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(54) Title: HARVESTER HEAD AND METHOD IN A HARVESTER HEAD

(57) Abstract: The invention relates to a harvester head, which has a frame; tree processing members attached to the frame, which are arranged to define a longitudinal direction of the harvester head, i.e. a direction in which the tree trunks to be processed in the harvester head mainly are during the processing; a pivot means, such as a tilt arm, attached to the frame with detachable attaching means, via which pivot means the harvester head can be attached to a base machine using it, which pivot means is arranged to be turnable around a pivot axis in relation to the frame of the harvester head; power means arranged between the frame and the pivot means for turning the frame and the pivot means around the pivot axis in relation to each other. The harvester head is character - ized in that the power means comprise a rotary actuator located on the pivot axis and in that the rotary actuator is arranged to turn the frame and the pivot means in relation to each other by over 90 degrees, or that the attaching means are arranged to allow an al- teration of the location of the pivot axis of the pivot means in relation to the frame.

HARVESTER HEAD AND METHOD IN A HARVESTER HEAD

TECHNICAL FIELD OF THE INVENTION

The object of the invention are harvester heads and methods in a harvester head according to the preambles of the independent claims presented further below. The invention especially relates to a new way of boosting the operation of harvester heads, which are attachable to a base machine via a so-called tilt arm.

PRIOR ART

A typical harvester head is attached to a base machine which operates it via a tilt arm attached to the frame of the harvester head. The tilt arm and the frame of the harvester head are turnable in relation to each other around a pivot axis in the bottom end of the tilt arm. The position of the harvester head is altered around the pivot axis from a horizontal position, i.e. delimbing or cutting position, into a vertical, i.e. felling position, with the aid of power members, for example hydraulic cylinders. In order to facilitate the turning motion and to decrease the stress caused to the apparatus and for operational reasons, the aim is to place the pivot axis of the tilt arm close to the centre of gravity of the harvester head.

For example when moving from the delimbing position into the felling position, one or more hydraulic cylinders push, via attaching brackets attached to the tilt arm, the tilt arm typically into an angle of over 90 degrees in relation to the frame of the harvester head. The tilt arm is returned to the horizontal position as the tree falls when the harvester head is attached to the falling tree. The falling of the tree can be aided with hydraulic cylinders or the tree can be allowed to fall freely without hydraulic pressure. Said hydraulic cylinder is typically attached at its one end to the frame of the harvester head with a pin joint, and typically bearing-mounted on ball joints. This solution causes strong stresses in the direction of the cylinder, both to the frame structure of the machine, the tilt arm and to its pivot point. Stresses are especially caused to all above-mentioned brackets and bearings. Further the manufacturing precision in welded structures, such as the above-mentioned brackets, causes post-machining needs and other tolerance problems.

The solution requires many wearing parts and serviceable objects, e.g. greasing points.

The above-mentioned centre of gravity can however afterwards move, for example if additional devices are connected to the harvester head, such as a topping saw device installed at the front end of the machine. The moving of the centre of gravity can cause front-heaviness and thus instability to the operation of the harvester head, especially to its delimbing properties. The centre of gravity also continuously changes during the processing of a tree, for example when the tree is moved through the harvester head. The devices according to prior art are thus subject to a continuous additional stress due to the movement of the centre of gravity.

The installing of additional devices, such as a top saw, to the harvester head can sometimes be difficult or impossible due to an insufficient length of the tilt arm. Sometimes the new additional devices cannot fit to turn underneath the tilt arm. Thus the traditional, expensive solution has been to at least partly exchange the tilt arm.

Publication FI 107870 presents a delimbing apparatus for delimbing tree trunks. The apparatus has a frame structure, a member which rotates in relation thereto for processing a tree trunk, and means for controlling the position and power impact of this member, which means comprise a pivot frame, a pivot axis and a wing structure arranged inside the joint for providing a rotation effect. The solutions in publications US 4,194,542 and US 2004/020238068 are also delimbing apparatuses, the aim of which is to alter the position of the processor head so that the picking of a tree from the ground is easier.

OBJECT AND DESCRIPTION OF THE INVENTION

It is an object of the present invention to reduce or even eliminate the above-mentioned problems appearing in prior art.

It is an object of the present invention to provide a harvester head and a method in a harvester head, with the aid of which stress caused to the harvester head by the turning of the tilt arm or other pivot means is reduced and/or the stress caused to the harvester head by the movement of the centre of gravity is reduced.

It is an object of the present invention to provide a harvester head, which functions more efficiently and is more reliable than before.

It is still an object of the present invention to provide a harvester head, to which the connection of additional devices and from which the detaching of additional devices is easy, efficient and appropriate with regards to the entire operations of the harvester head.

Among others, in order to realize the objects mentioned above, the harvester heads and methods in a harvester head, and other objects according to the invention are characterized by what is presented in the characterizing parts of the enclosed independent claims.

The embodiment examples and advantages mentioned in this text are in suitable parts applicable both to all the harvester heads and methods according to the invention, even if this is not always specifically mentioned.

A typical harvester head according to the invention has a frame and tree processing members attached to the frame. The tree processing members can for example be tree support rollers or other tree support members, tree feeding rollers, delimbing devices, debarking devices. The tree processing members define the longitudinal direction of the harvester head with their structure and operation. The structure and operation of some tree processing members do not as such require a certain direction from the tree to be processed. Such members are for example some blades or measuring devices, which measure the tree. The tree trunks to be processed in the harvester head are during the processing mainly in the longitudinal direction of the harvester head. A pivot means has typically been attached to the frame of the harvester head, via which pivot means

the harvester head is attachable to a base machine that uses it, such as for example a base machine made especially for use with a harvester, whicti base machine generally travels either on wheels or on tracks. Other possible base machines are for example a wheel loader, an excavator or another excavating machine, a tractor, a truck or another mobile device. The pivot means is typically attached to the frame of the harvester head with detachable attaching means. Traditionally the frame has axis points, to which the pivot means is attached. The pivot means is tumable around the pivot axis in relation to the frame of the harvester head. The turning motion is typically achieved with one or more power means arranged between the frame and the pivot means, which power means have traditionally been hydraulic cylinders.

In a typical harvester head according to the invention the power means, which achieve the turning motion around the pivot axis between the pivot means and the frame of the harvester head, comprise a rotary actuator located on the pivot axis of the pivot means.

Typically the rotary actuator is arranged to turn the frame and the tilt arm in relation to each other around the pivot axis by over 90 degrees. Due to the rotary actuator, so-called blind angles are avoided, which are typical in traditional hydraulic cylinder/bracket solutions. Thus the maximum torque or the pressure inside the cylinder changes as the angle of the bracket of the cylinder changes. The felling position, i.e. the so-called upper dead centre of the turning motion, has especially been a problem. In a rotary actuator the torque can be optimal during the entire movement, at the maximum if needed, during the entire movement of the tilt arm, which is typically up to 135 degrees, for example c. 120-135 degrees. It is possible that the frame and the tilt arm can be turned in relation to each other by over 135 degrees, for example even 220 degrees, with the rotary actuator. With a traditional cylinder solution it is difficult to reach beyond 135 degrees so that a sufficient torque remains. With a larger turning angle the harvester head can more reliably be set in a perfect felling position, i.e. as close as possible to a 90 degree angle in relation to the horizontal. Thus the felling of the tree is made quicker, because the felling cut is quicker as the saw bar and its chain at the start of the

sawing is closer to the tree trunk and as perpendicular as possible to it. Additionally the felling sawing is thus more certainly in a 90 degree angle in relation to the midline of the tree.

In an embodiment of the invention the harvester head according to the invention fells trees, i.e. a cutting device, for example a felling saw, has been connected or arranged to it.

In an embodiment of the invention the rotary actuator provides a sufficient so-called self-holding force, with the aid of which the harvester head stays in the felling position more firmly. This is advantageous for example in an energy wood application, where the aim is to collect several trees at once inside the harvester head before the felling is released into a so-called threshing position. A sufficient self-holding force is possible for example if the rotary actuator comprises a so-called screw-type solution.

The rotary actuator can obtain its driving force from any suitable source, such as a base machine's electric, hydraulic or pneumatic system. In an embodiment of the invention the rotary actuator is a hydraulic rotary actuator. Hydraulic power is a common power source in forestry machines.

In a typical method according to the invention, tree processing members have been attached to the frame of the harvester head, which members define the longitudinal direction of the harvester head.

The method comprises:

- processing tree trunks in the harvester head,
- keeping the harvester head attached to the base machine which uses it via the pivot means, such as a tilt arm, attached with detachable attaching means to the frame of the harvester,
- turning the pivot means in relation to the frame of the harvester head around the pivot axis with the aid of the rotary actuator arranged on the pivot axis between the pivot means and the frame of the harvester head.

A typical pivot means is a tilt arm, which can also be called for example a pendant arm. This text talks about tilt arms, even if also another type of pivot means would be meant. The pivot means can be any kind of means, which makes possible the pivotable attaching between the harvester head and the base machine which uses it. The pivot means is typically attachable both to the frame of the harvester head and to the base machine, either directly or via some connecting pieces.

Now it has thus been discovered that the turning of the harvester head into the felling position and the delimbing position can be handled with a so-called rotary actuator, which can also be called a torque motor or a servo motor. The solution can include a screw mechanism, a cogwheel, chain or gear transmission or some combination of these, which is used for example with a hydraulic motor.

The rotary actuator can simultaneously also function as the pivot axis of the tilt arm. A separate pivot axis is needed in a traditional hydraulic cylinder solution.

One of the biggest advantages of the invention is that with its aid, no hydraulic cylinder for turning the tilt arm of the harvester head in relation to the frame is necessarily needed. Thus also other attaching points than the rotary actuator's attaching points to the frame of the harvester head are not needed. The hydraulic controlling of the hydraulic rotary actuator, such as a valve which controls the hydraulic fluid and its controlling electronics and pipework, can be very similar as when using a traditional hydraulic cylinder.

One of the biggest advantages of the invention is that stress caused by turning to the different parts of the apparatus, such as the bearings or brackets, can be decreased or it can even be eliminated.

Another great advantage of the invention is that with its aid, significant savings are obtained in the amount of parts needed, such as parts of the frame, pins, shafts, screws, nuts, brackets etc. The number of service objects and joints can also be reduced.

In an embodiment of the invention the harvester head comprises means arranged in the hydraulic line leading to the rotary actuator for controlling the rotation of the rotary actuator as desired. With the aid of said means, the turning between the tilt arm and the frame can be halted during the processing of tree trunks, for example in order to halt the falling of the tree. With the aid of said means, the turning of the tree trunks between the tilt arm and the frame can also be accelerated, for example in order to accelerate the falling of the tree.

In an embodiment of the invention the power means, which turn the tilt arm and the frame in relation to each other, comprise both a rotary actuator and a hydraulic cylinder. Thus the tilt arm and the frame can be turned in relation to each other with the aid of both the rotary actuator located on the pivot axis and the hydraulic cylinder. This increases the torque used for turning the tilt arm, when necessary. In an embodiment of the invention, the tilt arm can with the aid of the hydraulic cylinder be locked in a certain position, for example in the felling position.

In an embodiment of the invention the attaching means of the tilt arm are arranged to allow a change in the location of the pivot axis of the tilt arm in relation to the frame. It is possible that the axis is moveable in different directions, i.e. in the longitudinal direction of the harvester head or for example in the direction of the pivot axis itself or in a direction, which is perpendicular to the pivot axis and the longitudinal direction. In an embodiment of the invention the pivot axis of the tilt arm is mainly perpendicular to the longitudinal direction of the harvester head. A moveable pivot axis of the tilt arm can be held close to the centre of gravity of the harvester head with a very simple solution. One of the greatest advantages of this is that the turning motion of the harvester head around the pivot axis of the tilt arm becomes easier. This is especially true in situations where the centre of gravity of the harvester head would traditionally have moved far from the pivot axis. By optimizing the location of the pivot axis in relation to the centre of gravity of the harvester head, the torque required for turning the harvester head around the pivot axis can be minimized. Simultaneously the stress caused by turning to the different parts, such as the bearings, can be reduced.

Another typical harvester head according to the invention has

- a frame;
- tree processing members attached to the frame, which have been arranged to define a longitudinal direction of the harvester head, i.e. a direction, along which tree trunks to be processed in the harvester head mainly are during the processing;
- a pivot means attached to the frame with detachable attaching means, via which pivot means the harvester head can be attached to a base machine which uses it, which pivot means is arranged tumable around a pivot axis in relation to the frame of the harvester head.

The attaching means of the pivot means are arranged to allow a change in the location of the pivot axis of the pivot means in relation to the frame. It is possible that the axis is moveable in different directions, i.e. in the longitudinal direction of the harvester head or for example in the direction of the pivot axis itself or in a direction, which is perpendicular to the pivot axis and the longitudinal direction. In another typical harvester head according to the invention, the power means, which achieve the turning motion between the pivot means and the frame of the harvester head around the pivot axis, can comprise any suitable means, such as hydraulic cylinders or a rotary actuator located on the pivot axis of the pivot means.

Another typical method according to the invention comprises

- processing tree trunks in the harvester head,
- keeping the harvester head attached to the base machine which uses it via the pivot means, such as a tilt arm, attached with detachable attaching means to the frame of the harvester,
- turning the pivot means around the pivot axis in relation to the frame of the harvester head,
- altering, if necessary, the location of the pivot axis of the pivot means in relation to the frame, for example in the longitudinal direction of the harvester head.

In an embodiment of the invention the attaching means of the tilt arm are arranged to allow a change in the location of the pivot axis of the tilt arm in relation to the frame at least in the longitudinal direction of the harvester head.

In an embodiment of the invention the pivot axis of the tilt arm is mainly perpendicular to the longitudinal direction of the harvester head.

It has thus now been discovered that the pivot axis of the tilt arm can be held close to the centre of gravity of the harvester head with a very simple solution.

One of the greatest advantages of the invention is that the turning motion of the harvester ,head around the pivot axis of the tilt arm becomes easier. This is especially true in situations where the centre of gravity of the harvester head would traditionally have moved far from the pivot axis. By optimizing the position of the pivot axis in relation to the centre of gravity of the harvester head, the torque required for turning the harvester head around the pivot axis can be minimized.

With the invention the special circumstances of different use situations can be taken into account. Even a small deviation in the centre of gravity can cause a significant tilting in the work position of the harvester head. The centre of gravity of the harvester head can with the aid of the invention be moved to a desired location, taking into account for example the harvesting method used, the inclination of the terrain, the size of the tree to be processed, the tree species to be processed, the type of forest, the properties of the base machine, the driving style and skill of the driver. Thus the desired work position of the harvester head is obtained. For example in steep slope terrains it is in certain circumstances advantageous that the turning axis is slightly to the side of the centre of gravity. Thus the work position of the harvester head is adjusted into an angle, according to the inclination of the slope.

The moving of the centre of gravity according to the invention also makes it possible that the need for extra space required by the additional devices added to the harvester head is compensated, when the tilt arm is moved in the direction of

the added additional device. The same tilt arm, the reach of which would previously not have sufficed, may after the moving for example reach over the added topping saw in the felling position of the harvester head. The invention makes possible the optimization of the location of the pivot axis in relation to the centre of gravity always in connection with the installation or removal of an additional device.

In an embodiment of the invention the frame of the harvester head has several attachment points, which are arranged at a distance from each other in the longitudinal direction of the harvester head, such as openings suitable for screws, whereto the tilt arm can be attached.

In an embodiment of the invention the attaching means are such that the location of the pivot axis of the tilt arm in relation to the frame can be adjusted in a stepless manner. The openings for bolts formed in the frame can for example be elongated.

In an embodiment of the invention the attaching means allow a change in the location of the pivot axis of the tilt arm in relation to the frame during the processing of a tree in the harvester head. The pivot point can thus be moved for example all the time according to which work stage is performed or what kind of tree is processed. The moving can be done manually or automatically. The moving can be performed completely mechanically - for example a lever arrangement or chains moving along with the position of the feeding rollers or other tree processing member can move the pivot point. The moving of the pivot axis can be done with mechanic, electric, hydraulic or pneumatic means.

In an embodiment of the invention the harvester head comprises sensor means, which are arranged to observe at least one control value, which describes change in the location of the centre of gravity of the harvester head. In an embodiment of the invention the harvester head also comprises control means, which are arranged to alter the location of the pivot axis of the tilt arm in relation to the frame, based on the at least one control value obtained from the sensor. The

control means can comprise for example a computer and a computer program to be run in its memory, and power means, such as hydraulic cylinders, which are controlled with the computer program. An embodiment of the invention comprises

- observing at least one control value with sensor means in the harvester head,
- evaluating change in the location of the centre of gravity of the harvester head based on the at least one control value,
- altering, if necessary, the location of the pivot axis of the tilt arm in relation to the frame, based on the at least one control value.

In an embodiment of the invention the control value measured with the sensor is one or more from the following group: diameter of the tree to be processed; weight of the tree to be processed; length or shape of the trunk of the tree fed by the tree processing members. Conventional sensors meant for said uses can be used as sensors. For example the weight of the tree to be processed can be measured with a strain gauge attached at a suitable spot on the device.

In an embodiment of the invention the power means in the harvester head comprise a rotary actuator located on the pivot axis of the tilt arm, between the tilt arm and the frame of the harvester head. The rotary actuator can obtain its driving force from any suitable source, such as a base machine's electric, hydraulic or pneumatic system. In an embodiment of the invention the rotary actuator is a hydraulic rotary actuator. Hydraulic power is a common power source in forestry machines. Thus the turning motion between the tilt arm and the frame of the harvester head is done with the aid of the rotary actuator. Now it has thus been discovered that the turning of the harvester head into the felling position and the delimbing position can be handled with a so-called rotary actuator, which can also be called a torque motor or a servo motor. The solution can include a screw mechanism, a cogwheel, chain or gear transmission or some combination of these, which is used for example with a hydraulic motor. If a rotary actuator is used as the power means with a movable centre of gravity, an attaching arrangement for the hydraulic cylinder, which easily becomes complicated, does not need to be considered.

In an embodiment of the invention the location of the centre of gravity changes, when tree processing members are added to or removed from the harvester head. The. same harvester head can be equipped with different and differently sized additional devices, which alter the centre of gravity of the harvester head. As an example, a topping saw device to be installed in the front of the machine often weighs 5-10 % of the weight of the entire harvester head. The topping saw can cause the centre of gravity to move by several centimetres. Without moving the centre of gravity according to the invention, the work position of the harvester head can change to be inclined by several degrees or the delimbing or debarking and cutting properties of the harvester head decrease from the optimal situation.

In an embodiment of the invention the harvester head according to the invention is constructed out of modules and can be constructed by combining various modules to fit each need. At its simplest, the harvester head can comprise a frame and out of the tree processing devices only the means for feeding the tree through the device, such as a feeding roller, and debarking means or delimbing means. A cutting device is not necessarily needed in the harvester head, but the felling of the tree and the cutting to length can be handled manually with a chain saw or other simpler machines than the harvester head. Measuring of the diameter or even the length of the tree is also not needed in the harvester head in all situations. The tree does also not always need to be felled, i.e. instead of the tilt arm there can be a direct connection to the base machine, for example a simpler member than the tilt arm, which makes possible the free hanging of the harvester head and the connecting of the base machine to the arm. It can be attached to the same attaching point of the frame as where the tilt arm module is designed to be attached.

The structure and attachment of the cutting saw or main saw can be realized as a boltable cutting module, which comprises a cutting device, such as a chain saw and necessary attaching means and power means. Other units suitable for use as detachably attachable modules are for example a topping saw module, a delimbing knife module, a tilt arm module. The separate modules typically comprise, in addition to their actuators, detachable connecting means to the frame

or to other modules, such as openings for bolts and necessary power means, such as a hydraulic cylinder or a rotary actuator and the necessary electronics and hydraulic connections. In a simple harvester head according to the invention the controlling devices of the machine can also be simplified, at least when it comes to the computer program which controls the devices.

An advantage of the modular harvester head is that the customer can invest only in the properties of the harvester head he wants. The initial investment can thus be smaller than the acquisition of a traditional harvester head. All the necessary components can still be installed afterwards, and thus the device can be upgraded for example gradually into a complete harvester head.

Because only the devices the user really needs can be installed in the modular harvester head, at least the following advantages can be achieved with the invention: the use and user training of the simple device is easy, the utilization degree of the device becomes high, the structure is simple and thus reliable, i.e. the service need and repair need are small. The further build-up of the device is easy, the total weight of the device is lower than a complete harvester head, whereby it fits on a smaller base machine and thus the capital cost is smaller also for that reason.

The moveable attachment of the pivot point of the tilt arm according to the invention, which makes possible the moving of the centre of gravity of the harvester head, is excellently suited for use in the above-mentioned modular harvester head. For example the weight of the main saw can be about 15-20 % of the total weight of the harvester head. The detaching and attaching thereof moves the centre of gravity of the harvester head to a significant degree.

The use according to the invention of the rotary actuator as the power means between the frame of the harvester head and the tilt arm, is excellently suited for use in the above-mentioned modular harvester head. The installation and removal of the rotary actuator along with the tilt arm is simple.

BRIEF DESCRIPTION OF THE FIGURES

The invention is described in more detail below with reference to the enclosed schematic drawing, in which

Figure 1 shows a harvester head according to the first embodiment of the invention as seen from the side,

Figure 2 shows a frame and a tilt arm of a harvester head according to the second embodiment of the invention as a perspective view,

Figure 3 shows the embodiment of figure 2 as seen from the side,

Figure 4 shows the embodiment of figure 2 seen in the direction of the tree to be processed, and

Figure 5 shows a harvester head according to a third embodiment of the invention as an exploded view.

DETAILED DESCRIPTION OF THE EXAMPLES OF THE FIGURES

For the sake of clarity, the same reference numbers have been used for corresponding parts in the figures.

Figure 1 shows a harvester head 1 according to the invention. The harvester head has a frame 2 and tree processing members attached to the frame, such as a tree feeding roller 3, delimbing blades 4, a cutting saw 5 and a length measuring roller 6. Some tree processing members, such as the feeding rollers 3 and the delimbing blades 4, when they grab the trunk of the tree to be processed and hold it in a grip, direct it in a certain direction. Typically the tree to be processed is mainly in this direction during its entire processing in the harvester head. This direction is called the longitudinal direction A of the harvester head. The longitudinal direction A is marked in the figure with dotted lines. Said tree processing members thus define the longitudinal direction A of the harvester head 1 with their structure and operation. The structure and operation of some tree processing members do not as such force the tree to be processed into a certain direction. Such members can for example be typical support points or support surfaces in the frame. A tilt arm 7 is attached to the frame 2 of the harvester head. In the top part of the tilt arm 7 there is a connecting device 8, via which the harvester head 1 is connectable to the base machine which uses it, typically to the

end of the arm of the base machine. The base machine is not shown in the figures. From the base machine the hydraulic fluid needed for the power means of the harvester head 1 is provided, the connections 9 of which fluids are shown in figure 1. The tilt arm 7 is attached to the frame 2 of the harvester head to be tumable around its pivot axis B. By the pivot axis B, between the ends 10 of the tilt arm 7, but not visible in figure 1, there is a hydraulic rotary actuator 11. A traditional hydraulic cylinder 12, arranged between the frame 2 and the tilt arm 7, has further been drawn to be visible in figure 1. With the aid of the power produced by the rotary actuator 11 or the hydraulic cylinder 12, the tilt arm 7 and the frame 2 can be turned in relation to each other around the pivot axis B. A hydraulic cylinder 12 is typically not needed in a harvester head 1 equipped with a rotary actuator 11. If both are used, additional power is provided to the turning motion of the tilt arm 7, if necessary. On the other hand, the tilt arm 7 can with the aid of the hydraulic cylinder 12 be locked in a certain position, for example in the felling position. This could be necessary for example in multi-tree processing, such as in a tree collecting situation. The attaching means 13 of the tilt arm 7 are arranged to allow a change in the location of the pivot axis B of the tilt arm 7 in relation to the frame 2.

Figures 2, 3 and 4 show the frame 2 of a harvester head according to a second embodiment of the invention and a tilt arm 7 turnably attached thereto. The frame 2 has been stripped of tree processing members. Several openings can be seen in the frame 2, wherein necessary tree trunk processing members, such as delimbing knives or a saw, can be attached. The tilt arm 7 is attached to the frame 2 at its attaching points. A hydraulic rotary actuator 11 has been attached to the pivot axis B of the tilt arm, between the tilt arm 7 and the frame 2. The pivot axis B is shown with dotted lines. The rotary actuator 11 is firmly attached to the ends 10 of the tilt arm with connecting flanges 14. The rotary actuator 11 is attached to the frame 2 with an attachment which can be opened, such as screws, bolts, pins or latches. A turner 16 has been arranged in the middle of the tilt arm 7, at its upper edge 15, with the aid of which turner the harvester head 1 can be connected turnably to a base machine which uses it.

The attaching opening 17 of the rotary actuator formed in the frame of the harvester head, whereto the rotary actuator 11 is attached, is seen in figures 2 and 3. The attaching opening is elongated in the longitudinal direction A of the harvester head. By loosening the attaching members 13 which attach the frame 2 to the rotary actuator 11, the location of the rotary actuator 11, and thus of the tilt arm 7 attached thereto, in relation to the frame 2 can be moved in a stepless manner in the longitudinal direction A of the harvester head.

The rotary actuator 11 could also be attached to the frame 2 of the harvester head with bolts, for example to the openings 18 shown in figure 2. There are several openings 18 in the frame in figure 2, which are arranged at a distance from each other in the longitudinal direction A of the harvester head. Thus the tilt arm 7 and its pivot axis B can easily be moved in the longitudinal direction A of the harvester head 1 by changing the attaching point of the tilt arm 7 in the openings 18.

Figure 5 shows a device 1 according to the invention, which is made up of modules, which can be attached to and detached from the frame 2. The frame has one or more pivot points 19 for one or more feeding rollers 3, and for a moving delimbing knife 4 or a delimbing blade 4. One feeding roller 3 and one knife 4, which belong to the device 1, have been drawn in figure 5. The feeding rollers 3 and knives 4 can also function as debarking members. The frame 2 has one or more support points, support lines or support surfaces 20 for supporting the tree to be processed during the processing. The support point, support line or support surface 20 can for example be a mechanical support, a support slide, a support roller or a drive roller, i.e. a so-called upper roller, or a combination of said members. A knife module 40 can be connected to one side of the frame 2, which comprises on or two knives 4'. A tree cutting module 50 can be connected to the second end of the frame 2. The cutting module in figure 5 has a saw box 51 and a chain saw inside it. Instead of the chain saw there can also be another cutting device, such as knives, pliers or a circular saw-like cutting device. Other processing members can also be connected to the device 1 as their own modules. A topping saw device can for example be arranged in front of the knife module 40.

The modules, arranged to be detachable, are attached to the frame 2 or to each other for example with screw connections.

In an application of the invention the device according to the invention comprises a frame 2 and out of the tree processing devices one or more feeding rollers 3 and a knife pair 4 connected to the frame 2, and the power means, such as hydraulic cylinders, needed by them. Such a simple device 1 is usually called a delimbing or debarking device.

The frame of the device 1 in figure 5 usually has adhesion members to a base machine which uses it or its arm. The adhesion members can have a direct adherence, such as a screw connection, a lock pin connection, a bayonet connection or another known manner. In figure 5 the tilt arm 7, tumably attachable to the frame 2, is shown as the adhesion member, with the aid of which a tree felling possibility is provided in the device. The adhesion member 7 typically includes a pivot point or pivot points or a turner (not shown), with the aid of which the device can be turned in relation to the base machine. The turner can be arranged for example at the upper edge 15 of the tilt arm. A rotary actuator 11 or a traditional axis and hydraulic cylinder 12 can according to the invention be attached between the ends 10 of the tilt arm and the frame 2. The pivot axis B between the tilt arm 7 and the frame 2 (see figures 1-4) can be movable in accordance with the invention in the longitudinal direction A of the device 1 (see figures 1-4).

In the module-structured device 1 shown in figure 5, the modules can be attached to the frame 2 together or separately, and in any order, in a manner to suit each purpose. Only certain modules can be used at the same time in the same device, for example sometimes the delimbing knife module 40, sometimes the cutting module 50 or sometimes both, or for example only the topping saw module. The selection of various combinations depends on each need, for example on if debarking or delimbing is performed, if trees are felled or not, if the processing of a long tree is performed or some other method in the field.

In the device in figure 5, only one knife 4, 4' and one feeding roller 3 are shown, for the purpose of the clarity of the figure. Conventionally the harvester head has tree processing members in pairs, so that each pair of the same processing members is located on the frame on opposite sides of it, to face each other.

The longitudinal direction A is schematically shown in the figure. The location of the tree trunk to be processed in the harvester head 1 depends for example on the used processing devices and their positions.

Not all things needed by the harvester head, such as hydraulic tubes and electric wires, which are known to those skilled in the art, are shown in the embodiments in the figures. Figures show only some preferred embodiment examples according to the invention. The operation of the harvester head is known to those skilled in the art, and it is not further described in this text. It is obvious to someone skilled in the art that the invention is not limited merely to the above-described examples but the invention may vary within the scope of the claims presented below. The dependent claims present some possible embodiments of the invention, and they are not to be considered to restrict the scope of protection of the invention as such.

CLAIMS

1. A harvester head, which has

- a frame;
- tree processing members attached to the frame, which have been arranged to define a longitudinal direction of the harvester head, i.e. a direction, along which tree trunks to be processed in the harvester head mainly are during the processing;
- a pivot means, such as a tilt arm, attached to the frame with detachable attaching means, via which pivot means the harvester head can be attached to a base machine which uses it, which pivot means is arranged turnable around a pivot axis in relation to the frame of the harvester head,
- power means arranged between the frame and the pivot means for turning the frame and the pivot means in relation to each other around the pivot axis,

characterized in that the power means comprise a rotary actuator located on the pivot axis and in that the rotary actuator is arranged to turn the frame and the pivot means in relation to each other by over 90 degrees.

2. The harvester head according to claim **1, characterized** in that the rotary actuator is a hydraulic rotary actuator.

3. The harvester head according to claim 1 or 2, **characterized** in that the power means comprise both a rotary actuator and a hydraulic cylinder.

4. The harvester head according to claim 2 or 3, **characterized** in that it comprises means arranged in the hydraulic line leading to the rotary actuator for controlling the rotation of the rotary actuator as desired.

5. The harvester head according to any of the preceding claims, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame.

6. The harvester head according to claim 5, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame in the longitudinal direction of the harvester head.

7. The harvester head according to claim 5 or 6, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame during the processing of a tree in the harvester head.

8. The harvester head according to any of the preceding claims, **characterized** in that it has been equipped with a tree cutting device, such as a cutting saw.

9. A method in a harvester head, to a frame of which tree processing members have been attached, which define a longitudinal direction of the harvester head, i.e. a direction, along which tree trunks to be processed in the harvester head mainly are during the processing, whereby the method comprises:

- processing tree trunks in the harvester head,
- keeping the harvester head attached to a base machine which uses it via a pivot means attached with detachable attaching means to the frame of the harvester,
- turning the pivot means in relation to the frame of the harvester head around a pivot axis with the aid of power means arranged between the pivot means and the frame of the harvester head,

characterized in turning the pivot means and the frame with the aid of a rotary actuator placed on the pivot axis by over 90 degrees in relation to each other.

10. The method according to claim 9, **characterized** in

- turning the pivot means and the frame in relation to each other with the aid of the hydraulic rotary actuator located on the pivot axis.

11. The method according to claim 9 or 10, **characterized** in

- turning the pivot means and the frame in relation to each other with the aid of both the rotary actuator located on the pivot axis and a hydraulic cylinder.

12. The method according to claim 11, **characterized** in

- locking the pivot means with the aid of the hydraulic cylinder in a certain position, for example in a felling position.

13. The method according to any of the preceding claims 9-12, **characterized** in

- decelerating the turning between the pivot means and the frame during the processing of three trunks with the aid of controlling means of hydraulic fluid arranged in a hydraulic line leading to the rotary actuator.

14. The method according to any of the preceding claims 9-12, **characterized** in

- accelerating the turning between the pivot means and the frame during the processing of three trunks with the aid of controlling means of hydraulic fluid arranged in a hydraulic line leading to the rotary actuator.

15. The method according to any of the preceding claims 9-14, **characterized** in

- altering the location of the pivot axis of the pivot means in relation to the frame.

16. The method according to claim 15, **characterized** in

- altering the location of the pivot axis of the pivot means in relation to the frame at least in the longitudinal direction of the harvester head.

17. The method according to claim 15 or 16, **characterized** in

- turning the pivot means in relation to the frame around the pivot axis, which is mainly perpendicular to the longitudinal direction of the harvester head.

18. The method according to any of the preceding claims 15-17, **characterized** in

- altering the location of the pivot axis of the pivot means in relation to the frame during the processing of a tree in the harvester head.

19. The method according to any of the preceding claims 9-18, **characterized** in

- cutting trees with the aid of the cutting device of the harvester head.

20. A harvester head, which has

- a frame;
- tree processing members attached to the frame, which have been arranged to define a longitudinal direction of the harvester head, i.e. a direction, along which tree trunks to be processed in the harvester head mainly are during the processing;
- a pivot means, such as a tilt arm, attached to the frame with detachable attaching means, via which pivot means the harvester head can be attached to a base machine which uses it, which pivot means is arranged turnable around a pivot axis in relation to the frame of the harvester head,

characterized in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame.

21. The harvester head according to claim 20, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame at least in the longitudinal direction of the harvester head.

22. The harvester head according to claim 20 or 21, **characterized** in that the pivot axis is mainly perpendicular in relation to the longitudinal direction of the harvester head.

23. The harvester head according to any of the claims 20-22, **characterized** in that the frame has several attaching points, which are arranged at a distance from each other in the longitudinal direction of the harvester head, to which attaching points the pivot means can be attached.

24. The harvester head according to any of the claims 20-23, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame in a stepless manner.

25. The harvester head according to any of the claims 20-24, **characterized** in that the attaching means are arranged to allow altering the location of the pivot axis of the pivot means in relation to the frame during the processing of a tree in the harvester head.

26. The harvester head according to any of the claims 20-25, **characterized** in that the harvester head comprises sensor means, which are arranged to observe at least one control value depicting a change in the location of the centre of gravity of the harvester head.

27. The harvester head according to claim 26, **characterized** in that the harvester head comprises control means, which are arranged to alter the location of the pivot axis of the pivot means in relation to the frame based on the at least one control value.

28. The harvester head according to claim 26 or 27, **characterized** in that the control value measured by the sensor is one or more from the following group: diameter of the tree to be processed; weight of the tree to be processed; shape of the tree to be processed; length of a trunk of a tree fed by the tree processing members.

29. The harvester head according to any of the claims 20-28, **characterized** in that a rotary actuator has been arranged between the frame and the pivot means, on the pivot axis, for turning the frame and the pivot means in relation to each other around the pivot axis.

30. The harvester head according to any of the claims 20-29, **characterized** in that it has been equipped with a tree cutting device, such as a cutting saw.

31. A method in a harvester head, to a frame of which tree processing members have been attached, which define a longitudinal direction of the harvester head, i.e. a direction, along which tree trunks to be processed in the harvester head mainly are during the processing, whereby the method comprises:

- processing tree trunks in the harvester head,
- keeping the harvester head attached to a base machine which uses it via a pivot means, such as a tilt arm, attached with detachable attaching means to the frame of the harvester,
- turning the pivot means around a pivot axis in relation to the frame of the harvester head,

characterized in

- altering the location of the pivot axis of the pivot means in relation to the frame.

32. The method according to claim 31, **characterized** in

- altering the location of the pivot axis of the pivot means in relation to the frame at least in the longitudinal direction of the harvester head.

33. The method according to claim 31 or 32, **characterized** in

- turning the pivot means in relation to the frame around the pivot axis, which is essentially perpendicular to the longitudinal direction of the harvester head.

34. The method according to any of the previous claims 31-33, **characterized** in altering the location of the pivot axis of the pivot means in relation to the frame in a stepless manner.

35. The method according to any of the previous claims 31-34, **characterized** in altering the location of the pivot axis of the pivot means in relation to the frame during the processing of a tree in the harvester head.

36. The method according to any of the preceding claims 31-35, **characterized** in

- observing at least one control value with sensor means in the harvester head,
- evaluating change in the location of the centre of gravity of the harvester head based on the at least one control value,
- altering the location of the pivot axis of the pivot means in relation to the frame, if necessary, based on the at least one control value.

37. The method according to claim 36, **characterized** in observing with the sensor means at least one control value, which is one or several from the following group: diameter of the tree to be processed; weight of the tree to be processed; shape of the tree to be processed; length of a trunk of a tree fed by the tree processing members.

38. The method according to any of the preceding claims 31-37, **characterized** in altering the location of the centre of gravity of the harvester head by adding or removing tree processing members attached to the frame of the harvester head.

39. The method according to any of the preceding claims 31-38, **characterized** in

- turning the pivot means in relation to the frame of the harvester head around the pivot axis with the aid of a rotary actuator arranged between the pivot means and the frame of the harvester head.

40. The method according to any of the preceding claims 30-39, **characterized** in

- cutting trees with the aid of the cutting device of the harvester head.

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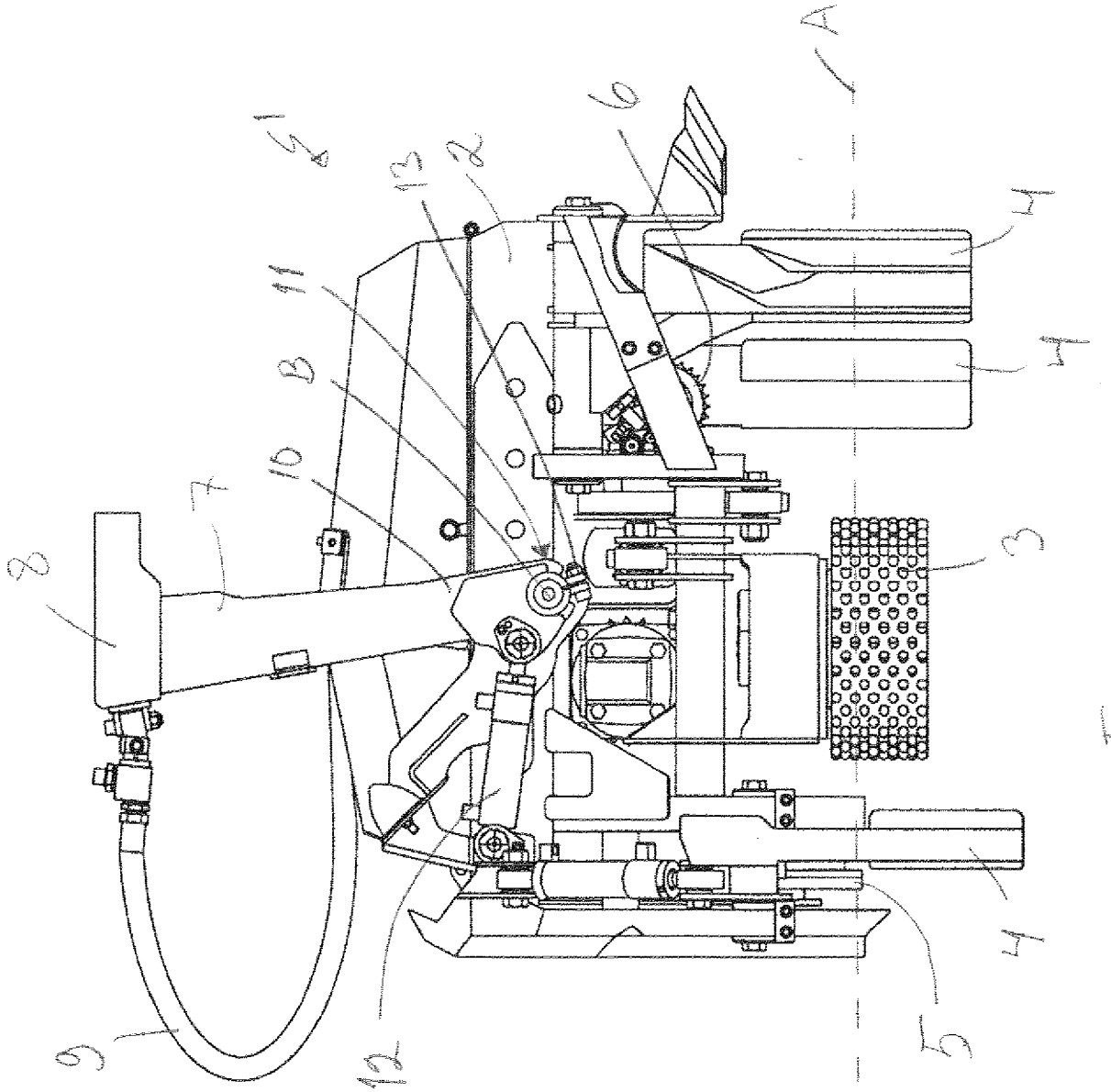

Fig. 1

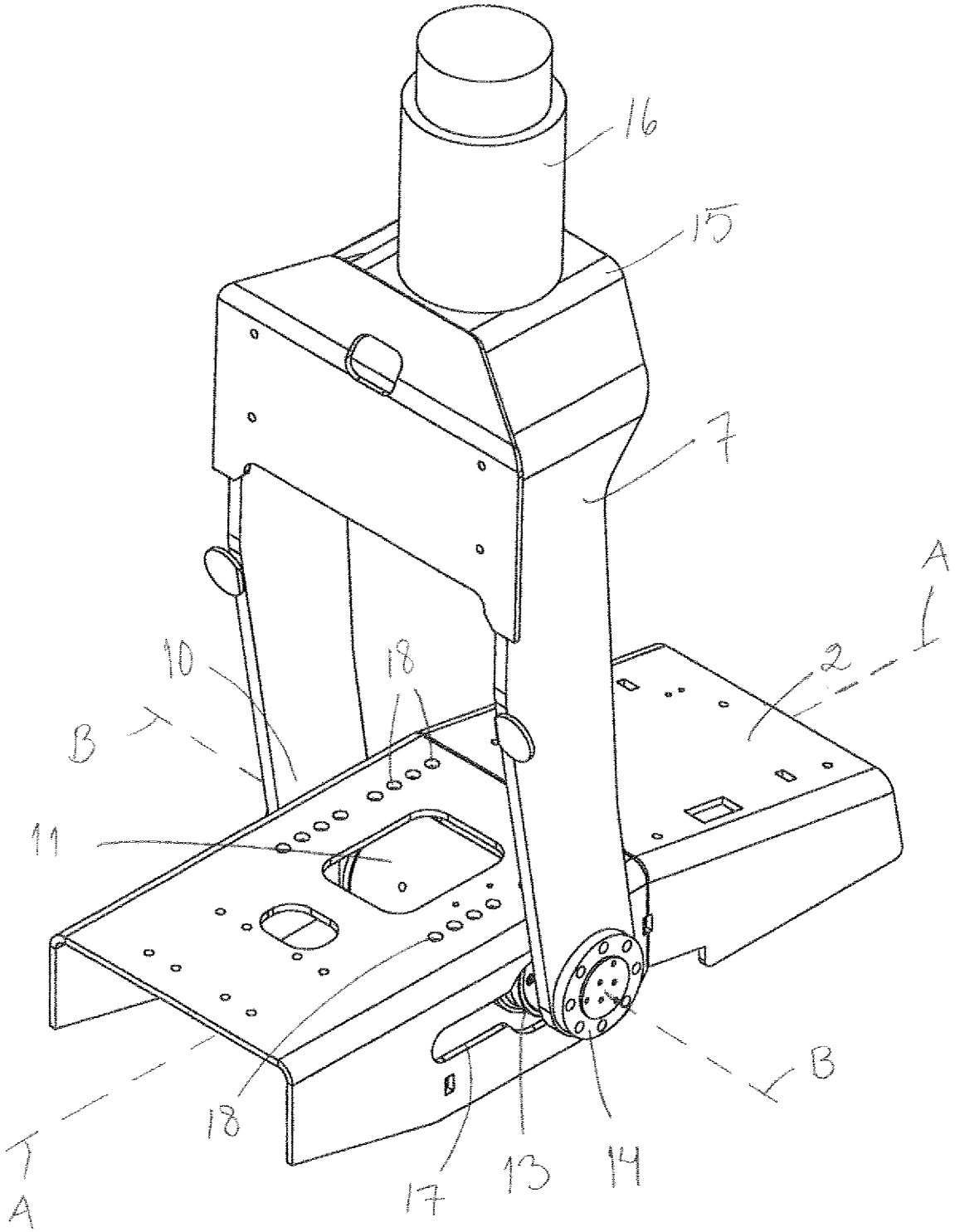

Fig. 2

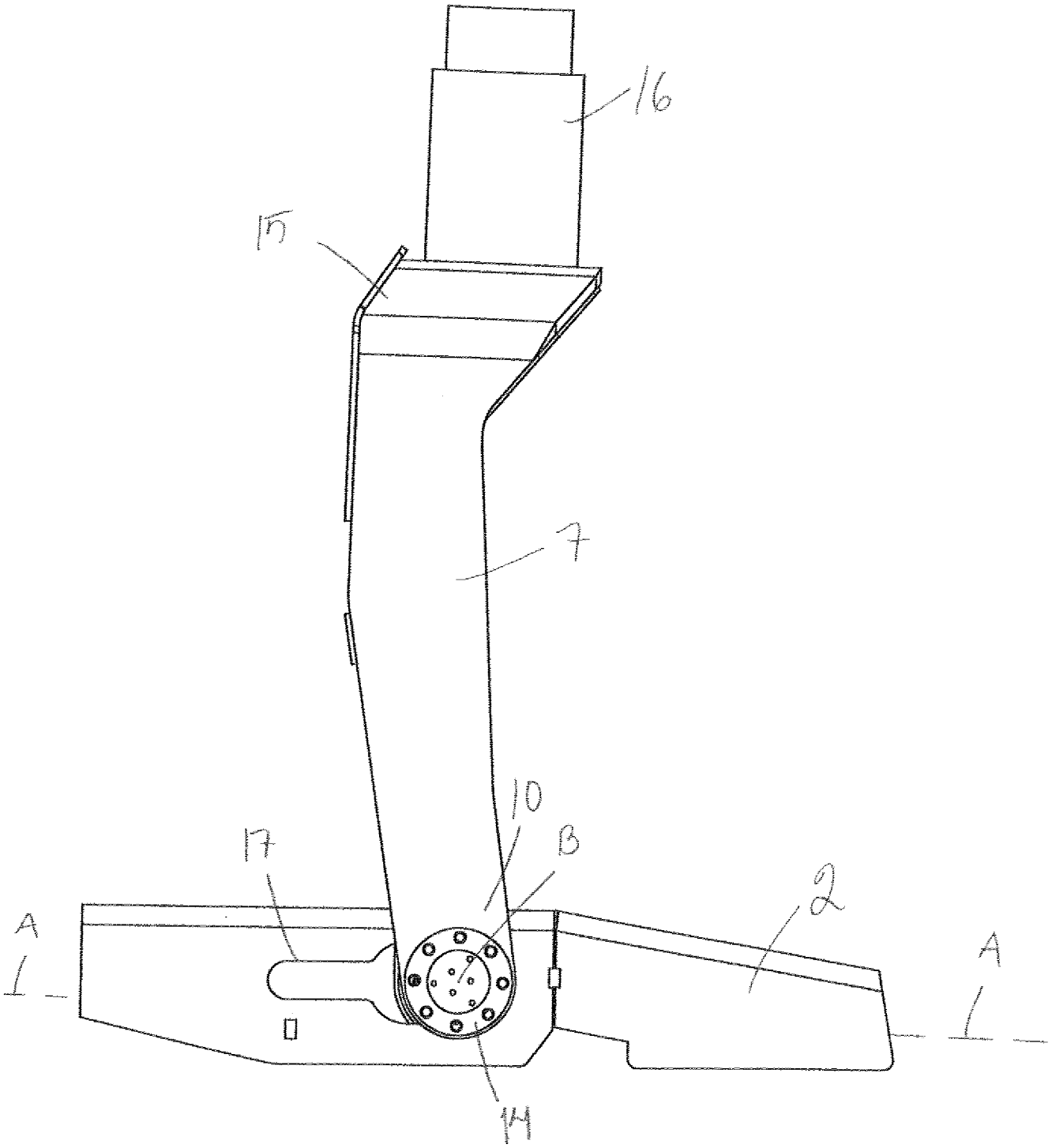

Fig. 3

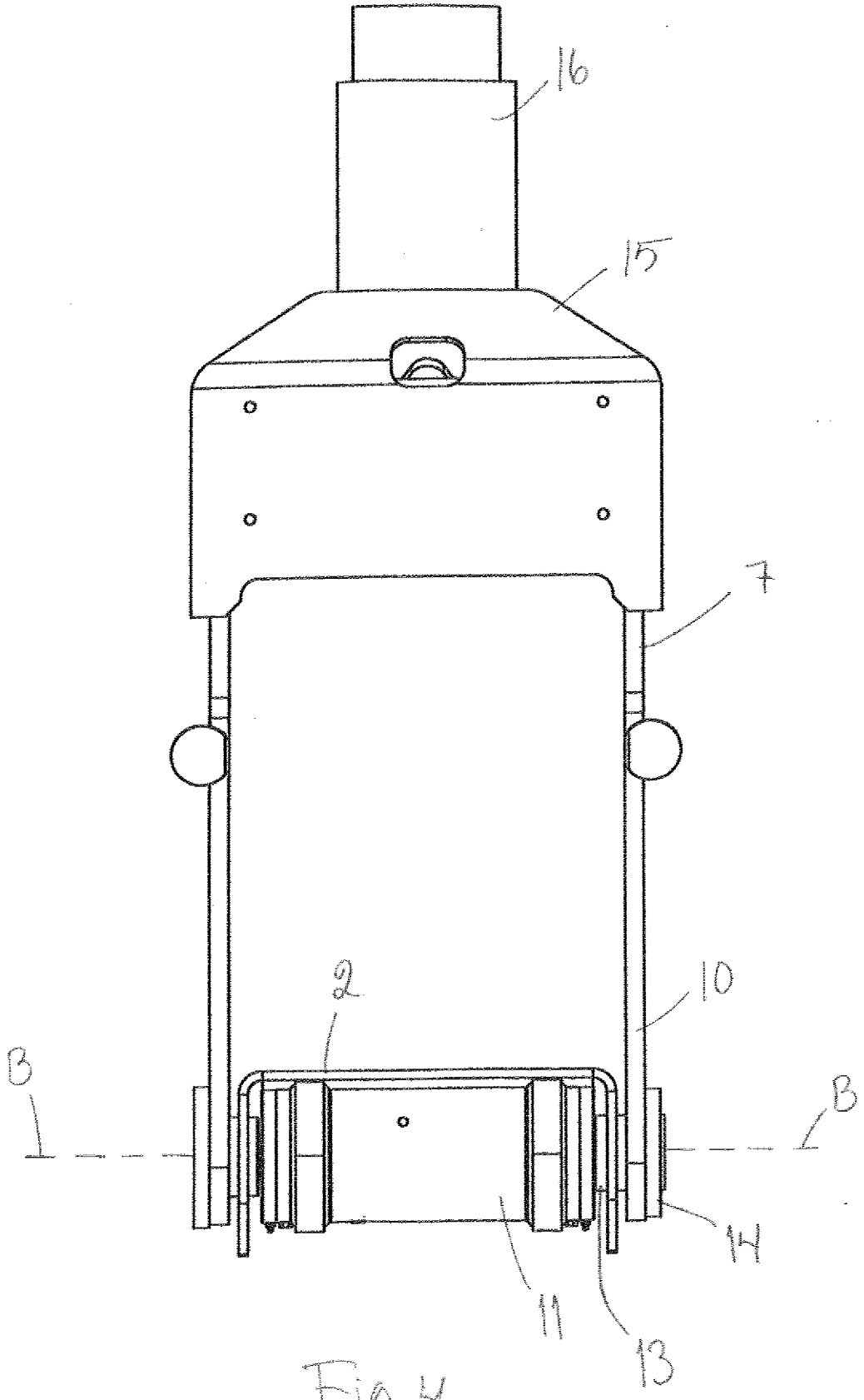

Fig. 4

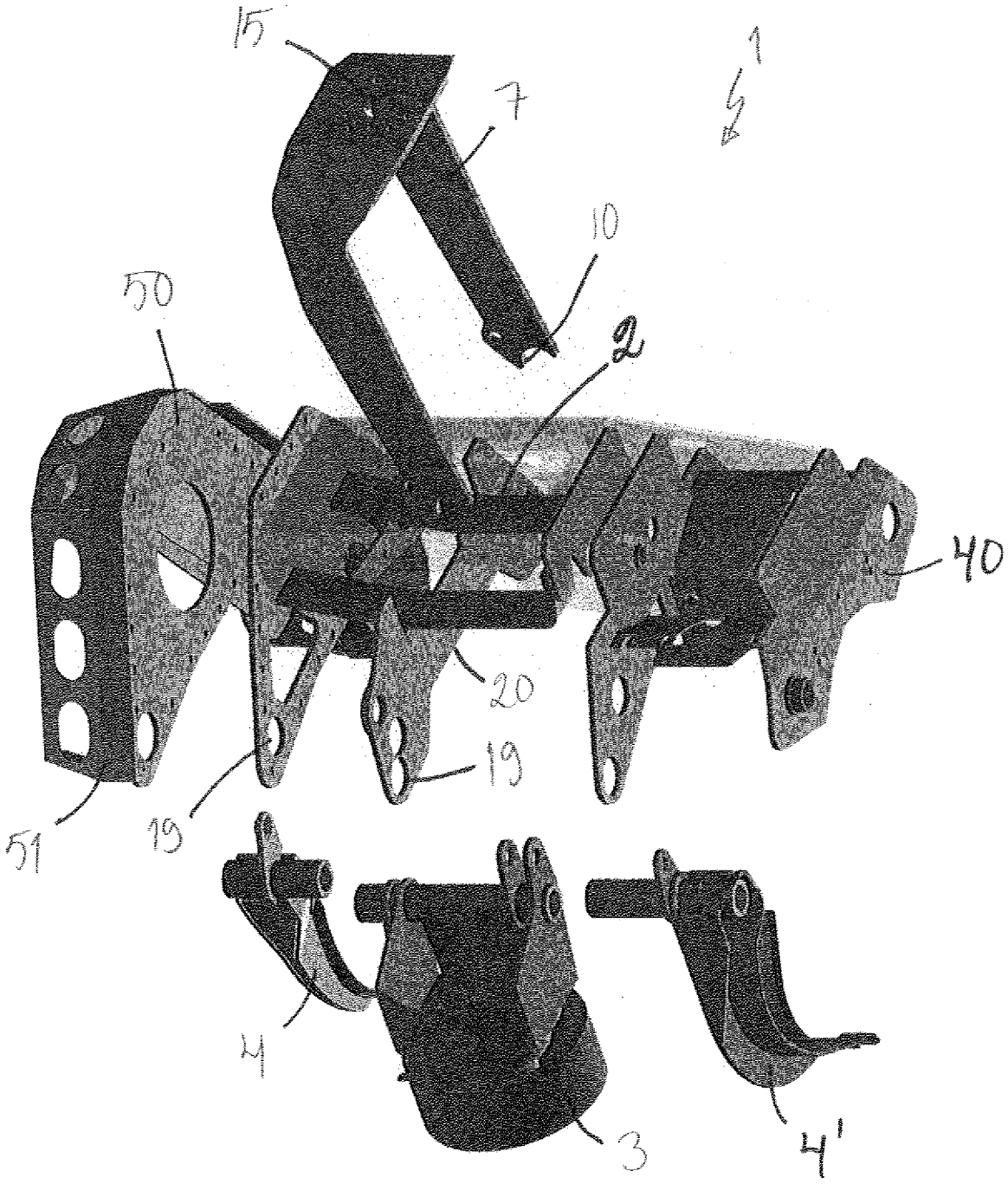

Fig. 5