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Research Article

SELF-PROPELLED MECHANISED PLATFORM FOR HARVESTING APPLES AND OTHER SIMILAR FRUITS

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ABSTRACT

This article explores the design and analysis of a mobile mechanized system for harvesting apples and other similar fruits, addressing critical challenges in the agricultural sector such as labor shortages and rising operational costs. The proposed system is designed to meet key requirements for mobility, performance, compactness, and energy efficiency, with a capability to harvest up to 2 tons of fruits per hour. Components such as a lightweight chassis, conveyor belt, electric drive system, and loading mechanisms are described. Performance calculations demonstrate the system's efficiency, while an economic analysis highlights its cost-effectiveness, with projected returns on investment within 1–2 harvesting seasons. This mechanized solution offers a sustainable and profitable approach to modernizing fruit harvesting practices, particularly in regions like Uzbekistan with significant orchard production.

KEYWORDS

Orchard, orchard machinery, harvesting and transport mechanization, mobile harvesting and transport chassis.

INTRODUCTION

In modern agriculture, the efficient harvesting of fruits like apples, pears, and similar produce remains a critical challenge. Traditional manual harvesting methods, though effective, are labor-intensive and time-consuming. With labor costs rising globally and shortages of agricultural workers becoming increasingly common, the need for mechanized solutions has grown substantially. Uzbekistan is a key agricultural producer, with a significant portion of its economy driven by the cultivation of fruits. However, many orchards still rely heavily on manual harvesting methods, leading to increased operational costs, inefficiencies, and potential fruit damage. Furthermore, delicate fruits such as apples require careful handling to maintain quality, creating additional complexities in mechanization. This paper

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aims to address these challenges by proposing a mobile mechanized system specifically designed for harvesting apples and similar fruits. The system is tailored to meet the unique requirements of fruit orchards, offering high performance, ease of use, and cost-effectiveness. Through careful design and performance analysis, this study demonstrates how mechanization can improve harvesting efficiency while preserving fruit quality and reducing labor dependency.

METHODS

The system was tested for maximum throughput with apples and fruits of similar size and weight. The belt speed and load distribution were adjusted to optimize performance. The energy efficiency of the battery-powered motor was monitored to ensure an operational duration of up to 8 hours. In order to achieve the stated task in the above-mentioned known mobile system for mechanized harvesting of apples and other similar fruits, including a mobile chassis with an engine, running wheels and steering, a platform with a transport vehicle for the harvested fruits installed on it and a height-adjustable device for accommodating the fruit picker, a conveyor with the ability to transform the shape in height and length is placed on the platform, while it should ensure quick assembly and disassembly of the structure, and the device for accommodating the fruit picker should be made with a variable cradle height, convenient for harvesting fruits and equipped with a local (address) control panel for the cradle on site.

RESULTS AND DISCUSSION

Having analyzed several horticultural technologies, we propose a compact and efficient device. The essence of the proposed device is explained by the drawings, where Fig. 1 shows a basic diagram of a mobile mechanized system for harvesting apples, pears, plums and other stone fruits, a side view, then a top view (b), then front view (c); the technical process of work, and Fig. 2 shows a removed view of the mobile system.

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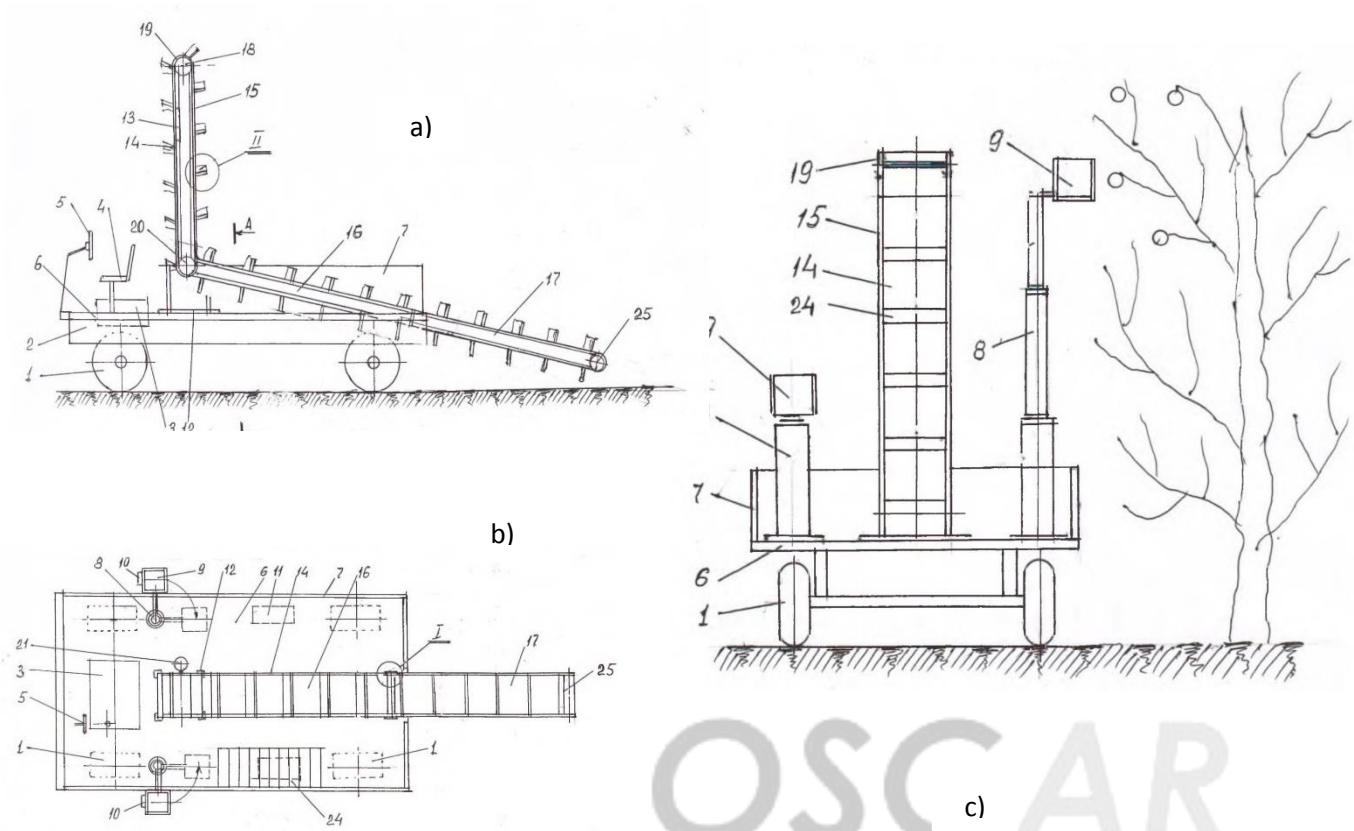

Figure 1. Schematic diagram of a mobile mechanized system and technical process of work of the device

The proposed mobile mechanized system for collecting apples and other stone fruits includes a welded frame 2 mounted on running wheels 1, on which an internal combustion engine 3, a landing seat 4, a steering control 5 and a platform 6 with a side 7 are placed. On the platform, on both sides, two telescopic three-stage hydraulic lifts 8 are placed, on which a cradle 9 is mounted for accommodating an apple picker (worker) (not shown in the figure) and a control panel 10 for the lift 9. Containers 11 for storing and pumping working oil for the hydraulic lifts are located under the platform 6. A frame 12 is fixed to it along the central axis of the platform, on which a supporting frame 13 of a chain vertically inclined conveyor 14 is mounted. The latter consists of a vertical 15, intermediate 16 and final 17 inclined sections. In the upper part of the frame 13 there is an axle 18 with sprockets 19, and in the lower part there is an intermediate axle 20 with the corresponding sprockets and kinematically interconnected with the electric drive 21. The right and left branches of the conveyor 14 are interconnected by rods 22 located between them at a certain interval, on which removable returnable containers 24 are hung by means of hooks 23. The container can be made of plastic, light and durable, and mutually stackable. At the end of the frame 13 of the terminal 17 inclined section, an axle with sprockets 25 is installed. The terminal 17 section of the conveyor is pivotally 26 interconnected with the intermediate section 16 with the ability to rotate in the vertical plane by 180°. The entire structure of the conveyor 14 is made of a standard angle section by welding. In the free

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spaces of the platform 6, it is possible to store returnable empty containers 26. The mobile mechanized system for collecting apples operates as follows. Before starting work, the terminal 17 section of the conveyor 14 is dismantled from the folded state and, turning it relative to the hinge joint by 180° degrees, it is connected to section 16, the tension of the right and left chain transmission on the sprocket 25 is checked. The drive 21 is started and the operation of the chain conveyor 14 is checked in idle mode. Having made sure of the rhythmic operation, the mobile system is adjusted to the apple tree and they begin to collect apples from the lower branches. As the height increases, the collector, being in the cradle 9, controls the height of the cradle with the control panel 10. The container 24 filled with apples is hung by means of a hook 23 on the chain conveyor 14, which is constantly in motion.

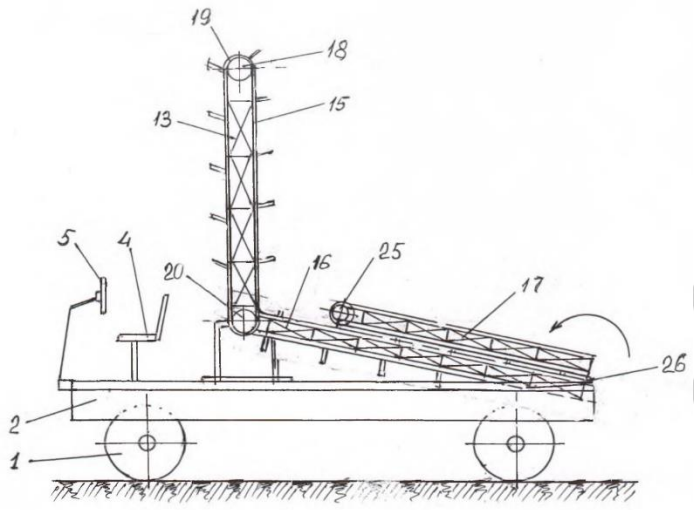

Figure 3. Movable mechanized system for collecting apples and other similar fruits in assembled form.

A secondary worker, being at ground level, removes the filled container from the conveyor and stores it, either on site, or immediately transfers it to another vehicle for sending to the warehouse. Empty containers are hung on the rear free branch of the conveyor 14, which can be stacked in sufficient quantities on the free spaces of the platform. The system can be serviced by two or more people.

CONCLUSION

We suggest that the mobile system can be widely used in intensive gardening and will facilitate the harvesting of not only apples, but also other fruits and vegetables: pears, plums, peaches and others. The device used for harvesting fruit in orchards, when attached to a tractor, harvests the fruit in an apple orchard in a semi-mechanized way, puts the fruits in containers, collects the filled containers and carries them out of the field, reducing labor costs by 50-60% and increasing productivity by 2-3 times, resulting in an economic benefit of 30,000,000-35,000,000 soums. The performance indicators of the mobile device intended for use in harvesting apples and other types of fruit trees fully meet the requirements of agrotechnology, with fruit loss not exceeding 0.5% and damage not exceeding 1%, while significantly increasing productivity and reducing labor costs, operating and transportation costs by 2-2.5 times.

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