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Selection And Justification of the Kinematic Scheme of the Grapple Mechanism of the Loader

Sotvoldiev Nozimjon Zikiryaevich
Candidate of Technical Sciences, Associate Professor,
Mukimov Zohijon Alizhanovich
Teacher Fergana State University
E-mail: zoxidjonmukimov1974@gmail.com

Abstract: The article presents a brief overview of the work of existing grapple loaders and the results of a kinematic study of the grapple mechanism of a universal loader, substantiation of the parameters of the mechanism that ensure the preservation of the quality of cargo materials and coatings of loading platforms when loading loose lightweight fibrous materials (raw cotton, chicken pile, hay, etc.).

Key words: forked grapple, loader, raw cotton, heap heap, digging, kinematics, raking, coating of sites.

Introduction: In agricultural production, universal grapple loaders equipped with interchangeable working bodies-fork and bucket grapples are widely used for loading various cargo materials into vehicles.

For loading loose lightweight materials, forked grapples are usually used and their scooping ability largely depends on the nature of the movements of the grapple jaws and both the physical and mechanical properties and the height of the stack layer and piles of immersed materials.

Body.

Studies of the work of forked grapples of existing loaders, which have a burrowing nature of jaw movement, have shown that when loading raw cotton and heaps located on drying and cleaning areas having asphalt covered, as well as when loading hay, straw and other loose lightweight materials from stacks and piles with a layer height less than the distance from the center of rotation of the jaw O to the end of tooth D (i.e. the radius of rotation of the end of the tooth-r) the coating of the areas is destroyed by the grapple tooth (Fig. 1), and the immersed material is contaminated with particles of the fragment of the coatings [1-6]. The width of the destruction is on average 2-7 cm, the length is 5-20 cm. On sites with very hard coatings, the teeth of the grapple bend or break.

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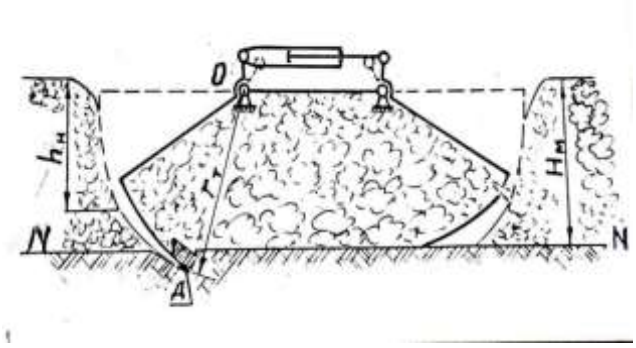

Rice. 1. *Scheme of operation of the grapple at H < r: H-viscose of the material layer; h-value of the initial introduction of the teeth into the mass of the material; r-radius of rotation of the end of the tooth of the jaws; NN-surface of the loading dock*

Since the height of the layer of the above immersion materials in the field is usually no more than 1.5-2.5 meters, in order to eliminate these shortcomings in the work of the existing grapple working bodies of the loader, we conducted a kinematic study of the forked grapple mechanism by the graphic method in order to determine the rational type of the mechanism.

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As part of modern machines, flat lever mechanisms are widely used, the movement of all links of whichoccurs in parallel planes [7-12]

The purpose of kinematic analysis is to determine the parameters of the movements of the links of the mechanism according to a given law of motion of its initial link and the constructive scheme.

In particular, one of the main tasks of kinematic analysis is to determine the positions of the links and trajectories of their individual points.

When determining the kinematic scheme of the grapple, the criterion was the trajectory of the tooth end, in which the teeth of the jaws of the opened grapple are initially introduced into the mass of material and, in the process of closing the jaws, move parallel to the surface of the site, raking and compacting the captured portion of material. This trajectory is provided by the end of the tooth DE (Fig. 2), rigidly attached to the connecting rod BE (in the form of a jaw) of a flat four-hinge mechanism [13-20].

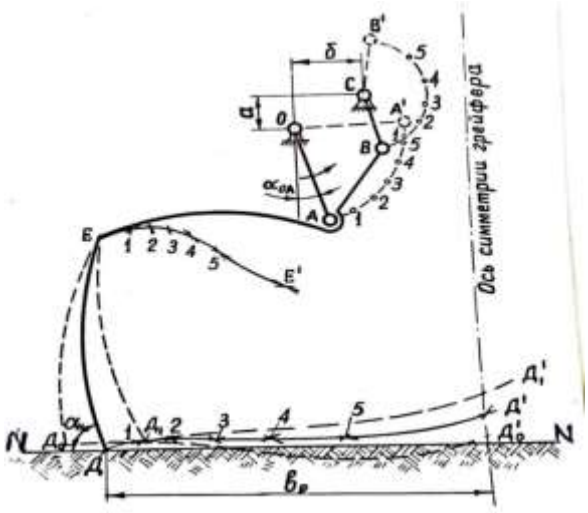

Fig.2. *Scheme to determine the ratio of the links of the grapple mechanism and the trajectory of the movement of the end of its tooth; D0-D1 - the trajectory of the tooth end; b-width of the opening of one jaw of the grapple; and b-coordinates of fixed points of the four-hinge mechanism.*

If the trajectory of the end of tooth D crosses the surface line of the NN area, then the teeth damage the coating of the area, above the NN line part of the material remains unselected, and only when moving the end of the tooth D parallel to the surface of the site, effective capture and increased completeness of the selection of raw cotton and other materials without damaging the coatings of the squares is ensured.

The ratio ofthe links of the grapple mechanism under study and their relative location were determined by the graphical method. The plans of the mechanism and the trajectory of the movement of the end of the tooth are constructed by the method of serifs [21-25].

According to the selected ratios of links, an experimental sample of a grapple with a jaw tooth length of 620 mm was made. (Fig. 3.)

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Fig.3. *Experimental grapple*

Laboratory and field tests were carried out on a drying and cleaning site with an asphalt coating when loading raw cotton and hay into tractor trailers. (Fig.4.) The height of the piles of materials was 1.5-2.0 m. with their diameter of 4.5-5 m., which corresponded to the width of the working area of the loader [26-30].

Fig.4. *Work of a loader with an experimental grapple on loading raw cotton into a trailer.*

As a result of the experiments, it was established:

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Conclusions and proposals

1) the use of an experimental grapple on the loading of loose lightweight agricultural materials eliminates the destruction of the coatings of loading areas, while maintaining the quality of cargo materials;

2) increases the completeness of selection to 95-98% and practically provides the capture of material from a layer of height found in the field, without reducing productivity compared to similar machines

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