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Review Article

Mathematical Justification of the Methodology for Improving the Efficiency of the Executive Mechanism of the Working Body of the Blade of the Bulldozer

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Abstract

The article proposes a method that provides the intensification of working processes carried out by the executive mechanism of the working body of the bulldozer blade, which is to rationalize the shape of the knife system of the executive mechanism of the working body of the bulldozer blade, also provides an innovative structural and kinematic scheme of the executive mechanism of the working body of the bulldozer blade with a removable cutting knife.

Keywords: Mathematical Model; Actuator; Agriculture; Bulldozer

Introduction

In the modern period of time (the beginning of the XXI- century), the scale of the use of some earth-building machines, which include bulldozers, is increasing dramatically.

Nowadays, it can be argued that bulldozers have become very common in the field of agriculture in recent years.

Bulldozers are used mainly for excavation, transport and planning works in all types of construction. Using these machines develop pits for the foundations of civil, industrial and agricultural buildings and structures, erect dams and develop channels in reclamation and hydraulic engineering construction, plan a plot of arable land for growing rice or other crops, construct a roadbed for roads and railways.

In the paper describes issues of improving the reliability and efficiency of the executive mechanisms of the bulldozer blade working body.

The analysis of the work of predecessors in the field of improving the operational reliability of the mechanism have done. The analysis of works in the field of improving the operational reliability of the executive mechanism of the working body of the mechanism have done, as well as have done an overview of the current state of research in the field of reliability, dynamics and strength of technical systems, including the complex mechanism, the reliability of measurements and optimization of the use of diagnostic tools. The analysis of works in the field of strength and reliability of technical systems of mechanisms is given.

Improving the efficiency of the executive mechanism of the working body of the blade of the bulldozer is achieved mainly by methods that ensure the reduction of the fracture resistance force of a portion of the soil mass when exposed to the executive mechanism of the working body of the bulldozer blade. The effect of reducing the resistance to destruction of a section of the ground mass is mainly achieved through the use of techniques that facilitate the introduction of the actuator of the bulldozer blade body into the section of the ground mass and the subsequent separation of lumps and soil particles from it.

The research methodology is based on a systems approach, in which the working body - the developing environment is considered as a single system of interconnected and interacting elements. Figure 1 shows the structural diagram of the effectiveness of the executive mechanism of the working body of the mechanism.

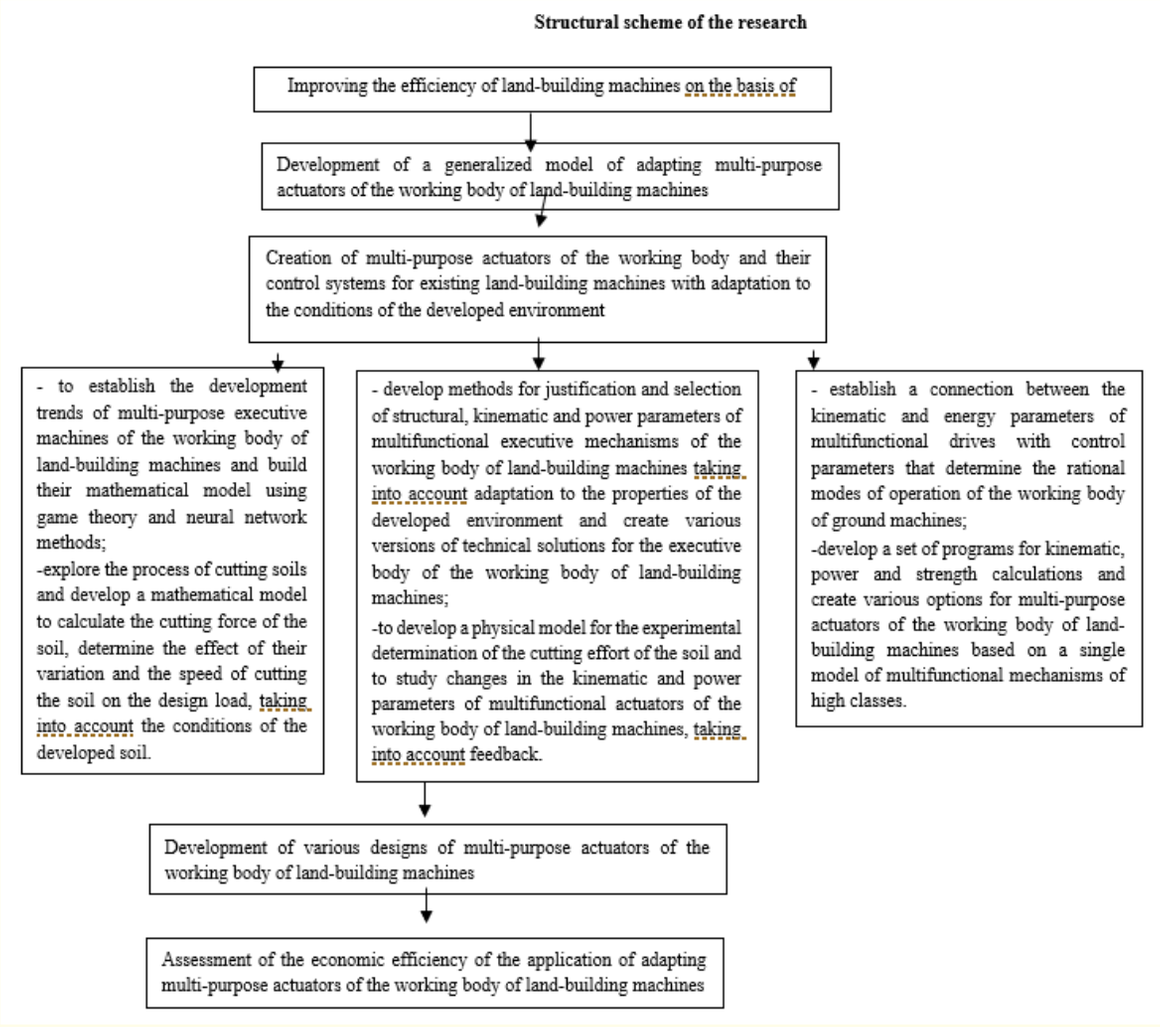

Figure 1: Structural scheme of the effectiveness of the executive mechanism of the working body of the mechanism

As a result of the analysis, the study poses the following interrelated tasks:

- Study of methods for assessing the reliability of the executive mechanism of the working body of the mechanism and the workload of their parts and assemblies;
- Research methods for processing experimental data and testing the actuator mechanism of the working body mechanism.

To improve the technical and economic indicators of the destruction of a section of the ground mass of the executive mechanism of the bulldozer blade working body, an innovative scheme of its design and operation is proposed (a positive decision to issue an innovation patent for the invention on application No. 1361 "Dozer equipment. Republic of Kazakhstan - Astana. 2015)[1].

Main part

The technical effect is achieved by the fact that to the bottom edge of the bulldozer blade attached quick release plate wedge-shaped cutting knife rigidly, the transverse axis of the lower base of which is horizontal and parallel to the upper outer horizontal surface of the destroyed part of the soil mass.

At the same time, the destruction of the area of the soil array of the executive mechanism of the working body of the bulldozer blade with a removable cutting knife is carried out by applying a force to it, causing deformation of the area of the soil array by cutting and tearing, the optimal position of the bulldozer blade with a removable cutting knife, determined by the angle of its installation, depending on the geometric and kinematic parameters of the Executive mechanism of the working body of the bulldozer blade with

a removable cutting knife without feedback and constructive parameters of the bulldozer blade with a removable cutting knife [2-3].

Adjustable installation angle of the blade of the bulldozer with a removable cutting knife is determined by the formula:

$$\omega = \alpha + \beta_0, \qquad (1)$$

where ω - variable (controlled) installation angle of the blade of the bulldozer with a removable cutting knife between a straight line connecting the outer upper and lower edges of the blade and a horizontal line of the outer transverse axis of the base of the rigidly mounted removable cutting knife of the blade of the bulldozer when the horizontal section of the array of soil is destroyed; α - variable angle between the line of the longitudinal axis of the pushing bar and the line connecting the hinges attaching the lower pushing bar to the blade of the bulldozer with a removable cutting knife, and the hinges of mounting the brace to the blade of the bulldozer with a removable cutting knife removable cutting knife, as well as design parameters of the blade of the bulldozer with a removable cutting knife, i.e. α =f (φ, ψ, δ, r, R, L, l), which is determined by the formula [1]:

$$\alpha = arccos\left(\frac{L^2+l^2}{2Ll} - \frac{R^2+r^2}{2Ll} + \frac{Rr}{Ll}\cos(\varphi - \psi) - \delta)\right), \qquad (2)$$

where δ – constant constructive angle between the line, which is a continuation of the longitudinal axis of the pushing beam, and the line of the longitudinal axis of the bracket, rad.; φ - the angle between the longitudinal axes of the pushing bar and bracket, rad.; ψ - the angle between the line connecting the hinges of the bracket, and the line connecting the hinge brace, rad.;

L- bracket length between push bar and brace, m; l- the distance between the hinge mounting pusher bar and brace to the blade of the bulldozer with a removable cutting knife, m; r- the length of the pushing bar between the hinges attaching it to the blade of the bulldozer with a removable cutting knife and the hinges attaching it to the bracket, m; R – the length of the brace between the hinges attaching it to the blade of the bulldozer with a removable cutting knife and the hinges attaching it to the bracket, m; β_0 - constant constructive angle between the straight line connecting the outer upper and lower edges of the blade of the bulldozer with a removable cutting knife, and the line connecting the hinges of the push bar and the crossbar to the blade of the bulldozer with a removable cutting knife, rad.

In this case, the maximum thickness of the layer (shavings) of a destructible horizontal section of the soil mass by the blade of a bulldozer with a removable cutting knife is determined by the formula:

$$H_{max} = \int_{-\infty}^{\infty} P(\omega)d\omega = 1, \qquad (3)$$

where H_{max} - the maximum thickness of the layer of the destroyed site of the array of soil by a bulldozer blade with rigidly established removable cutting knife, depending on the angle of installation of the bulldozer blade with a removable cutting knife ω and parameters of the executive mechanism of the working body of the bulldozer blade with a removable cutting knife, м; P(ω) – probabilities of formation of optimum thickness of a layer of the destroyed site of the massif of soil a bulldozer blade with a removable cutting knife [4-7].

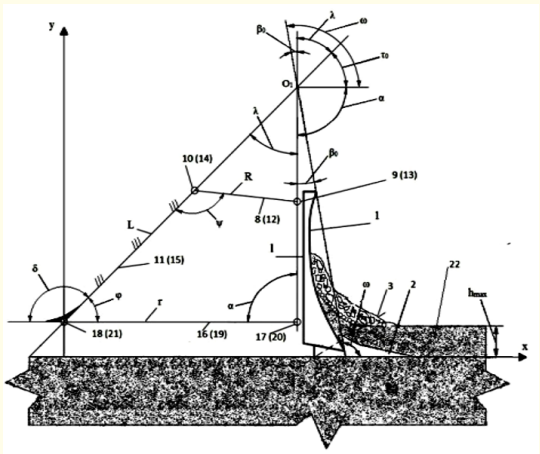

Figure 2: Innovative structural-kinematic scheme of the executive mechanism of the working body of the blade of a bulldozer with a removable horizontal cutting knife and scheme for determining the angle of destruction of a section of the soil mass by the blade of a bulldozer with a removable cutting knife and setting its optimum position depending on the physicomechanical properties of the destroyed section of the soil mass.

Conclusions

1. An integrated approach to the study of the interconnected system "working body - developed environment" allowed creating a new scientific direction of designing highly efficient, competitive, ensuring the operational reliability of the executive mechanism of the working body of the bulldozer blade with a removable cutting knife the mechanism of the working body of the blade of the bulldozer with a removable cutting knife, which received polo decision to issue an

innovation patent for an invention on application No. 1361 "Bulldozer Equipment". RK. Astana, 2015.

2. The scientific results obtained are a further development and generalization of well-known theoretical studies aimed at improving the operational reliability of the executive mechanism of the bulldozer blade working body with a removable cutting knife based on modern scientific and practical achievements, the introduction of which makes a significant contribution to the acceleration of scientific and technological progress in agriculture and construction.
3. Created mathematical model of the Executive mechanism of the working body of the bulldozer blade with a replaceable cutting knife and a method of assessing changes in its kinematic and power parameters, taking into account the adaptation to the destroyed area of the soil mass.

Bibliography

1. TT Kaiym., *et al*. "A positive decision to issue an innovative patent for an invention on the application No. 1361 "Bulldozer Equipment". Kazakhstan, Astana, (2015): 17.
2. TT Kaiym., *et al*. "Structural-kinematic synthesis of the parameters of the adaptive actuating mechanism of the working bodies of hoisting-and-building and road machines". *Scientific Journal* 2 (2013): 17-22.
3. Kayim T. "Adaptable multipurpose working bodies of construction and road machinery". (1998): 148.
4. TT Kaiym., *et al*. "Mechanization of overloading work on transport". (2002): 323.
5. IB Flerov. "Placers/Mountain Encyclopedia". (Ortia-Sociosphere) M: Soviet Encyclopedia 4 (1989): 400.
6. IF Larin Peat. "Mountain Encyclopedia". (USSR-Jashma) - M: Soviet Encyclopedia Publishing House 5 (1991): 166-171.
7. TT Kaiym., *et al*. "Justification and selection of parameters for the adaptive suspension of the attachment equipment of the bulldozer". Collection of materials of the international conference dedicated to the 90th anniversary of Academician O.D.Alimov - Bishkek (2013): 31-35.

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