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Creation of the Construction of the Digger-Loader with a Centrifugal Separation

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Abstract--- *Qualitative performance indicators of potato harvesters largely depends on the design of the separating working bodies. In this regard, the purpose of this article is to create a centrifugal lifting separating working body of a potato-harvesting machine, which ensures the effective separation of potato tubers from the soil with centrifugal forces. Therefore, it was proposed to modernize the separating working bodies of the potato harvester, namely, to use an elevator with a centrifugal separation and a clamping device with flanges in the potato harvester, this device is new in that the flanges are made in the form of separate sectional elements and installed with the possibility of radial change of position. This design of the separating working body to provide increased productivity, expanding technical capabilities and reducing the energy intensity of the process.*

Keywords--- *Digger, Potato Harvester, Elevator, Device, Tubers, Soil, Separation, Design*.

I. INTRODUCTION

Analysis of the current state of the theory and practice of operating machines for preparing soil and harvesting potatoes showed that there are gaps in the development of technology and technical tools for harvesting potatoes for the design of such machines and the justification of their parameters. In particular, at present times [1,2]:

A further increase in the level of harvesting potatoes is hindered by the unsatisfactory operation of potato harvesters on heavy soils with low humidity, prone to clumping soils;

It is not possible to significantly increase the productivity and quality of work of combines on such soils only by improving the device for separating solid impurities directly on the combine;

There are no sufficient theoretical and experimental studies on the destruction of soil lumps and soil separation with a full load of separating working bodies;

Reduce damage and loss of tubers; it is possible to increase the performance of potato harvesters on lumpy soils using special technology for harvesting potatoes using a potato harvester equipped with centrifugal separators.

The most serious factor reducing the productivity of machines in heavy soils of low humidity, including in Uzbekistan for planting, hilling and harvesting potatoes, is the prevalence of heavy soils, prone to clumping.

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From the foregoing, it follows that the technological complexes of machines and equipment must be formed on the most suitable for work in difficult soil and climatic conditions. In this regard, the development of mechanized harvesting of potatoes on heavy soils of low humidity is very relevant and is carried out in two directions:

- Use of appropriate agricultural techniques;
- Creation of special working bodies and devices for intensifying soil separation at elevators, with additional separating working bodies, and as a result, a new construction of a potato harvesting machine is required "Classic" layout. Therefore, taking into account the shortcomings of existing combines and solving the issue of creating a machine for harvesting potatoes in heavy soils of low humidity, we tried to create machines based on existing machines, introducing the appropriate new working bodies into them, and made it workable in Uzbekistan. When creating the harvester, it was found that the cylinder-clodger, when increasing its diameter, could ensure the tubers rise up by centrifugal separation. Based on the foregoing, it is advisable to adopt, as a basis for further improvement, potato harvesters adapted for work in heavy soils of low humidity, including in Uzbekistan, a combine of the "classic" layout KST - 1.4-potato digger, as well as their technological schemes and working bodies.

II. LITERATURE SURVEY

KCT potato digger - 1.4 elevator semi-mounted. The main components of a potato digger are a gear, a copy wheel, a ploughshare, a high-speed elevator, a main elevator, frames, a running wheel, a cascade elevator, a reflector, and transverse linkages.[1,2,3,4,5,6]. Cropped and partially destroyed formation enters the high-speed elevator having a speed of 2.02 and 2.25 m / s. Then, from the high-speed elevator, the mass enters the main elevator, where due to the significant separation surface of the canvas and shaking it with special shakers, the soil is further separated and the tubers and remaining impurities are laid on the field surface [7,8,9,10].

Using the results of studies [11,12,13,14], it is not difficult to calculate that with normal functioning of the high-speed elevator, the soil disengagement from it does not exceed 20 - 25 kg / s.

This means that the cascade elevator is under loaded, which will lead to increased damage to potato tubers.

An attempt to modernize a serial combine in the direction of increasing its productivity by increasing the separation surface and some changes in speed conditions and designs of working bodies without fundamentally changing the technological scheme of the combine did not give positive results. At all stages of the development of the design of potato harvesting machines, the focus has always been on improving the work of separating working bodies, which should weed out and separate at least 80% of the soil from potato tubers [14,15].

Although efficient potato harvesting machines have been created both in the CIS countries and abroad, nevertheless, the problem of soil separation cannot be considered finally solved. This is primarily due to the specifics of the cleaning process because the soil entering the separating working bodies of harvesting machines can be very diverse, in the form of loose and small particles of lumps, plastic mass, etc. The separation of soil on the bar elevators of existing machines is unsatisfactory in severe conditions of low humidity. Under these conditions, due to poor separation, there may be a complete disruption to the harvester.

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Various methods and corresponding technical solutions aimed at improving soil separation lead to a complication of the design, a decrease in the working life due to the uneven distribution of loads and to increased damage to the tubers due to forced mechanical impact on the tubers with shaking of the blade.

III. MATERIAL AND METHODS

This work is aimed at eliminating these shortcomings and improving the efficiency of soil separation on bar elevators of potato harvesters using centrifugal forces. The aim of the work is the creation of a centrifugal lifting separating working element of a potato-harvesting machine, which ensures the tubers are lifted to be loaded into a vehicle without bucket or belt conveyors and improves separation due to the use of centrifugal forces. To achieve this goal, a new PTSPE lifting-centrifugal separating bar elevator has been developed that can significantly improve soil separation and reduce damage to potato tubers.

The main working bodies of the developed potato harvesting machine is a centrifugal lifting and separating bar elevator, which consists of a lifting bar elevator, a guide drum with flanges and a falling conveyor belt. These working bodies have a number of requirements:

- Effective screening (separation);
- Minimum damage to tuber losses;
- Reliable transportation with lifting mass up the cylindrical surface and along the inclined surface of the conveyor;
- Minimal dynamic loads and machine vibrations;
- Simplicity of design and reliability.

The main of these requirements is contradictory; the fulfillment of one does not allow the other to be fulfilled. The optimal operation of the separating working bodies is largely determined by the correct drum design and kinematic parameters of their equipped with centrifugal separators.

The new rod elevator PTSPE has significant advantages compared to the separating rod elevators widely used in potato harvesting machines with shaking of the working branch of the elevator blade and will find application in these machines.

IV. SIMULATION & RESULTS

In addition to technological advantages, a bar elevator with centrifugal separation can improve the design parameters of harvesting machines by increasing the lifting height and decreasing the elevation angle of the working branch of the elevator blade. The new elevator allows the machine to be executed not only in a once-through flow diagram, as is the case with the current bar elevators, but also with counter-current flow of the separated mass, which reduces the dimensions and improves the layout of the machine.

The tubers rising to the top on a centrifugal elevator, then fall onto the conveyor belt and then feed them to the loading conveyor, which immerses them in the body of a nearby vehicle. The basic technological scheme of the KP-2 potato harvester is shown in Fig. 1. the machine consists of: a front track roller and wheels 1, digging plowshares 2, a first bar elevator 3, a second bar separating lifting bar elevator 4, a guide drum 5 with flanges 6, a drive shaft of

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the second elevator 7, a conveyor belt 8, a haul conveyor 9, transverse loading conveyor 10, topping lattice-tray 11 and running wheels 12 [15].

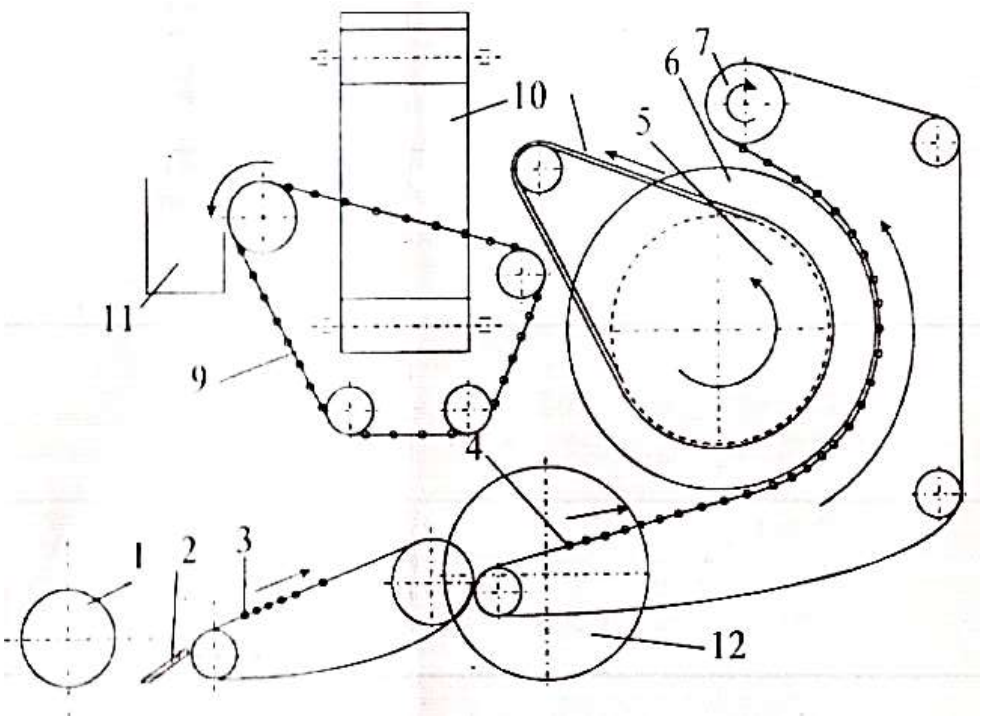

Fig. 1: Schematic Diagram of the KP-2 Potato Harvester

V. EXPERIMENTAL RESULTS

The work of the potato harvester KP-2 is as follows. The ploughshare 2 digs up two potato beds and transfers them to a bar elevator 2, where the whole soil is sifted out, and the soil is most intensively sifted out when the mass and the elevator move along the cylindrical surface of the drum 5. Then the feeding conveyor 8 to the topping conveyor 9 and the transverse loading conveyor 10 conveys the tubers and tops. Tops rarely rod conveyor 9 falls on the tops of the grid-tray 11, which is removed from the machine to the harvested field. The tubers conveyor 10 is loaded into the body of the vehicle.

VI. CONCLUSION

A new technical solution in the KP-2 combine, which provides a new positive effect, is a lifting and separating device consisting of a separating-lifting elevator, a drum with flanges 6 and a feeding conveyor belt.

This device separates the soil under the action of centrifugal forces, and the tubers are lifted in a way that is different from the known machines without buckets or blades. Concentrically, the centrifugal elevator web is located drum with conveyor belts. Tubers rising on a centrifugal elevator upward fall further on the conveyor belt, which immerses them in the vehicle body. There is a gap between the belt conveyor on the drum and the centrifugal elevator, which is set within 30 ... 120 mm, depending on the soil and climatic conditions and the size characteristics of the tubers.

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