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Determination of MASS MOVEMENT portions Bread

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Presented research portion of the meat mass movement in the gap-beater concave. It was established equation of motion portion of the meat massAnd constructed a graph of the change in angular velocity portion of the evening mass on the angle of rotation of the drum threshing combine harvester.

Threshing drum, concave, a portion of the meat mass, equations of motion.

Formulation of the problem. To date, the effectiveness of all work associated with collecting crops depends on the combine harvester - the main cleaning machines. The main part of every combine harvester is the threshing-separating device, which depends on the efficiency performance of the machine. While moving the meat supply in the gap threshing-separating device, it has various forces that affect the quality of threshing.

Therefore, in this study as the basis of theoretical studies put solving the problems associated with finding the equations of motion portion of the evening mass in the gap-beater concave.

Analysis latest research. The movement of the grain mass between drum and concave threshing was investigated by many authors [1-5]. The authors found that the meat mass is exposed, normal compression forces, the forces of friction that occurs in the area contact between the whip and the portion of the grain mass and aimed at a tangent to the drum in the direction of rotation; friction, which occurs in the contact zone between the portion of the grain mass and bar deck, aimed in the direction opposite to the movement of the grain mass.

In [3] stated that treadeth grain threshing machine for the first time is likely due to blows with whips for ears and partially dragging them between elements of drum and deck. Also, the authors suggest that the meat mass is moving in the threshing gap with a constant average speed and the appropriate thickness. Thus, the forces that are determining to undergo the process of threshing and separation time remain constant.

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the purpose ofresearch is to determine the equation of motion portion of the meat mass and changes depending on the angular velocity of the grain mass beater angle of rotation.

Results. Consider the movement portion of the evening mass, which accounts for one beat a concave (Fig. 1). To determine the law of motion portions of meat mass use the following assumptions:

1. We consider the portion of the meat mass to the one scourge that is above the concave.
2. As the gap δ between drum and concave is insignificant compared to the drum radius R, the dynamic calculations neglect it and assume that all the forces applied to the meat mass exerted a circle speech whips.

In and th (i = 0, ..., n) portion of the meat supply in power threshing gap are: normal compressive strength $N_б$ beat beater from the side; the driving force (the friction between the drum and bylom portion of meat weight), which is tangential to the circle appearances whips toward the drum $f_б \cdot N_б$; normal compression force on the part concave $\overline{N}_n$ Which is directed opposite to the force $N_б$; friction between the portion of the meat mass and a concave deck bar, which is aimed at a tangent to the curved shape of the deck in the opposite movement of the grain mass $f_n \cdot N_n$; gravity portion of the grain mass mg; centrifugal force acting on a portion of the meat mass during its rotation.

The kinetic energy portion of the meat mass, which accounts for one beat a drum at:

$$T = \frac{1}{2} \cdot m(\varphi) \cdot V_c^2 = \frac{1}{2} \cdot m(\varphi) \cdot R^2 \cdot \omega^2, \tag{1}$$

where: $m(\varphi)$ - Mass portion of the grain supply, which accounts for one beat in a drum, which is variable, depending on the rotation coordinates of the center of mass of bread weight φ; V_c - Linear velocity of the mass center portion of the meat mass, which accounts for one beat; R - radius beater circle appearances Bill; ω - Angular speed of rotation of the center of mass portions of meat mass per one was the axis of rotation A.

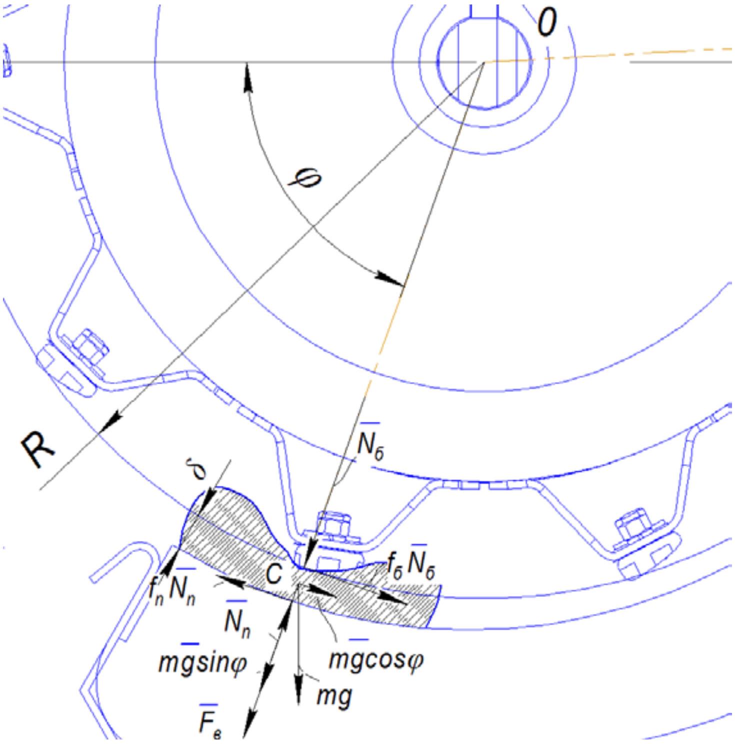

Fig. 1. Scheme of forces acting on the portion of the grain mass.

The equations of motion portion of the meat mas

$$\frac{\partial T}{\partial \varphi} = \sum_{i=1}^{n} M_{oi} \,, \tag{2}$$

where M_{oi} - And the first time (i = 1,2, ..., n) forces the axis of rotation, acting on a portion of the meat mass; n - number of forces.

$$\frac{\partial T}{\partial \varphi} = m(\varphi) \cdot R^2 \cdot \frac{d\omega}{d\varphi} + \frac{1}{2} \cdot \frac{dm(\varphi)}{d\varphi} \cdot R^2 \cdot \omega^2 \,; \tag{3}$$

$$\sum_{i=1}^{n} M_{oi} = f_б \cdot N_б \cdot R - f_n \cdot N_n \cdot R + m(\varphi) \cdot g \cdot R \cdot \cos(\varphi) \,. \tag{4}$$

After substituting dependencies (3) and (4) in equation (2) Ne-gymayemo:

$$m(\varphi) \cdot R^2 \cdot \frac{d\omega}{d\varphi} + \frac{1}{2} \cdot \frac{dm(\varphi)}{d\varphi} \cdot R^2 \cdot \omega^2 = f_б \cdot N_б \cdot R - f_n \cdot N_n \cdot R + m(\varphi) \cdot g \cdot R \cdot \cos(\varphi) \,. \tag{5}$$

To determine the reaction concave on meat weight N_n will design all the forces acting on the weight of the meat on the normal connecting the center of rotation O of the center portion of the meat mass weight S. bringing will have:

$$F_в + m(\varphi) \cdot g \cdot \sin(\varphi) + N_б - N_n = 0 \,. \tag{6}$$

The centrifugal force acting on a portion of the meat mass is determined by the relationship:

$$F_в = \frac{m(\varphi) \cdot v^2}{R} = m(\varphi) \cdot \omega^2 \cdot R \,. \tag{7}$$

Substituting expression (7) in equation (6), as a result we get:

$$m(\varphi)\cdot\omega^2\cdot R+m(\varphi)\cdot g\cdot\sin(\varphi)+N_б-N_n=0. \quad (8)$$

From this equation we find:

$$N_n=m(\varphi)\cdot\omega^2\cdot R+m(\varphi)\cdot g\cdot\sin(\varphi)+N_б=0i. \quad (9)$$

Substituting (9) into the equation (5), we get:

$$m(\varphi)\cdot R^2\cdot\frac{d\omega}{d\varphi}+\frac{1}{2}\cdot\frac{dm(\varphi)}{d\varphi}\cdot R^2\cdot\omega^2= \quad .(10)$$
$$f_б\cdot N_б\cdot R-f_n\cdot\left[m(\varphi)\cdot\omega^2\cdot R+m(\varphi)\cdot g\cdot\sin(\varphi)+N_б\right]\cdot R+m(\varphi)\cdot g\cdot R\cdot\cos(\varphi)$$

On the drawing portion of the meat supply in the period of threshing drum, concave content of the grain in the grain mass decrease. At the beginning of the movement portion will have a lot:

$$m_0=\rho\cdot l\cdot h_0\cdot\Delta\alpha\cdot R, \quad (11)$$

Where: ρ - density of the grain mass; l - length of the rod (drum); h0 - the thickness of the meat mass flow at the inlet of threshing machine; R - radius beater.

Considering equation (11) we obtain the dependence of the weight portion of the meat mass:

$$m[\varphi]=\frac{m_0}{K_c+K_з}\cdot\left[K_c+K_з\cdot e^{-a\cdot(\varphi-\varphi_0)}\right] \quad (12)$$

where Ks, Ks - factors that take into account the content as straw and grain of the meat in bulk; and - factor screening ability concave (determined experimentally).

Prodyferentsiyuvavshy equation (12) we get:

$$\frac{dm[\varphi]}{d\varphi}=-\frac{m_0\cdot K_з\cdot a}{K_c+K_з}\cdot e^{-a\cdot(\varphi-\varphi_0)} \quad (13)$$

The value of the normal response to the scourge of the grain mass can be determined following relationship:

$$N_б=c\cdot b\cdot l\left(h_0-\delta_n-(\delta_0-\delta_n)\cdot\left(\frac{\varphi_n-\varphi}{\varphi_n-\varphi_0}\right)^2\right) \quad (14)$$

Given (12) - (14) and making some transformations and reductions obtain the equations of motion of the grain mass per one scourge:

$$\frac{m_0}{K_c+K_з}\cdot\left[K_c+K_з\cdot e^{-a\cdot(\varphi-\varphi_0)}\right]\cdot\left[R\cdot\frac{d\omega}{d\varphi}+f_n\cdot\omega^2\cdot R+g\cdot\left(f_n\cdot\sin(\varphi)-\cdot\cos(\varphi)\right)\right]+ \quad (15)$$
$$+(f_n-f_б)\cdot c\cdot b\cdot l\left(h_0-\delta_n-(\delta_0-\delta_n)\cdot\left(\frac{\varphi_n-\varphi}{\varphi_n-\varphi_0}\right)^2\right)+\frac{1}{2}\cdot\left(-\frac{m_0\cdot K_з\cdot a}{K_c+K_з}\cdot e^{-a\cdot(\varphi-\varphi_0)}\right)\cdot R\cdot\omega^2=0$$

Equation (15) is a non-linear differential equation of the first order, so the interpretation will use numerical method prof. GG Baranov [1].

According to the method of (10) in the present form:

$$2\cdot m(\varphi)\cdot d\omega+\omega\cdot dm(\varphi)=$$
$$=\frac{2}{\omega\cdot R}\cdot\left\{N_б\cdot(f_б-f_n)-m(\varphi)\cdot\left[g\cdot\left(f_n\cdot\sin(\varphi)-\cdot\cos(\varphi)\right)f_n\cdot\omega^2\cdot R\right]\right\}d\varphi. \quad (16)$$

Based on the absence of singularity points and special breaks, replacing in equation (11): $d\varphi = \Delta\varphi$ - Integration step; $dm(\varphi) \approx m_{i+1} - m_i$; $d\omega = \omega_{i+1} - \omega_i$; $\Delta\varphi = \varphi_{i+1} - \varphi_i$ get:

$$2 \cdot m_i \cdot (\omega_{i+1} - \omega_i) + \omega_i \cdot (m_{i+1} - m_i) =$$
$$= \frac{2}{\omega_i \cdot R} \cdot \left\{ N_{бi} \cdot (f_б - f_n) - m_i \cdot \left[g \cdot \left(f_n \cdot \sin(\varphi) - \cdot \cos(\varphi) \right) + f_n \cdot \omega_i^2 \cdot R \right] \right\} \Delta\varphi_i . \quad (17)$$

where: $\varphi_i, \omega_i, m_i, N_{бi}$ - In accordance with the angular coordinates, angular velocity, mass portion of the meat mass and normal pressure on it from the side of the drum in position and (i = 0,1, ..., n); n - the number of points of calculation; φ_{i+1}, ω_{i+1}, m_{i+1} - In accordance with the angular coordinates, angular velocity and weight portions meat supply in position and +1.

Solving equation (17) with respect to ω_{i+1} get function changes in the angular velocity of each subsequent position at the origin of all concave areas:

$$\omega_{i+1} = \frac{1}{2} \cdot \omega_i \cdot \left(3 - \frac{m_{i+1}}{m_i} \right) + \frac{1}{m_i \cdot \omega_i \cdot R} \times$$
$$\times \left\{ N_{бi} \cdot (f_б - f_n) - m_i \cdot \left[g \cdot \left(f_n \cdot \sin(\varphi) - \cdot \cos(\varphi) \right) + f_n \cdot \omega_i^2 \cdot R \right] \right\} \Delta\varphi_i , \quad (18)$$
$$i = 0, 1, 2, ..., n$$

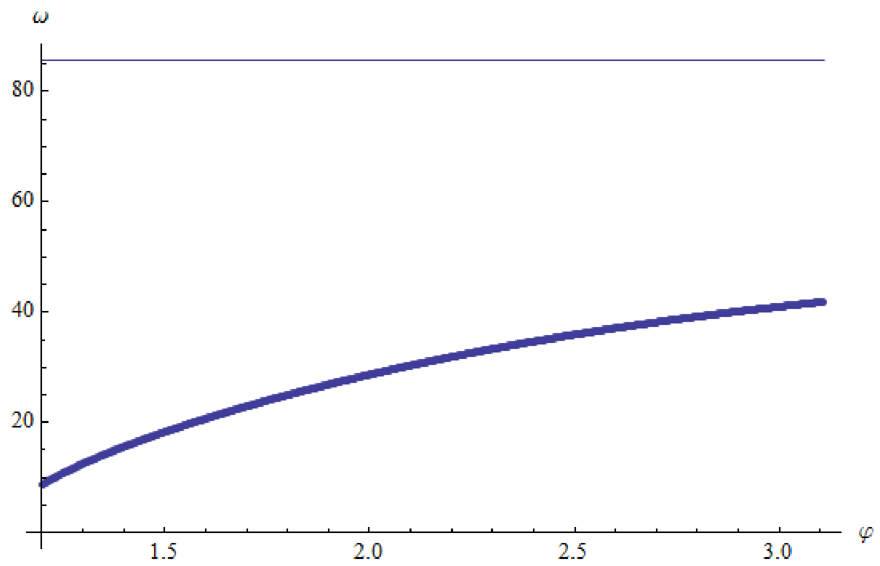

Fig. 2. Graph of the angular velocity portion of meat mass (culture - wheat) the angle of rotation of the drum.

With this method, as well as package Mathematica solve equations (15) and construct a graph of the angular velocity of the grain mass portions relative to the angle of rotation of the drum (Fig. 2).

Conclusion. The equations of motion portion of the meat supply in the gap threshing combine harvester. Based on this equation was constructed a graph of the change in angular velocity portion of the meat mass beater angle of rotation. After analyzing the present schedule, determined that the angular velocity of the grain mass portion size is variable and increases with the passage portions threshing gap from the beginning of the entry and the exit.

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Studies Predstavlenы movement portsyy hlebnoy Fire-proof compounds in the gap molotylnыy drum podbarabanya. That was the equation of motion set portsyy hlebnoy Fire-proof compounds, as well as graphics postroen dependence Changed uhlovoy Speed portsyy hlebnoy Fire-proof compounds from the corner twist beater zernouborochnoho combine.

Molotylnыy drum podbarabanya, portsyya hlebnoy Fire-proof compounds, equation of motion.

The research of grain mass's motion in concave gap is conducted. Motion's equation of grain portion was established. Also dependency's graph of change grain portion's angular velocity was plot.

Threshing drum, concave, grain portion, motion's equation.