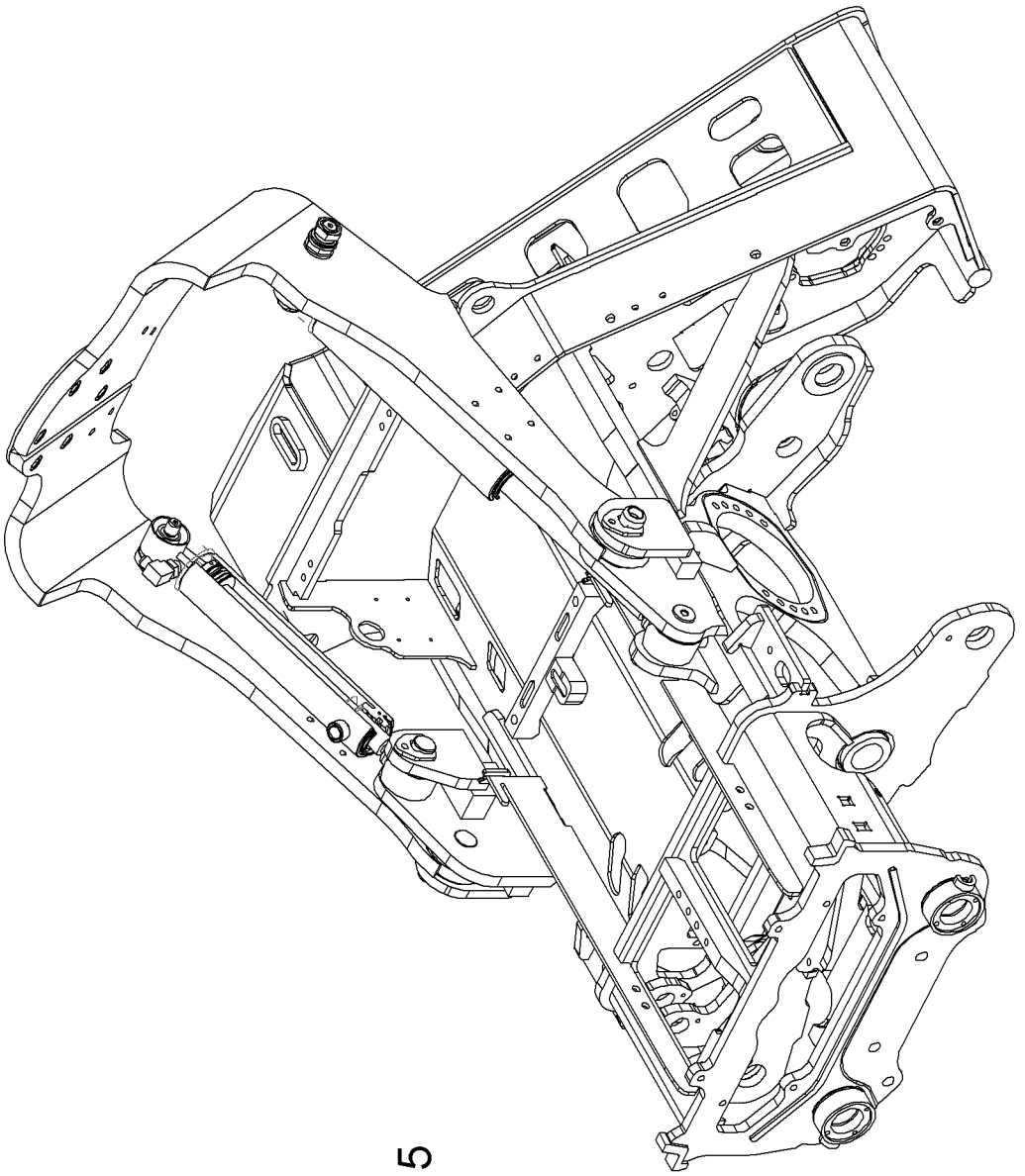

FIG. 5

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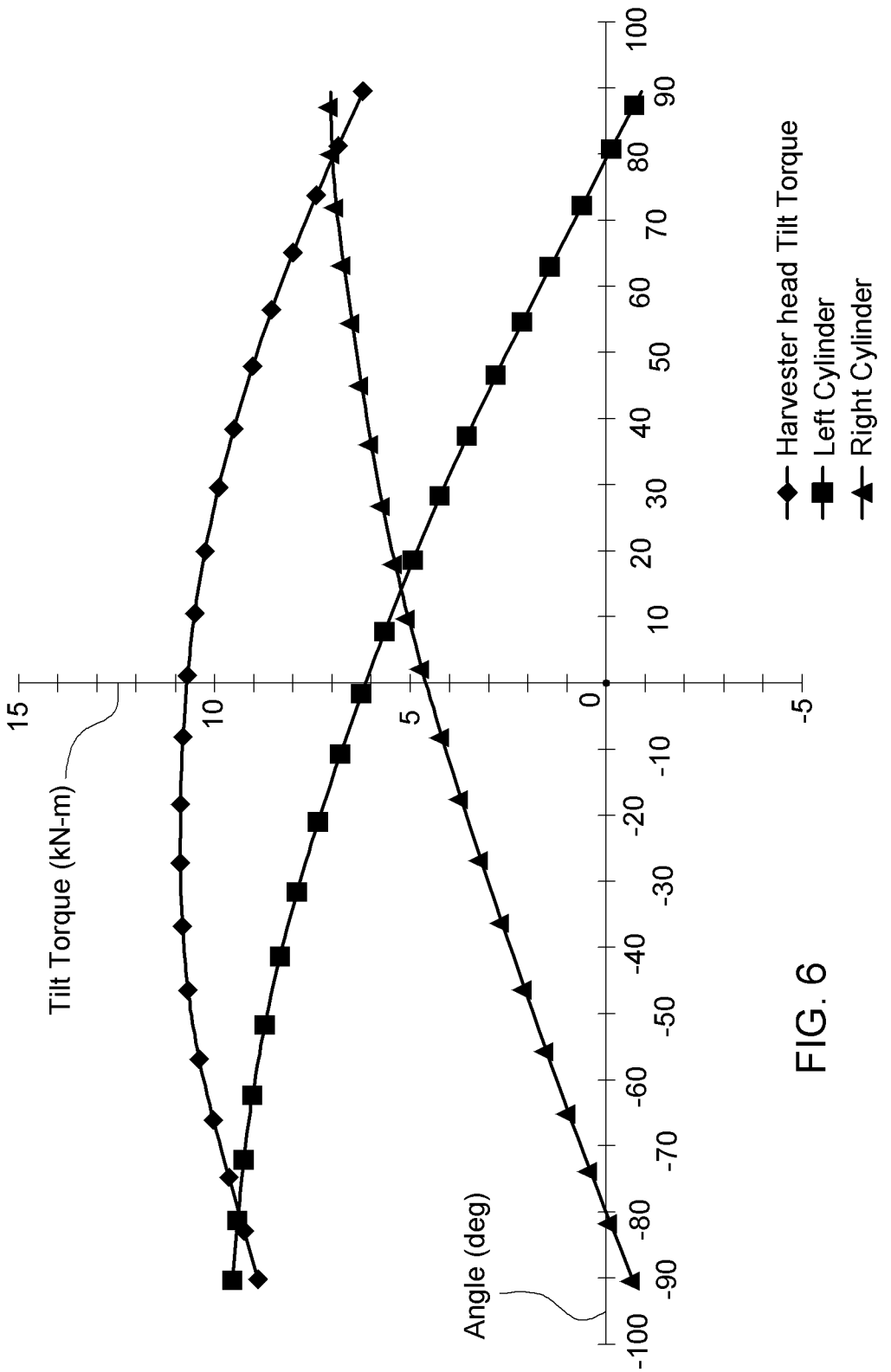

FIG. 6

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