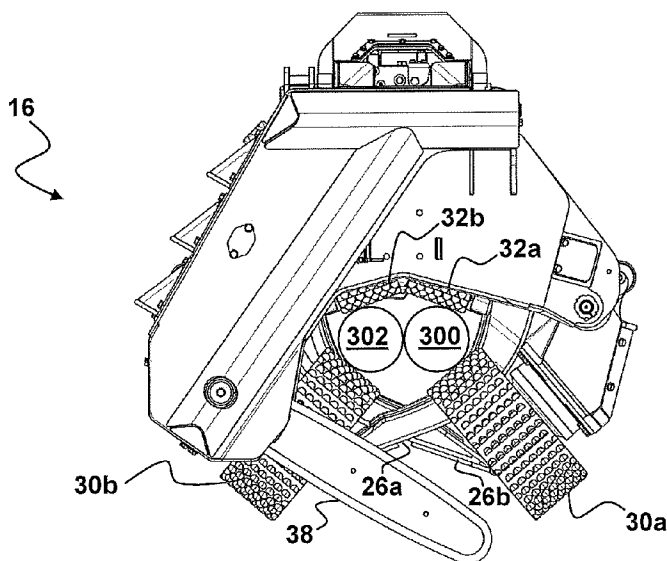




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(54) Title: A TIMBER-WORKING DEVICE AND METHOD OF OPERATION



(57) Abrégé/Abstract:

A timber-working device (16) including a frame (24) having a feed axis (34), and a drive system configured to feed at least one stem (300, 302) being processed by the timber-working device (16) along the feed axis (34). The timber-working device (16) includes a controller (102, 104) configured to receive a selection of a stem from at least two stems being processed by the timber-working device (16), and control the drive system to drive the selected stem out of the timber-working device (16).

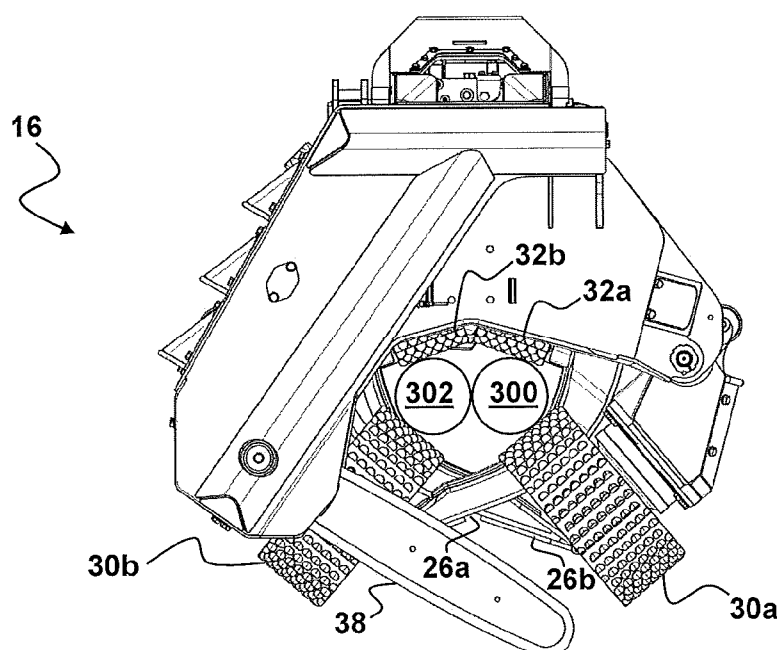
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[Continued on next page]

(54) Title: A TIMBER-WORKING DEVICE AND METHOD OF OPERATION

FIG. 4

(57) **Abstract:** A timber-working device (16) including a frame (24) having a feed axis (34), and a drive system configured to feed at least one stem (300, 302) being processed by the timber-working device (16) along the feed axis (34). The timber-working device (16) includes a controller (102, 104) configured to receive a selection of a stem from at least two stems being processed by the timber-working device (16), and control the drive system to drive the selected stem out of the timber-working device (16).

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A TIMBER-WORKING DEVICE AND METHOD OF OPERATION

FIELD OF THE DISCLOSURE

5 The present invention relates to a timber-working device and method of operation.

BACKGROUND

It is well-known to mount timber-working devices, commonly referred to as forestry or harvester heads, to a carrier vehicle in order to perform a number of operations in connection
10 with timber processing. These operations may include one, or a combination of, grappling and felling a standing tree, delimbing a felled stem, debarking the stem, and cutting the stem into logs (known as bucking) — commonly using at least one chainsaw.

Some forestry heads are configured to process multiple stems simultaneously. When the
15 operator of the head identifies that one of the stems is to be ejected, they must manually control the head to ensure that the other stem or stems are retained.

This process takes time and causes operator stress and fatigue, which may in turn lead to poor decision making with regard to control of the head and lost value to the forest owner.
20 It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

No admission is made that any reference cited herein constitutes prior art. The discussion of the references states what their authors assert, and the applicants reserve the right to
25 challenge the accuracy and pertinency of the cited documents. It will be clearly understood that, although a number of prior art publications are referred to herein, this reference does not constitute an admission that any of these documents form part of the common general knowledge in the art, in New Zealand or in any other country.

30 Throughout this specification, the word "comprise" or "include", or variations thereof such as "comprises", "includes", "comprising" or "including" will be understood to imply the inclusion of a

stated element, integer or step, or group of elements integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

5

DISCLOSURE OF THE INVENTION

According to one aspect of the present invention there is provided a method for operating a timber-working device including a drive system, the method including the steps of:

receiving, at a controller, an indication of a selection of a stem from at least two stems
10 being processed by the timber-working device; and

controlling the drive system to drive the selected stem out of the timber-working device.

According to another aspect of the present invention there is provided a timber-working device, including:

a frame having a feed axis;

15 a drive system configured to feed at least one stem being processed by the timber-working device along the feed axis; and

a controller configured to:

receive a selection of a stem from at least two stems being processed by the
timber-working device; and

20 control the drive system to drive the selected stem out of the timber-working device.

According to another aspect of the present invention there is provided an article of manufacture having computer storage medium storing computer readable program code executable by a computer to implement a method for operating a timber-working device including a drive
25 system, the code including:

computer readable program code receiving a selection of a stem from at least two stems being processed by the timber-working device; and

computer readable program code controlling the drive system to drive the selected stem out of the timber-working device.

30 The timber-working device may be a forestry or harvester head, and may be referred to as such

throughout the specification. Forestry heads typically have the capacity to grapple and fell a standing tree, delimb and/or debark a felled stem, and cut the stem into logs. However, a person skilled in the art should appreciate that the present invention may be used with other timber-working devices, and that reference to the timber-working device being a forestry head is not intended to be limiting.

The drive system may include a first drive mechanism located on a first side of the feed axis, and a second drive mechanism located on the other side of the feed axis. The first drive mechanism may be operable independently from the second drive mechanism.

Driving the selected stem out of the timber-working device may include holding the other stem stationary as the selected stem is ejected.

One well known system for forestry heads uses opposing drive arms, one on each side of a feed axis. Each drive arm may include a feed wheel configured to be brought in contact with stem. The arms may be driven, for example by hydraulic cylinders, to pivot relative to the frame of the device in order to grapple the stem with the feed wheels. The feed wheels may each connect to a rotary drive such that they may be used to drive or feed the stems along the feed axis of the head.

The timber-working device may further include one or more frame mounted feed wheels. The drive system may include a frame mounted feed wheel on either side of the feed axis, which may be controlled independently to each other. Where two stems are grasped by the drive arms, these frame mounted wheels may be controlled together with those of the respective drive arms to independently control the relative positions of the two stems along the feed axis.

When driving the selected stem from the timber-working device, the associated drive mechanism may operate at its highest speed. In doing so, the time until processing of the remaining stems resumes may be reduced. It should be appreciated that reference to highest speed is not intended to be limited to the highest absolute speed achievable, but may be the highest speed within operational parameters.

The selected stem may be driven from the timber-working device in an opposite direction along the feed axis to previous processing of the stem. It is envisaged that this may assist in preventing the ejected stem from becoming mixed with other processed stems.

For example, the stem may be processed by driving it by a predetermined distance along the feed axis towards the main saw, at which point the saw is used to sever the stem to create a log of a desired length which falls to the ground at that end of the timber-working device. This may be repeated until the last log has been sawn, leaving a stack of sawn logs at the main saw end of the timber-working device. On receiving selection of the stem to be driven from the

timber-working device, the drive mechanism may be operated in reverse so that the stem is ejected from the opposite end away from the stack of logs.

The timber-working device may include opposing delimb arms pivotally attached to the frame, as known in the art. Such delimb arms are closed about the stem, and include sharpened edges to cut limbs from the stem as it is fed by the drive system.

The delimb arms may be opened on receiving the selection of the stem, prior to driving the stem from the timber-working device.

In doing so, the friction on the stem may be reduced – potentially enabling the drive system to operate at faster speeds with a reduced likelihood of the drive mechanisms slipping. Driving the stem at higher speeds may reduce the time until processing of the remaining stem(s) may be resumed, improving efficiency.

The delimb arms may be subsequently closed after the stem has been driven from the timber-working device. This may be after a predetermined time period has passed, based on the speed of the drive mechanisms and associated rate at which they drive a stem.

The indication of the selection of the stem may be initiated by an operator of the timber-working device. For example, the operator may select an input button (whether physical or virtual) of an operator input device used to control operation of the timber-working device. This action may generate a signal indicative of the stem selection for transmission to a controller responsible for controlling various operations of the device, including those of the present invention.

It is envisaged that this selection may reference a side of the feed axis, where a first stem is substantially positioned on a first side of the feed axis, and a second stem is substantially positioned on a second side of the feed axis.

The timber-working device may include a cutting device. The cutting device may be any suitable means known to a person skilled in the art – for example at least one saw. It is known for forestry heads to include a main chainsaw which is primarily used for the felling and cross cutting of stems. Further, some forestry heads may include a secondary or topping chainsaw. The topping saw is typically of a lower specification than the main saw, and used primarily during processing once a tree is felled.

Reference to the cutting device being a chainsaw is not intended to be limiting, as the saw may take other forms – for example a disc saw. Further, the cutting device may take other forms known in the art, for example a shear.

The cutting device may be used to perform a reference cut from which further processing of the remaining stem(s) may be performed, as known in the art.

The various illustrative logical blocks, modules, circuits, and algorithm steps described in

connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. In particular, they may be implemented or performed with a general purpose processor such as a microprocessor, or any other suitable means known in the art designed to perform the functions described.

- 5 The steps of a method or algorithm and functions described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. If implemented in software, the functions may be stored as processor readable instructions or code on a tangible, non-transitory processor-readable medium – for example Random Access Memory (RAM),
- 10 flash memory, Read Only Memory (ROM), hard disks, a removable disk such as a CD ROM, or any other suitable storage medium known to a person skilled in the art. A storage medium may be connected to the processor such that the processor can read information from, and write information to, the storage medium.

15

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

- 20 FIG. 1 is a side view of an exemplary timber-working system including, for example, a timber-working device in the form of a forestry head according to one aspect of the present invention;
- FIG. 2 is an elevated view of the forestry head;
- FIG. 3 is a diagrammatic view of an exemplary control system for the timber-working system;
- 25 FIG. 4 is an end view of the forestry head in use, and
- FIG. 5 is a flowchart illustrating an exemplary method for operating the forestry head according to one aspect of the present invention.

DETAILED DESCRIPTION

- 30 FIG. 1 illustrates a timber-working system including a carrier 10 for use in forest harvesting. The carrier 10 includes an operator cab 12 from which an operator (not shown) controls the carrier 10. The carrier 10 further includes a boom assembly 14, to which a timber-working

device in the form of a forestry head 16 is connected.

Connection of the head 16 to the boom 14 includes a rotator 18, configured to rotate the head 16 about the generally vertical axis of rotation marked by dashed line 20. A tilt bracket 22 further allows rotation of the head 16 between a prone position (as illustrated) and a standing position.

Referring to FIG. 2, the head 16 includes a frame 24 to which the tilt bracket 22 of FIG. 1 is pivotally attached. Right hand (RH) and left hand (LH) delimb arms 26a and 26b are pivotally attached to the frame 24, as are opposing RH and LH feed arms 26a and 26b. RH and LH feed wheels 30a and 30b are attached to RH and LH drive arms 26a and 26b respectively, which together with RH and LH frame-mounted feed wheels 32a and 32b may be controlled to feed one or more stems (not illustrated) along feed axis 34 of the head 16. Feed wheels 30a, 30b, 32a and 32b are driven by hydraulic motors, and may collectively be referred to as the 'feed mechanism.'

A measuring wheel 36 may be used to measure the length of stems processed by the head 16. The measuring wheel 36 may be selectively raised and lowered into contact with the stems as desired.

A main chainsaw 38, and a topping chainsaw 40, are attached to the frame 24. The main saw 38 is typically used to fell a tree when the head 16 is in a harvesting position, and to buck stems into logs in the processing position of the head 16 (as seen in FIG. 1). The topping saw 40 may be used to cut off a small-diameter top portion of the stem(s) to maximize the value recovery of the trees.

The various operations of the head 16 may be controlled by the operator using hand and foot controls as known in the art. Further, certain automated functions of the harvester head 16 may be controlled by an electronic control system 100 as shown by FIG. 3.

The control system 100 includes one or more electronic controllers, each controller including a processor and memory having stored therein instructions which, when executed by the processor, causes the processor to perform the various operations of the controller.

For example, the control system 100 includes a first controller 102 on board the carrier 10 and a second controller 104 on board the head 16. The controllers 102 and 104 are connected to one another via a communications bus 106 (e.g., a CAN bus).

A human operator operates an operator input device 108, for example hand and foot controls, located at the operator's cab 12 of the carrier 10 to control the head 16. Details of operation are output to an output device 110 – for example a monitor. Certain automated functions may be controlled by first controller 102 and/or second controller 104.

The head 16 has a number of valves 112 arranged, for example, in a valve block and coupled electrically to the second controller 104 so as to be under its control. The valves 112 include, for example, RH drive valves 114 configured to control operation of the motors associated with the RH feed wheel 30a and RH frame-mounted feed wheel 32a. The valves 116 also include, for example, LH drive valves 116 configured to control operation of the motors associated with the LH feed wheel 30b and LH frame-mounted feed wheel 32b.

The valves 112 further include delimb drive valves 118 for controlling operation of the delimb arms 26a and 26b, saw drive valves 120 for controlling operation of the saws 38 and 40, and measuring wheel valves 122 for controlling the transfer of the measuring wheel 36 between its extended and retracted positions.

Referring to FIG. 5, the control system 100 is configured to implement method 200, which will be described with reference to FIG. 1, FIG. 2, and FIG. 3, together with FIG. 4 showing the head 16 in use.

In step 202, a human operator operates the operator input device 108 to grasp a first stem 300 and a second stem 302 with the delimb arms 26a and 26b, and feed arms 28a and 28b – as illustrated in FIG. 4 – such that the stems are positioned between the arm-mounted feed wheels 30a and 30b, and frame-mounted feed wheels 32a and 32b. The first stem 300 is positioned to the RH side of the feed axis 34 (see FIG. 2, not illustrated in FIG. 4), while the second stem 302 is positioned to the LH side of the feed axis 34.

In step 204, the first controller 102 receives from operator input device 108 a signal indicative of one or both of the stems 300 and 302 being selected for ejection from the head 16.

As an example, the first stem 300 may be selected for ejection while the second stem 302 is retained by the head 16.

In response to that signal, the first controller 102 broadcasts a request to eject the selected stem 300 on bus 106.

In step 206, the second controller 104 receives the request to eject the stem 300, and outputs a control signal to delimb drive valves 118. The delimb arms 26a and 26b are opened, so that they no longer contact the stems 300 and 302.

It is envisaged that the delimb arms 26a and 26b may only be partially opened, rather than to their full extent, in the interests of power and time economy. The extent of this partial opening may be determined based on a diameter measurement of the stems. Diameter measurement of stems held by the drive or delimb arms of a forestry head is well known in the art.

Further, the delimb arms 26a and 26b may be selectively operated depending on the stem

selected for ejection. For example, where stem 300 is selected for ejection, only delimb arm 26a may be opened, leaving delimb arm 26b closed to maintain friction on the second stem 302 to be held stationary.

5 In step 208 the second controller 105 outputs control signals to the measuring wheel valves 122 to retract the measuring wheel 36 from contact with the first stem 300.

In step 210 the second controller 104 outputs control signals to the RH drive valves 114 and LH drive valves 116 responsible for control of the RH and LH feed mechanisms respectively.

10 In the present example, the RH feed wheels 30a and 30a are driven at high speed to feed the stem 300 along the feed axis 34 away from saw 38 and eject it from the opposite end of the head 16. LH feed wheels 30b and 32b are held in position, preventing movement of the stem 302.

15 In step 212, as the stem 300 is fed along feed axis 34 the second controller 104 monitors the runtime of the RH feed wheels 30a and 30b, and uses this together with known geometry and speed of the wheels to determine the distance travelled. On reaching a predetermined distance indicative of the stem 300 having been ejected from the head 16, the second controller 104 controls the RH feed mechanism to stop driving the RH feed wheels 30a and 32a. It should be appreciated that rather than a determination of distance, control of the RH feed mechanism may be based on runtime alone.

20 In step 214 the second controller 104 outputs control signals to delimb valves 118 to close the delimb arms 26a and 26b. The second controller 104 may also close the feed arms 28a and 28b to centre the remaining stem 201 within the head 16.

25 In step 216 the second controller 104 establishes a measuring reference point for the remaining stem 302. This may be achieved by any suitable means known in the art. For example, the second controller 104 may output a control signal to saw drive valves 120 to operate the main saw 38 and perform a reference cut on the stem 302 to establish an end point. As a further example, the stem 302 may be moved until an end locating sensor registers the presence of the end of the stem 302. Stem 302 may then be processed as required.

30 Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

CLAIMS:

1. A method for operating a timber-working device including a drive system and delimb arms, the method including the steps of:
 - receiving, at a controller, an indication of a selection of a stem from at least two stems being processed by the timber-working device, wherein the indication of the selection of the stem is initiated by an operator of the timber-working device;
 - opening the delimb arms on receiving the selection of the stem; and
 - controlling the drive system to drive the selected stem out of the timber-working device.
2. The method of claim 1, including closing the delimb arms after the selected stem has been driven from the timber-working device.
3. The method of claim 1 or claim 2, wherein controlling the drive system includes driving the selected stem out of the timber-working device, and holding the other stem stationary.
4. The method of any one of claims 1 to 3, wherein the selected stem is driven from the timber-working device in an opposite direction to previous processing of the stem.
5. The method of any one of claims 1 to 4, including cutting a remaining stem of the at least two stems with a cutting device to establish a measuring reference point after the selected stem is driven from the timber-working device.
6. A timber-working device, including:
 - a frame having a feed axis;
 - a drive system configured to feed at least one stem being processed by the timber-working device along the feed axis;
 - a pair of pivoting delimb arms; and
 - a controller configured to:
 - receive a selection of a stem from at least two stems being processed by the timber-working device;
 - open the delimb arms on receiving the selection of the stem; and

control the drive system to drive the selected stem out of the timber-working device.

7. The timber-working device of claim 6, wherein the drive system includes a first drive mechanism located on a first side of a feed axis of the timber-working device, and a second drive mechanism located on a second side of the feed axis.

8. The timber-working device of claim 7, wherein the first drive mechanism includes a first pivoting drive arm and a first frame mounted feed wheel, and the second drive mechanism includes a second pivoting drive arm and a second frame mounted feed wheel.

9. The timber-working device of claim 7 or claim 8, wherein the controller is configured to control the first drive mechanism and the second drive mechanism to drive the selected stem out of the timber-working device, and hold a non-selected stem of the at least two stems stationary.

10. The timber-working device of any one of claims 6 to 9, wherein the controller is configured to close the delimb arms after the selected stem is driven from the timber-working device.

11. The timber-working device of any one of claims 6 to 10, wherein the controller is configured to drive the selected stem from the timber-working device in an opposite direction to previous processing of the stem.

12. The timber-working device of any one of claims 6 to 11, including a cutting device.

13. The timber-working device of claim 12, wherein the controller is configured to cut a remaining stem of the at least two stems with the cutting device to establish a measuring reference point after the selected stem is driven from the timber-working device.

14. An article of manufacture having computer storage medium storing computer readable program code executable by a computer to implement a method for operating a timber-working device including a drive system and delimb arms, the code including:

computer readable program code receiving a selection of a stem from at least two stems being processed by the timber-working device;

computer readable program code opening the delimbs arms on receiving the selection of the stem; and

computer readable program code controlling the drive system to drive the selected stem out of the timber-working device.

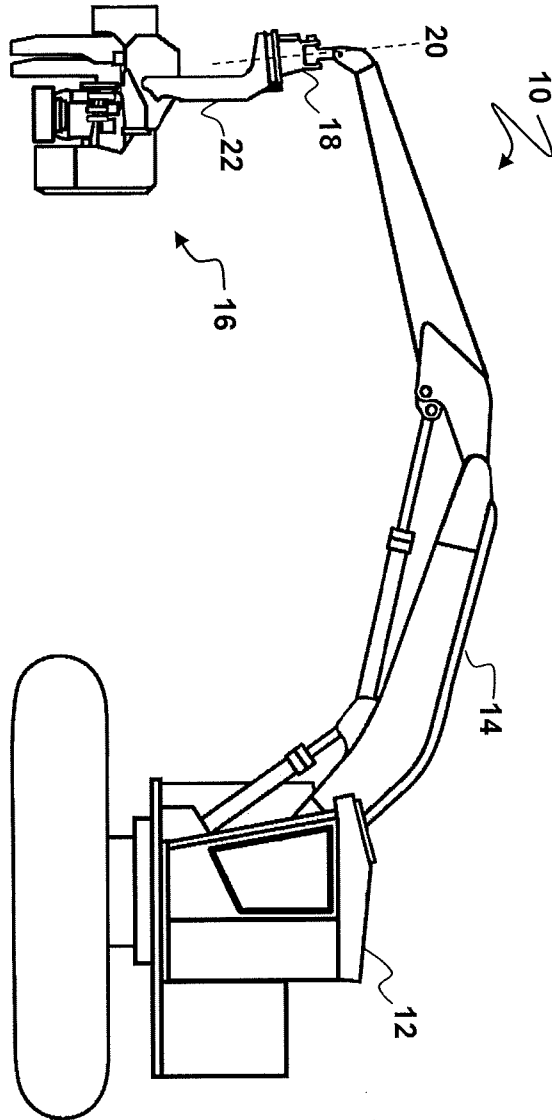
**FIG. 1**

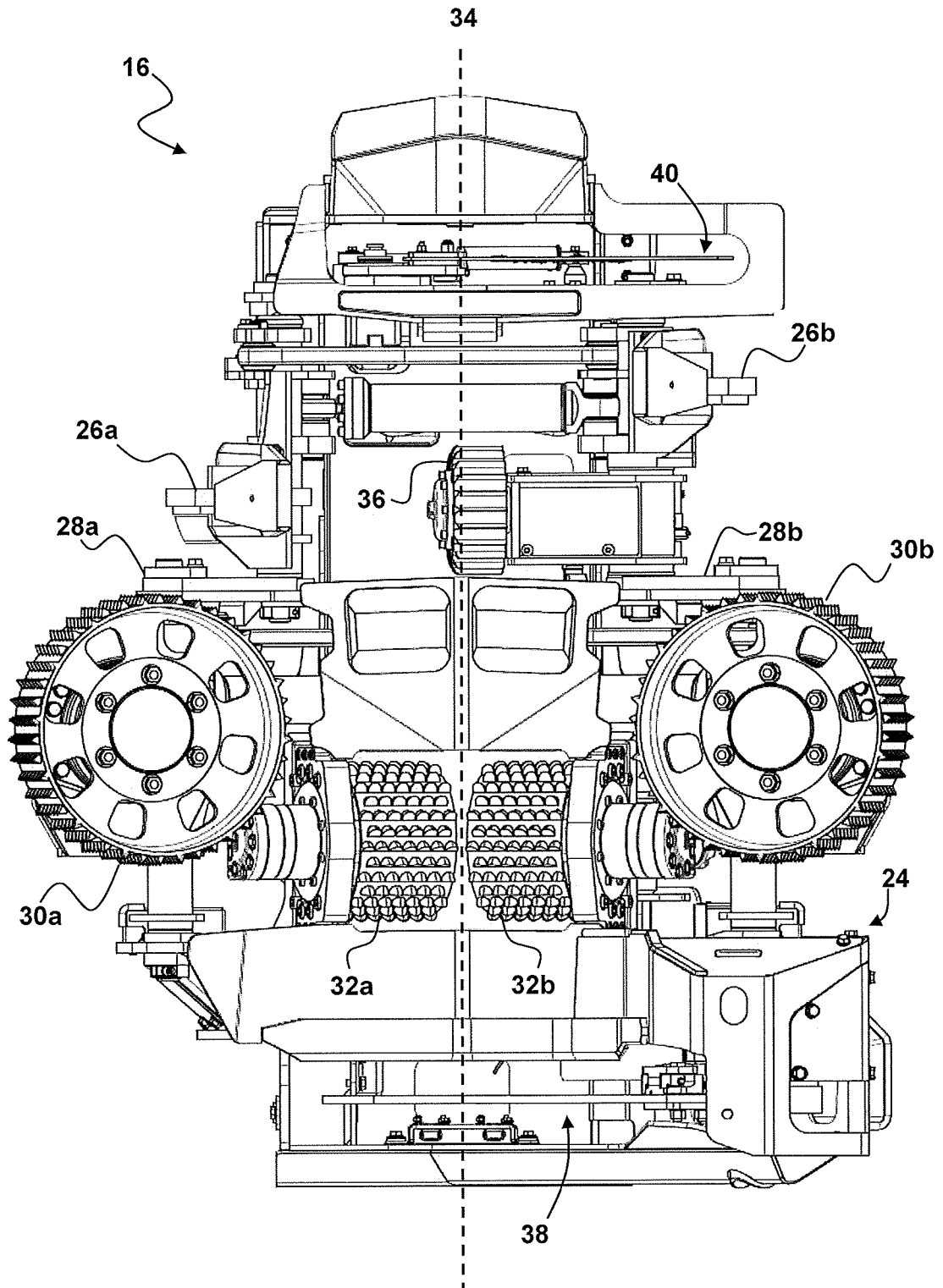
FIG. 2

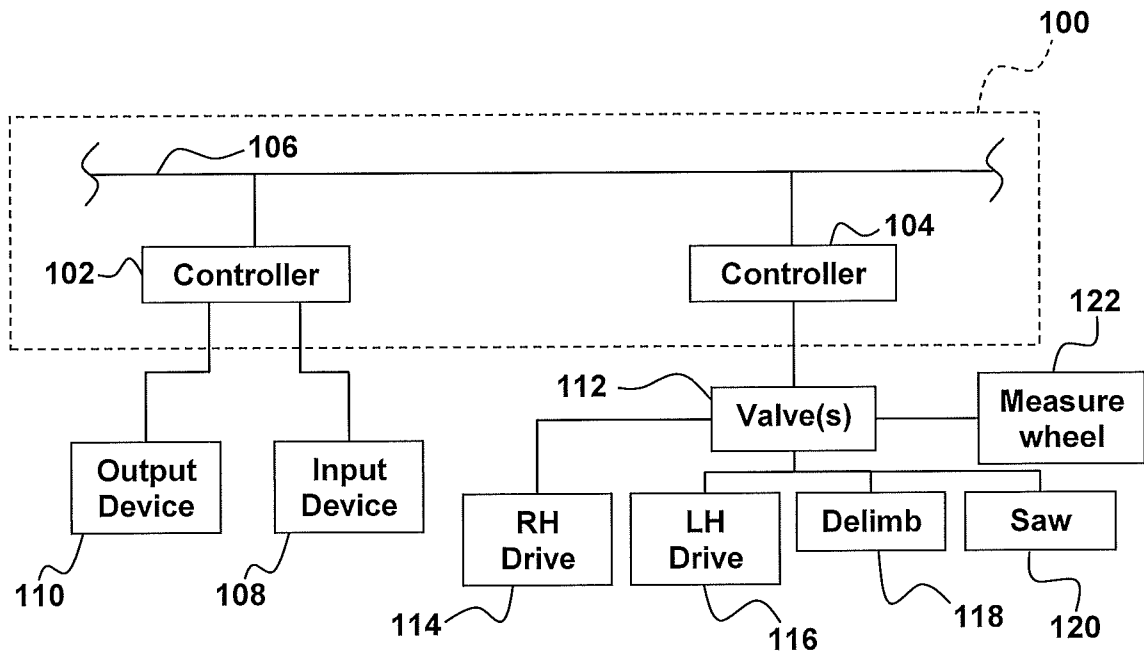
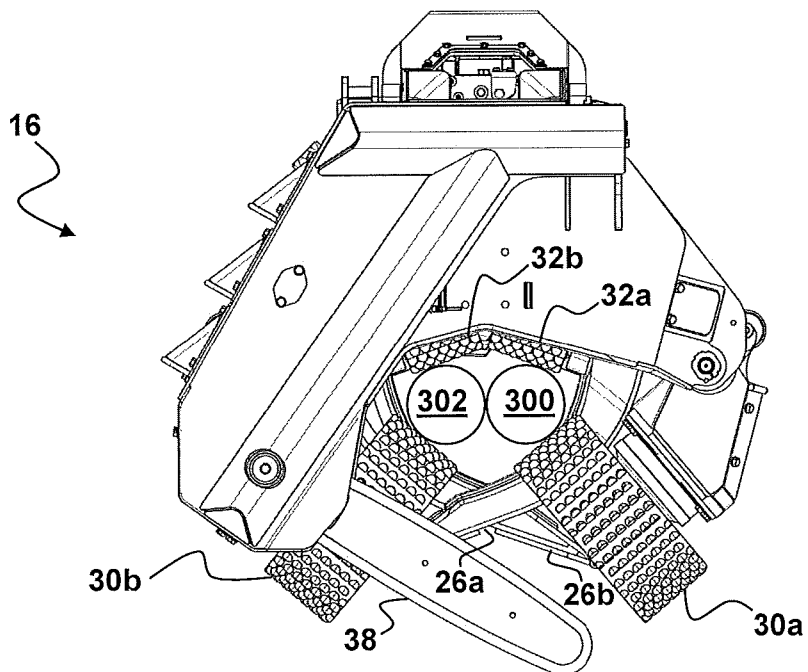
FIG. 3**FIG. 4**

FIG. 5