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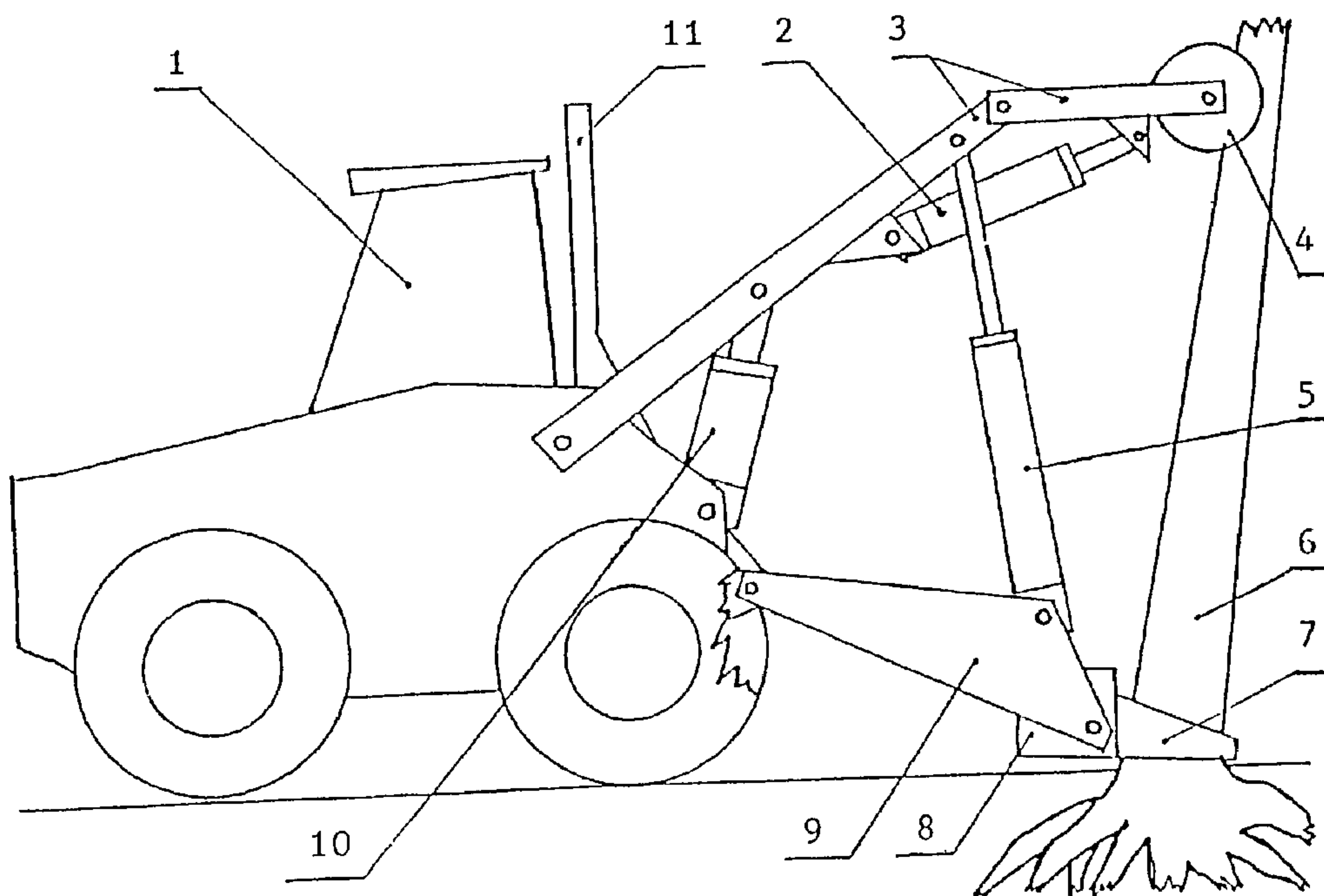
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(54) Titre : PROCEDE ET APPAREIL DE DERACINEMENT D'ARBRES

(54) Title: PROCESS AND APPARATUS FOR UPROOTING TREES



(57) Abrégé/Abstract:

The subject of the invention is the excavation of trees by disrooting them by a hydraulic equipment, when the power machine (1) is connected in a rotatable manner to the timber holding frame (9), the supporting frame (3) and the elevating working cylinder (10); the timber holding frame (9) is connected to the timber holding equipment (8), which is able to catch the timber (6) by its arms (7); the timber holding frame (9) is connected to the throwing working cylinder (5) and the supporting frame (3) is attached in a rotatable manner to the supporting cylinder (4); and in case of articulated setting-up of the supporting frame (3) the movement of the two parts of the supporting frame is done by the adjusting tool (2); then the upper part of the throwing working cylinder (5) is connected to any part of the supporting frame (3); furthermore the other end of the elevating working cylinder (10) is connected to the supporting frame (3) or in case of rigid joint setting-up of the supporting frame (3) one end of the adjusting tool (2) is connected to it, while the other end to the throwing working cylinder (5); furthermore the elevating working cylinder (10) can be connected to the timber holding frame (9) directly or via articulated power transmission.

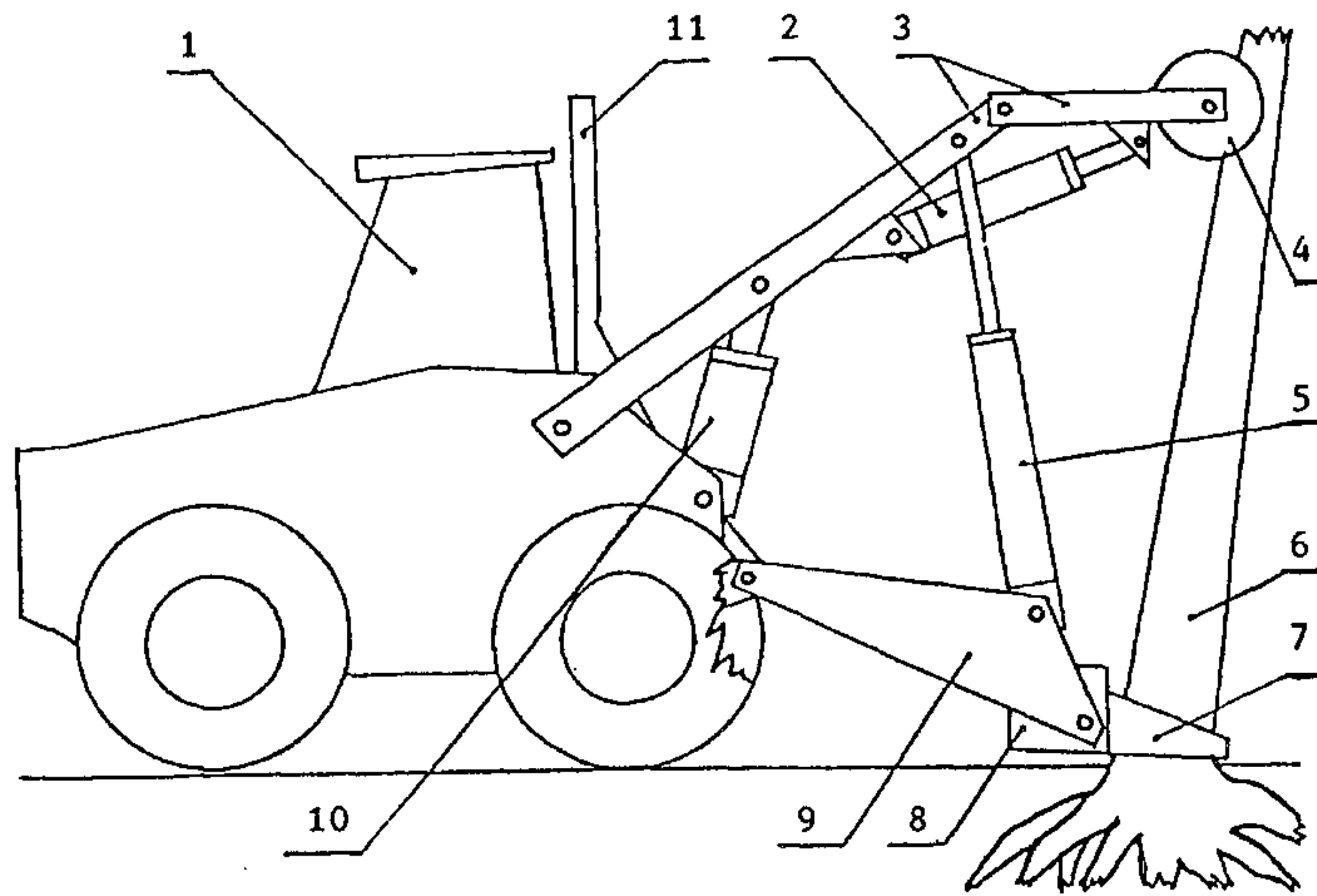


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(54) Title: PROCESS AND APPARATUS FOR UPROOTING TREES



(57) Abstract

The subject of the invention is the excavation of trees by disrooting them by a hydraulic equipment, when the power machine (1) is connected in a rotatable manner to the timber holding frame (9), the supporting frame (3) and the elevating working cylinder (10); the timber holding frame (9) is connected to the timber holding equipment (8), which is able to catch the timber (6) by its arms (7); the timber holding frame (9) is connected to the throwing working cylinder (5) and the supporting frame (3) is attached in a rotatable manner to the supporting cylinder (4); and in case of articulated setting-up of the supporting frame (3) the movement of the two parts of the supporting frame is done by the adjusting tool (2); then the upper part of the throwing working cylinder (5) is connected to any part of the supporting frame (3); furthermore the other end of the elevating working cylinder (10) is connected to the supporting frame (3) or in case of rigid joint setting-up of the supporting frame (3) one end of the adjusting tool (2) is connected to it, while the other end to the throwing working cylinder (5); furthermore the elevating working cylinder (10) can be connected to the timber holding frame (9) directly or via articulated power transmission.

PROCESS AND APPARATUS FOR UPROOTING TREES

The subject of the invention is an equipment for the excavation of trees by uprooting them and a process for taking down the trees by this way.

Basically there are two types of processes for lumbering, i.e. separation of the bole from the root-trunk, and the assart (also called "grubbing-up"). In the first case the root-trunk being remained in the earth after chopping down the bole is regularly extracted separately by forked pushing tools or tines mounted on a tractor (using considerably large stroke) or by blasting. According to the current methods grubs can be used as well. One type of them drills into the root-trunk and slices or splinters it. The other type drills around the root-trunk with a sharp cylinder, cuts the roots and finally excavates the root-trunk.

In case of assart the separation of the bole from the earth is done below the terrain level. If the root-trunk should also be excavated being as a more favourable solution regularly this method is used. Both types of lumbering have advantages and disadvantages. Positive character of the assart is that the quantity of the wood increases, complete soil preparation and re-trenching can be carried out afterwards, the falling tree suffers less damage, and no effort should be made to excavate the root-trunk. The assart can be carried out either manually or by machine. In the first case the rootage is dug out then cut just at the root-trunk toward the falling direction. This accident-prone work is considerably slow. Regarding the machine-made solutions drawing and expelling methods are known. In the former case a throwing double-wheel is fastened vertically to the timber (the timber is felled on it) and the rope of the pulley tackle is fastened at a certain (calculated) height to the timber as well. By the pulling power of the pulley tackle the timber is taken down then the approaching by the double-wheel can be done too. A disadvantage of the method is that due to the high pulling power very often the timber breaks.

According to the expelling method the timber is turned out by lifting the root-trunk with the blade or fork of a power machine being mounted with a felling-frame, felling-beetle and a lifting fork while in the meantime the bole is pushed ahead. In this case very often the problem is that during the holding process of the root-trunk the tool gets clogged and consequently it is not able to carry out the process or considerably high pressing force is

needed. (University of Forestry and Timber Industry, textbook of Forestry Engineering faculty, Dr Rumpf János: Erdőhasználat I. 1986, Sopron)

Patent specification No. CH 674.118 discusses equipment mounted to the hydraulic system of a conventional machine (e.g. tractor), which in a nearly vertical position "rips out" the tree together with its roots from the earth. By the application of equipment mounted with arms for holding the timber it takes the bole and its hydraulic cylinders apply an upward force. In the meantime an eccentric disc is actuated from the machine which forces the units of the system and the timber into an alternative movement. According to the authors it makes the process easier, which is true, nevertheless this solution is applicable economically only in cases of smaller trees. Further disadvantage is that the timber holding arms may vertically slip causing difficulties in the process.

Patent application No. WO 93/04575 discusses equipment mounted on a machine and consists of an abutting arm and a V-shaped dipper-cultivating tool being attached to it, which is used for felling trees with their root-trunks. Disadvantage of the equipment is that sometimes it gets clogged and does not provide proper grabbing.

The US Patent 3823916 provides an apparatus for uprooting trees or tree stumps and for mounting on a tractor, and includes a first frame having plates which can be swung into a ground contacting position to provide a reaction to force used in the uprooting action, and a sub-frame mounted on the frame and hydraulically powered to lift relative to the frame, the sub-frame carrying a pair of jaws which are hydraulically powered to grip the tree or stump between them. This equipment is disadvantageous since it always contains a (16) footplate that leans against the earth during the uprooting of the tree. During the process it is not able to shift relative to the earth. The footplate transmits the pressure force to the earth. The (40) pair of jaws clamps the tree; thus there is not any other connection with the tree. There is not any assembly that moves vertically on the tree during the uprooting process. Consequently high force is needed for the uprooting of the tree since there is not any other additional aid under operation. In case of loose and wet soil the stand of the (16) footplate is very poor complicating the use of the equipment. The power machine is not able to move to-and-fro, consequently it is not able to provide additional tensile or pressure forces.

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The US Patent 4141398 provides a method, in which the standing tree is gripped by a gripping device, lifted and separated from its root system by a cutting device acting in parallel with the longitudinal direction of the tree, the roots being separated from its trunk accelerating the cutting device vigorously relative to the gripping device in the direction away from it, while storing a substantial amount of kinetic energy in the considerable mass cutting parts which in conjunction with the mass of inertia of the tree is used for the cutting of the roots of the tree. Presented equipment leans at a fixed point against the tree. Beside this support there are (12,17) knives that cut a part of the root. This equipment is very complicated and its operation needs several hydraulic circles and sophisticated control. There is not an assembly that moves vertically on the tree during the uprooting process.

Consequently high force is needed for the uprooting of the tree since there is not any other additional aid under operation.

During the development of the invention our target was to invent a proper equipment and process, which are reliable and suitable for assarting trees with relatively small effort in a safe manner.

It was recognised that the above target could be achieved by equipment which touching the timber basically at two points uses such a driving moment that the timber rotated below its centre of mass – being its centre of motion - falls.

This solution provides a quantity of power consumption or power demand being less than the normal. Unbalancing the timber from its equilibrium the sum of its potential energy and motional energy changes. Changing in the loading point of the motional energy generates a supplementary force which supports the felling process by inducing a supplementary driving moment.

According to one aspect of the present invention, there is provided a hydraulic equipment capable of excavating trees by uprooting them, which consists of a power machine, a timber holding equipment, working cylinders and timber holding arms; wherein one end of a timber

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holding frame, a supporting frame and at least one elevating working cylinder is connected to the power machine in a rotatable manner; the timber holding equipment, which is mounted with timber holding arms, is connected to the timber holding frame; the lower end of a throwing working cylinder is connected to at least one of the timber holding frame or the timber holding equipment in a rotatable manner; the supporting frame is mounted with a supporting cylinder revolving around an axis; and an adjusting tool is connected through a pin or shaft to the supporting frame; further the upper end of the throwing working cylinder and the other end of the elevating working cylinder are connected to some elements of the supporting frame.

According to another aspect of the present invention, there is provided hydraulic equipment capable of excavating trees by uprooting them, which consists of a power machine, a timber holding equipment, working cylinders and timber holding arms; wherein one end of a timber holding frame, a supporting frame and at least one elevating working cylinder is connected to the power machine in a rotatable manner; the timber holding equipment, which is mounted with timber holding arms, is connected to the timber holding frame; the lower end of a throwing working cylinder is connected to at least one of the timber holding frame or to the timber holding equipment in a rotatable manner; the supporting frame is mounted with a supporting cylinder revolving around an axis; and an adjusting tool is connected through a pin or shaft to the supporting frame, one end of the adjusting tool is connected to the supporting frame and the other end of it is connected to the throwing working cylinder; and the other end of the elevating working cylinder is connected to the timber holding frame directly or via a transmission mechanism.

The invention is presented by drawings. Figures 1 and 2 show the sketches of a favourable accomplishment. Units presented on them are the following.

The power machine (1) is a machine tool with suitable mass, specific ground pressure, stability, motor/hydraulic power, pulling power, cross-country capability, manoeuvrability. These factors depend on the conditions of the field, forest and the task, since in case of a forest consisting of small trees sparsely on a lowland the demands for e.g. the power, pulling power, cross-country capability are milder.

The adjusting tool (2) determines the position of the supporting cylinder (4), the point where the equipment touches the upper part of the timber (6), by influencing the location of the supporting frame (3). There are several types of solutions to it. If the supporting frame (3) consists of two arms being clamped in a rotatable manner then this adjusting tool determines the angular position of the two arms by connecting the two ends of the adjusting tool (2) to the two arms. If the supporting frame (3) consists of three arms which are connected by two articulations, the adjusting tool (2) is connected to the outer arms. It is possible to apply more adjusting tools (2), in case of two intermediate articulations two adjusting tools are necessary. The adjusting tool (2) is expediently a hydraulic working cylinder nevertheless it can be any other equivalent solution, such as hydro engine, tooth gear drive, electromotor, and the like. The throwing working cylinder (5) is connected to the supporting frame (3) expediently in a rotatable manner. If the supporting frame (3) is a fixed one then one end of the adjusting tool (2) connects to it while the other end of it with an articulated joint connects to the upper end of the throwing working cylinder(s) (5) and in the meantime adjusts the position of its upper part. The throwing working cylinder (5) can be favourably a hydraulic cylinder or even in this case it can be another unit which is able to apply the necessary force. It is possible to apply a hydro engine or an electromotor supplied with the necessary transmission, worm, rack or screw gearing.

The supporting frame (3) touches the timber (6) through the supporting cylinder (4) and is mounted on the power machine (1) with bolts/shafts.

The supporting cylinder (4) is able to rotate on the shaft of the supporting frame (3) and basically it is a rotation-symmetric body, expediently a cylindrical body, which provides the force while rolling down on the bole of the timber (6).

The two connecting points of the throwing working cylinder(s) (5) are directly or indirectly the supporting frame (3) and the timber holding frame (9) or the timber holding equipment

(8). (The latter is shown in Figure 2). The distance between these frames can be adjusted by setting the throwing working cylinder (5). This is connected to the independently operated (e.g. "B") hydraulic cycle of the power machine (1). It is possible to apply one throwing working cylinder (5) and adjusting tool (2) or more of them. These can be connected and utilised in a parallel manner. It is advantageous if greater force or operational safety is required.

The arms (7) are used for holding the timber (6). For having a better bearing area their shape is arched and the internal surface is supplied with canelures. Those are attached to the equipment (8) which holds the timber and which is mounted on the timber holding frame (9). In special cases upward power (pulling force) can be applied on the timber by the arms (7).

The timber holding equipment (8) is connected to another independently operated (e.g. "C") hydraulic cycle of the power machine (1) and provides the transfer of the lifting, pushing and pulling power through the timber holding arms (7) to the timber (6). Due to its articulated construction relative to the timber holding frame (9) the timber holding arms (7) and the timber holding equipment (8) are able to rotate while/after the cutting-down of the timber.

The timber holding frame (9) is mounted on the power machine (1) with bolts/shafts, its height from the earth can be adjusted, furthermore its relative position during the felling can be adjusted by the throwing working cylinder (5) and/or by the elevating working cylinder (10).

The elevating working cylinder(s) (10) can be controlled by the independently operated (e.g. "A") hydraulic cycle of the power machine (1), and it is connected via a rotatable (articulated) coupling to the power machine too. In the present description the word "rotatable" is used in its widest sense. It can mean revolving motion around a fixed shaft (i.e. a bolt or a bearing) or also the movement of a shaft as it can make for example in a longitudinal slot lengthwise motion and revolving motion around an axis as well.

The other direct or indirect connecting point of it is either the timber holding frame (9) or the supporting frame (3). The setting of the relative position of one of the two frames to the power machine (1) is carried out by the elevating working cylinder (10). Expediently this

connecting point of the elevating working cylinder (10) is also rotatable. If the elevating working cylinder (10) is connected to the timber holding frame (9) indirectly then articulated transmission mechanism can be applied. This solution is shown in Figure 2. Besides this other equivalent solutions can be applied.

From a safety point of view, it is recommended to protect the power machine from the falling timber by an emergency system (11). It can be a frame-like assembly unit made of steel, which due to its height and shape protects the cabin of the power machine (1). The emergency system (11) can be connected either to the supporting frame (3) or to the power machine (1) or to both of them. If it is more advantageous the emergency system (11) can also be connected to the adjusting tool (2) or to the throwing working cylinder (5).

The operation of the equipment is as follows. The power machine (1) drives to the timber (6) selected for felling. By the operation of the elevating working cylinder(s) (10) and the throwing working cylinder(s) (5) the supporting frame (3) is adjusted to an upper position, while the timber holding frame (9) is adjusted to a lower position on the timber (6).

By the operation of the timber holding equipment (8) the holding arm(s) (7) embraces the lower part of the timber (6). The adjusting tool (2) sets the conditions between the timber (6) and the throwing working cylinder (5). By the operation of the elevating working cylinder(s) (10) and the throwing working cylinders (5) the supporting cylinder (4) rolls down on the bole of the timber and fells the timber off the power machine (1). Then by the timber holding arms (7) elevating/pushing/pulling the timber is taken down.

Advantages of the equipment of the invention:

- simple and reliable construction;
- safe operation;
- suitable for cutting down trees being in a wide scale range.

Advantages of the process of the invention:

- damage (breaking) to timbers is very rare,
- direction of the felling can be determined accurately,
- force and power demand is less than that of the known processes.

The invention is illustrated by the following Examples but they are not intended to limit the scope of the claims.

Example 1

The equipment made according to this beneficial implementation is presented in Figure 1.

In this case the timber holding frame (9), the supporting frame (3) and one or more elevating working cylinders (10) are connected to the power machine (1) all in a rotatable manner. The other end of the elevating working cylinder (10) is connected to the supporting frame (3) and consequently providing the height setting of the latter one. There is/are one or more throwing working cylinder(s) (5) between the supporting frame (3) and timber holding frame (9). This way the position of the latter ones is adjustable. The upper connecting point of the throwing working cylinder (5) may equally be the part of the supporting frame (3) being nearer to the power machine (figure shows this solution), or the part being nearer to the supporting cylinder (4). The two parts of the supporting frame, such as the one which holds the supporting cylinder (4) and the other which is coupled to the power machine, are connected in an articulated way. The adjusting tool (2) sets the position of the above two supporting units. The timber holding arms (7) used for holding the timber (6) can hydraulically be operated in the timber holding equipment (8) which is mounted on the timber holding frame (9).

The equipment is operated by setting the supporting frame (3) to an upper position and the timber holding frame (9) to a lower position by operating the elevating working cylinder (10) and the throwing working cylinder (5). By operating hydraulically the timber holding equipment (8) the timber holding arms (7) take the stool of the timber (6). The bole of the tree is shouldered at the top by the adjusting tool (2) and the supporting cylinder (4). The felling of the tree is done

- by contraction of the throwing working cylinder (5)

and/or

- by contraction of the elevating working cylinder (10).

If it is desired the power machine (1) can move off from the tree for aiding the felling. Then the power machine (1) approaches and the timber holding arms (7) drop the tree.

Example 2

Deviations from the set-up presented in the Example 1 and Figure 1 are as follows. This implementation is shown in Figure 2.

The supporting frame (3) is not an articulated device except its hanging-up. The upper part of the throwing working cylinder (5) is connected in a flexible manner to the adjusting tool (2). The lower (other) part of the adjusting tool (2) is connected to the supporting frame (3). Since one end of the elevating working cylinder (10) is connected to the power machine (1), the elevating working cylinder (10) does not control the movement of the supporting frame (3) but either directly or via an armed-articulated device (as it is presented in the Fig.) it is able to arrange the movement of the timber holding frame (9) relative to the earth and the power machine.

The cutting-down of the tree and the operation of the equipment are the same as it is described in Example 1.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A hydraulic equipment capable of excavating trees by uprooting them, which consists of a power machine, a timber holding equipment, working cylinders and timber holding arms; wherein one end of a timber holding frame, a supporting frame and at least one elevating working cylinder is connected to the power machine in a rotatable manner; the timber holding equipment, which is mounted with timber holding arms, is connected to the timber holding frame; the lower end of a throwing working cylinder is connected to at least one of the timber holding frame or the timber holding equipment in a rotatable manner; the supporting frame is mounted with a supporting cylinder revolving around an axis; and an adjusting tool is connected through a pin or shaft to the supporting frame; further the upper end of the throwing working cylinder and the other end of the elevating working cylinder are connected to some elements of the supporting frame.

2. Equipment according to claim 1, wherein to at least one of the power machine or to the supporting frame an emergency system is connected, which is expediently a frame-like unit consisting of arched and straight sections.

3. Equipment according to claim 1, wherein the supporting frame consists of two parts and has one intermediate articulation.

4. Equipment according to claim 1, wherein the supporting frame consists of more parts connected to each other in a rotatable manner and has more intermediate articulation.

5. Equipment according to any one of claims 1 to 4, wherein the timber holding arms are connected to the timber holding equipment in a rotatable manner.

6. Equipment according to any one of claims 1 to 4, wherein the timber holding equipment is connected to the timber holding frame in a rotatable manner.

7. Equipment according to any one of claims 1 to 6, wherein the upper connecting point of the supporting frame and the throwing working cylinder are rotatable.

8. Equipment according to any one of claims 1 to 7, wherein at least one of the connecting points of the elevating working cylinder is fixed in a rotatable manner.

9. A hydraulic equipment capable of excavating trees by uprooting them, which consists of a power machine, a timber holding equipment, working cylinders and timber holding arms; wherein one end of a timber holding frame, a supporting frame and at least one elevating working cylinder is connected to the power machine in a rotatable manner; the timber holding equipment, which is mounted with timber holding arms, is connected to the timber holding frame; the lower end of a throwing working cylinder is connected to at least one of the timber holding frame or to the timber holding equipment in a rotatable manner; the supporting frame is mounted with a supporting cylinder revolving around an axis; and an adjusting tool is connected through a pin or shaft to the supporting frame, one end of the adjusting tool is connected to the supporting frame and the other end of it is connected to the throwing working cylinder; and the other end of the elevating working cylinder is connected to the timber holding frame directly or via a transmission mechanism.

10. Equipment according to claim 9, wherein the transmission machinery between the elevating working cylinder and the timber holding frame has an articulated setting-up.

11. Equipment according to claim 9 or 10, wherein to the power machine and to the supporting frame or to the mutual structural member of the adjusting tool and of the throwing working cylinder an emergency system is connected which restricts movement in space.

12. Equipment according to any one of claims 9 to 11, wherein the timber holding arms are connected to the timber holding equipment in a rotatable manner.

13. Equipment according to any one of claims 9 to 11, wherein the timber holding equipment is connected to the timber holding frame in a rotatable manner.

14. Equipment according to any one of claims 9 to 13, wherein the connecting point of the adjusting tool and the throwing working cylinder is rotatable.

15. Equipment according to any one of claims 9 to 14, wherein at least one of the connecting points of the elevating working cylinder is fixed in a rotatable manner.

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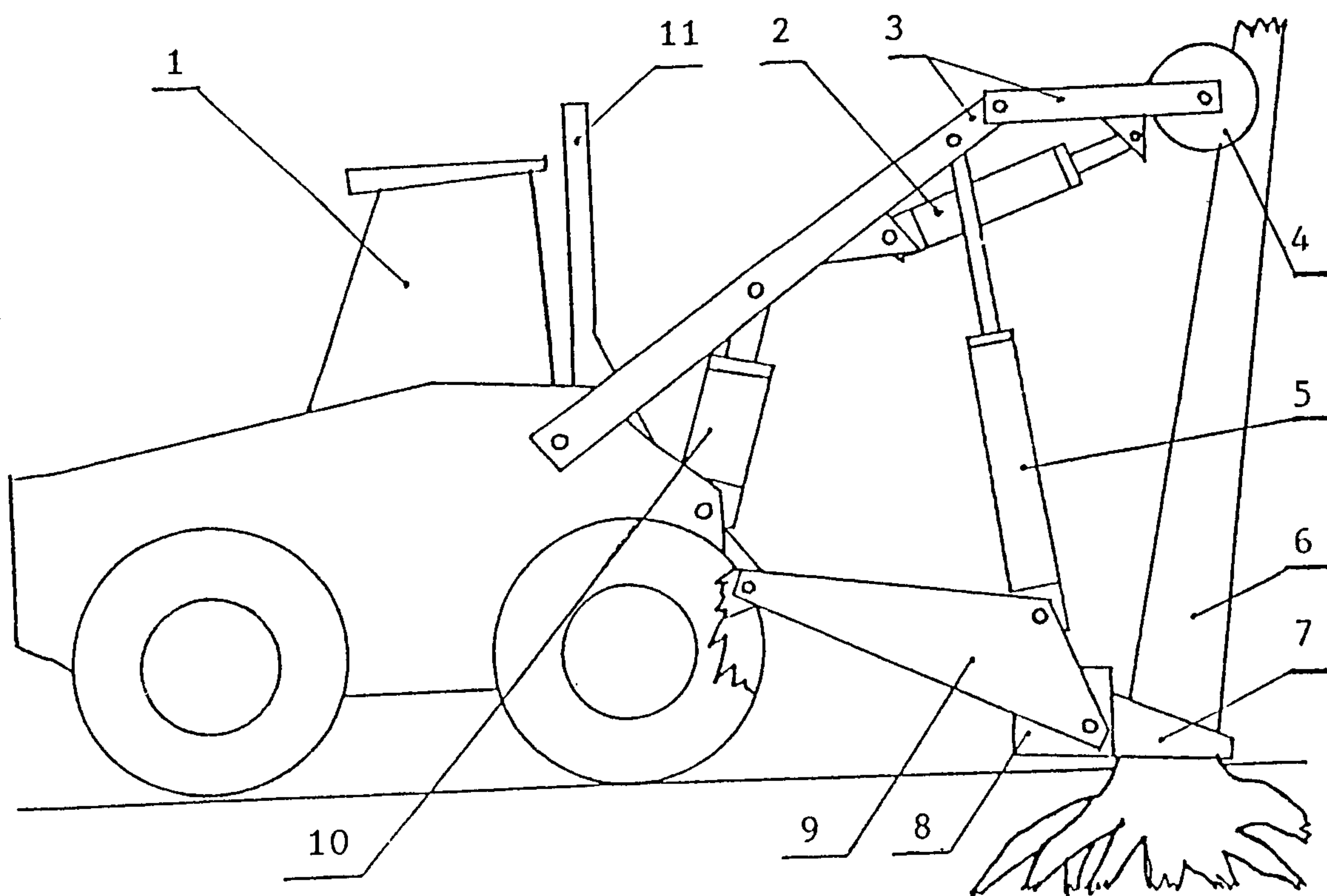


Fig. 1.

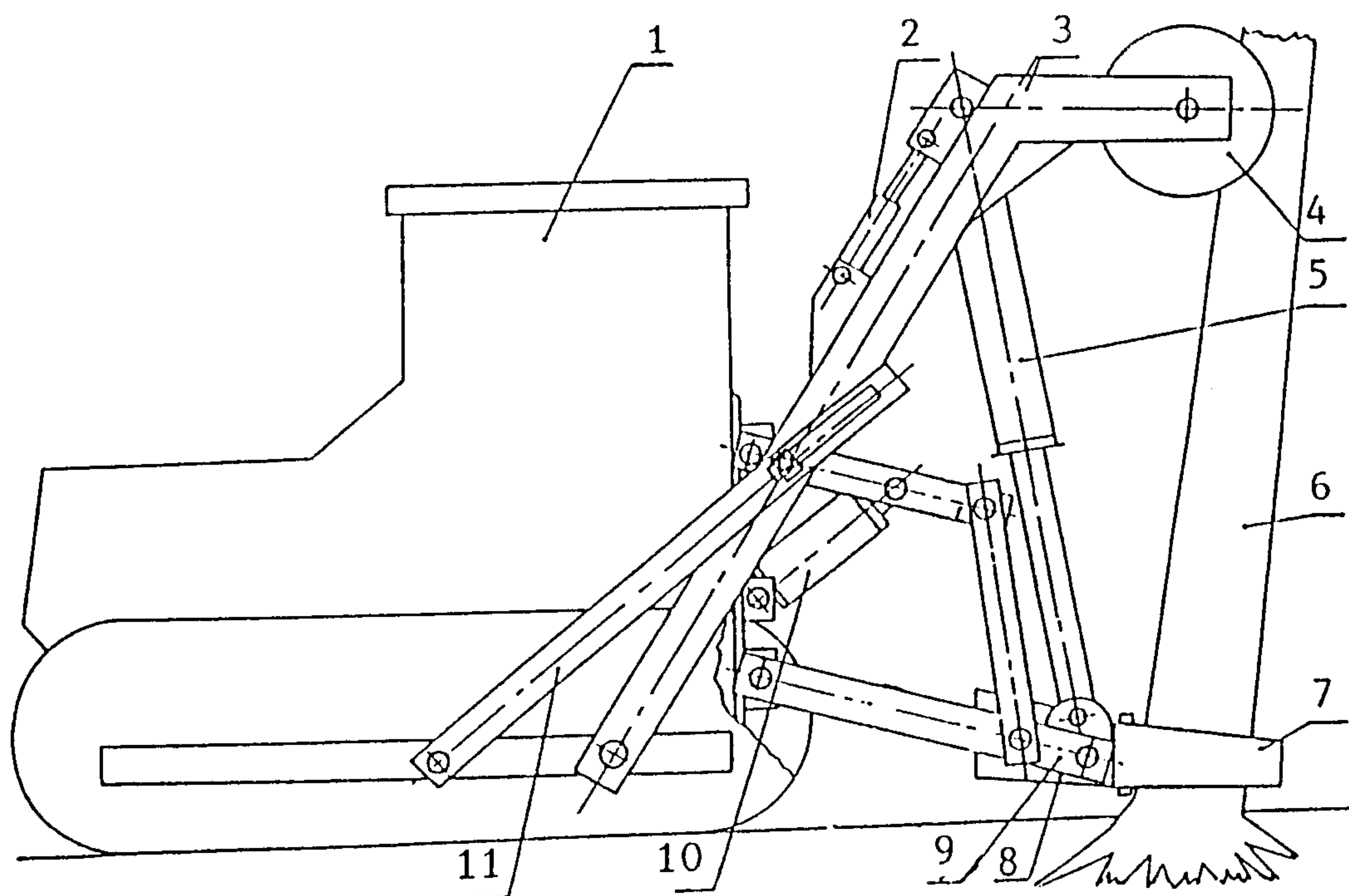


Fig. 2.

