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DEVICE FOR TRANSPLANTING YOUNG UNDERGROWTH WITH SOIL LUMP WHEN PERFORMING FORESTRY

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Abstract: The designs of devices for transplanting young undergrowth from under the forest canopy are considered. Patent search methods were used. Particular attention is paid to the designs of devices that allow digging outplanting with a soil lump in the form of a hemisphere and capturing a clod of earth from two sides. The proposed design allows you to upgrade these devices and reduce the likelihood of damage to the dug undergrowth. The device is recommended for replanting coniferous young undergrowth up to 1 meter high during forestry work.

KEYWORDS: Reafforestation, Young undergrowth, Undergrowth digging, Undergrowth transplant, Undergrowth with a closed root system

1 Introduction

Each of the currently existing methods of reafforestation has its own advantages and disadvantages [2, 5, 7, 17].

A method of combined reafforestation has been developed, in which it is proposed to combine felling and reforestation operations. Young undergrowth is dug out from the areas of its guaranteed destruction and planted in safe areas [12]. At the same time, an uneven-aged forest stand of a complex improved composition is formed, which ensures the effective growth of young stands and a ripening forest. This method combines the possibilities of both artificial and natural reforestation.

The task of the forestry specialists is to correctly determine the optimal ratio of reafforestation methods, based on forest growth and economic conditions, and at minimal cost to ensure the cultivation of forests of the best quality.

2 Materials and Methods

In preparing the materials of the article, methods of patent search were used. Special attention was paid to machines equipped with a manipulator [9, 14]

In fig.1. shows a general view of the machine used for relocation undergrowth with technological equipment for replanting undergrowth hung on its manipulator, consisting of a transport trolley (cargo compartment) for containerizing undergrowth, a manipulator and a digging device. The technological process of replanting undergrowth may involve the use of various machines, some of which are equipped with specialized equipment for digging and planting undergrowth. And the other part of the machines is involved in the transportation of undergrowth from the place of digging to the place of its landing on the prepared area.

Currently, various devices are known for transplanting undergrowth from under the forest canopy [3, 4, 10, 11]. The design of the digging device should not destroy the lump of soil

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when digging out the undergrowth, and the dug lump should correspond to the size and shape, respectively, equal to the size and shape of the root system of the transplanted tree.

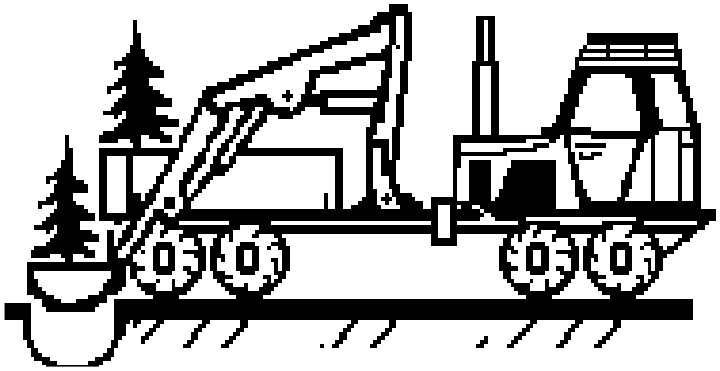


Fig. 1 General view of the machine for relocation young undergrowth

The most reliable in operation are technical solutions that allow the capture of a clod of earth from two sides. But this creates additional difficulties when pointing the device at the undergrowth being dug.

One of the designs is a digging device proposed by A.V. Lazarev. Two spherical knives are connected to the axis of rotation by means of lugs and rods with a rod, which is attached to the machine's manipulator. The knives are rotated by a hydraulic cylinder using levers [8].

The advantage of the structures is the possibility of digging up young coniferous undergrowth with a clod of earth in the form of a hemisphere. However, this circumstance leads to the need to aim the device at the undergrowth from above, which increases the likelihood of damage to the undergrowth due to the fact that the knives are interconnected and have a closed contour, while the distance between them cannot be changed.

The closest in technical essence is the device [12, 13, 15], which has a working body consisting of two identical knives. Knives in the closed position have the shape of a hemisphere. The bases of the knives are rigidly connected to two parallel horizontal axes installed inside the body, on which a two-sided gear rack is placed, rigidly connected to the hydraulic cylinder rod fixed to the body. The technological equipment has proven its performance under production conditions.

The disadvantages of this design are: the difficulties that arise when pointing the device with open knives on the undergrowth being dug from the side, in which undergrowth can be damaged due to the fact that its trunk must fall into a narrow space limited by two parallel horizontal axes of rotation of the knives and the body of the device.

As a result of studying the options for existing structures, the purpose of this work was to constructively increase the technological safety zone for the dug undergrowth when the gripping jaws of the device, having the form of a hemisphere, are pointed at it.

Solved tasks:

1. Modernization of the device for transplanting undergrowth by machine;
2. Constructive increase in the technological safety zone for the excavated undergrowth when spherical gripping jaws are pointed at it.

The proposed device is hung through the eyes (1) on the handle (2) of the machine manipulator (Fig. 2, 3). The undergrowth transplanting device comprises a bearing body (3), a fixed arc-shaped lower frame (10) is rigidly attached to it, at the ends of which the rotation axes (11) of the lower gripping jaw (4) are fixed, and an arc-shaped upper frame (5), with

axes of rotation (11) fixed at the ends of the upper gripping jaw (6). Rotation of the lower gripping jaw is possible due to the force of the hydraulic cylinder (9) directed at it, located on the lower part of the bearing body. Rotation of the upper gripping jaw is possible due to the force of the hydraulic cylinders (8) located at both ends of the arch of the upper frame, which, in turn, under the action of the force of the hydraulic cylinders (7) connecting it to the supporting body of the device, can be pressed against the fixed lower frame.

An arc-shaped fixed lower frame is rigidly attached to the device carrying body, at the ends of which the rotation axes of the lower gripping jaw are fixed. As well as the upper frame of an arcuate shape, with the axes of rotation of the upper gripping jaw fixed at the ends, pivotally fixed in the middle of the arc of the fixed lower frame at the point of its connection with the supporting body of the device.

The radii of the arc formed by the upper and lower frames of the arcuate shape, more than the radius of curvature of the gripping jaws, which allows free movement of the gripping jaws inside each of the frames. Rotation of the lower gripping jaw is possible due to the force of the hydraulic cylinder directed to it, located on the lower part of the supporting body. Rotation of the upper gripping jaw is possible due to the force of the hydraulic cylinders located at both ends of the arch of the upper frame, which, in turn, under the action of the force of the hydraulic cylinders connecting it to the supporting body of the device, has the ability to press against the fixed lower frame.

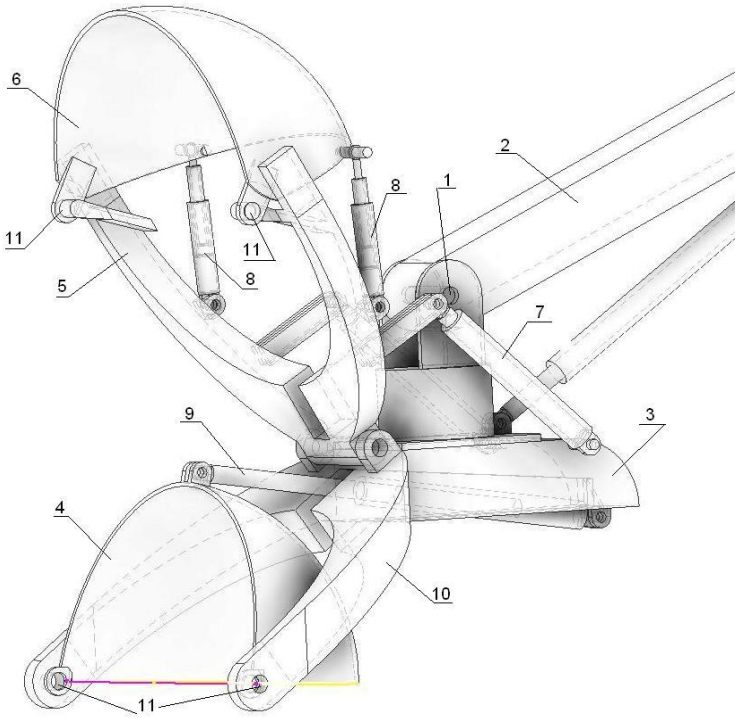


Fig. 2 Device for transplanting young undergrowth (view with the gripping jaws open)

3 Results

The solution of the tasks set is achieved due to the fact that a fixed lower frame of an arcuate shape is rigidly attached to the supporting body of the device, at the ends of which the rotation axes of the lower gripping jaw are fixed, and an upper frame of an arcuate shape, with the axes of rotation of the upper gripping jaw fixed at the ends, hinged on in the middle of the arc of the fixed lower frame at the point of its connection with the supporting body of the device. At the same time, the radii of the arc formed by the upper and lower frames of the

arcuate shape are greater than the radius of curvature of the gripping jaws. This allows free movement of the gripping jaws inside each of the frames.

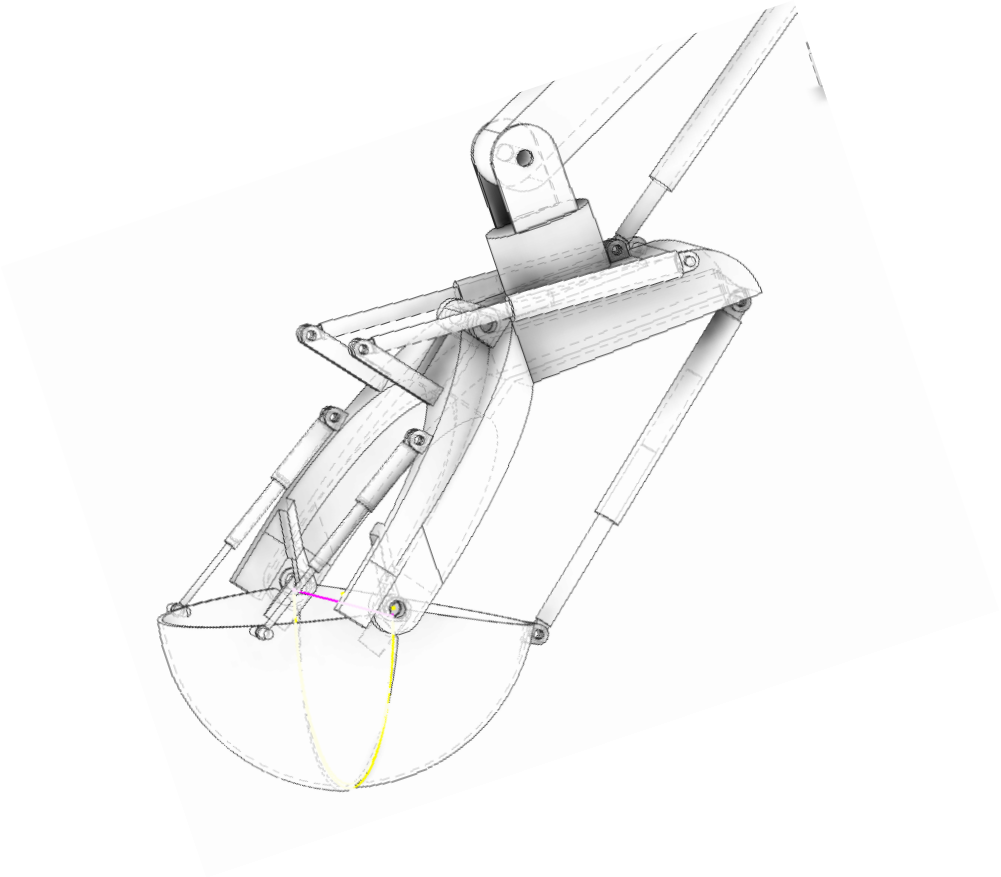


Fig. 3 Device for transplanting young undergrowth (view with closed position of gripping jaws)

The technological process of replanting undergrowth from those places where it can be damaged as a result of the planned logging operations consists of several main operations. Initially, the machine is moved to the place of excavation, set to a non-working position, pointing the manipulator at the dug out undergrowth. In this case, the undergrowth is in the center of the zone of action of the gripping jaws. Undergrowth is being excavated.

When this device for transplanting undergrowth works as follows.

At the moment when the gripping jaws of the device are separated, and the upper frame is retracted from the lower frame, the lower gripping jaw is aimed at the undergrowth. The upper gripping jaw is located above the center of the zone of closure of the gripping jaws.

The hydraulic cylinders for pressing the upper frame to the lower fixed frame are switched on. At the same time, the device is lowered to the ground and the upper jaw is aimed at the undergrowth, completely touching the ground with the cutting edge. The hydraulic cylinders for closing the gripping jaws are switched on. The gripping jaws penetrate into the ground. With the full extension of the rods of the hydraulic cylinders, the movement of the gripping jaws stops and the lifting of the device begins. The opening of the gripping jaws and their transfer to their original position when laying the undergrowth is carried out during the reverse stroke of the hydraulic cylinders for closing the jaws. The upper and lower gripping jaws begin to move around the axis. The layout of the upper frame with the lower frame is carried out due to the reverse stroke of the hydraulic cylinders.

The dug out undergrowth is placed in the transport trolley (body) of the machine and

transported to the place of its landing or temporary storage. Upon arrival at the landing site, the machine is set to a working position, digs one or more holes for planting undergrowth using the proposed device. Then the manipulator with the digging device is aimed at the undergrowth located in the transport trolley of the machine. Undergrowth is captured and transferred and placed in a hole.

4 Discussion

The works of many scientists confirm the high survival rate of young undergrowth [16, 18]. It has been proven that the transplantation of young trees with an open root system is less effective than their transplantation with a clod of soil [1]. The design of the undergrowth digging device proposed as a result of the research has a spherical shape, which minimizes damage to the root system of young trees. This does not contradict the studies of other scientists characterizing the root system of young trees [6, 8] and indicates the possibility of using the proposed structure in forestry. An analysis of existing studies allows us to recommend this design when digging and planting undergrowth of conifers up to 1 meter high. The results of the study can be recommended for use in forestry when performing reforestation work, however, they require experimental testing in production conditions in order to improve individual structural elements.

CONCLUSION

The goal set in this work was achieved by developing the design of a new device that allows digging undergrowth with a clod of earth in the form of a hemisphere. The use of the proposed device for transplanting undergrowth by machine makes it possible to increase the technological safety zone for the dug undergrowth when the gripping jaws of the device are pointed at it and to increase the safety of the undergrowth during its digging and replanting compared to other similar devices. The next step on the path of further research in this area should be the creation of an experimental sample of the proposed design and its further experimental research.

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