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Determining The Quantities Knives of The Chopper of Cotton Stems

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Abstract. The article gives the importance of grinding cotton stalks before chilly plowing, which helps to increase soil plowing and urazhinost. For this purpose, a cotton stem shredder was developed and the results of a theoretical study of the working process of a cotton shredder are given.

Keywords. Cotton, stems, chopper, knives, molds, cutting.

In the advanced cotton farms of the Republic, Karakalpakistan after harvesting raw cotton grinds cotton stalks. Grinding cotton stalks before fallow ploughing helps to increase the fertility of the arable layer and yield [1].

To carry out this operation, the KV-3.6A and KV-4 machines were previously used. In recent years, these machines have not been produced, are morally obsolete and do not meet modern requirements.

To ensure the quality of work, i.e. to increase the completeness and fineness of the grinding of the stems, a shredder with improved two disk working units has been developed [2,3]. Each disc working unit consists of two pairs of knives 1 and 4, fastened with a cross on disk 3, horizontally mounted at the lower end of the vertical shaft of rotation 5 (Fig. 1). In operation, each disc working unit covers two rows of cotton stalks.

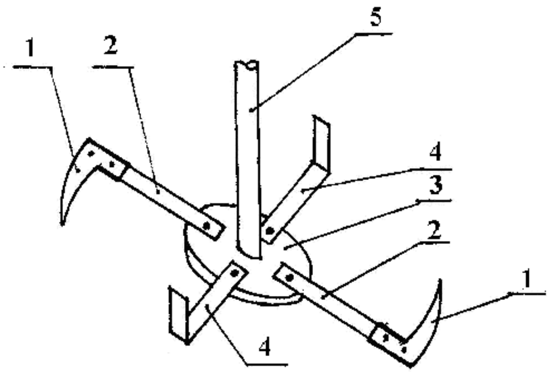

Fig.1. Disc working unit of the cotton stem chopper: 1-knives in the form of a scythe-cast; 2-hangers; 3-disc; 4-knives "G" shaped; 5-vertical rotation shaft.

The first pair - the main knives 1, made in the form of a scythe-cast and they are fastened to the disk 3 using a hanger 2, the second - auxiliary 4, made in the form of a "G" shaped shape. The radius of rotation of the auxiliary knives 4 is less than the radius of rotation of the main knives - scythes 1.

The knives of the disc working unit rotate in a horizontal plane, and they perform translational - v_a and angular - ω velocity.

The working process of the disk working node of the chopper includes two phases: cutting the stem and grinding it into small pieces. In the process of movement of the unit, the front beam 6 of the shredder

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frame tilts the stems in the direction of movement (Fig. 2). As a result of the rotational action of the scythe, the cut occurs with a slip in the lower surface part of the stem. Due to the frictional force that occurs when cutting with sliding, the stem is transferred by oblique-casting to the middle of the rows, i.e. to the zone of rotation of auxiliary knives made in the form of a "L" shape. Repeated impact actions of these knives on the stem occur both in the horizontal and in the vertical plane, which ensures high-quality grinding.

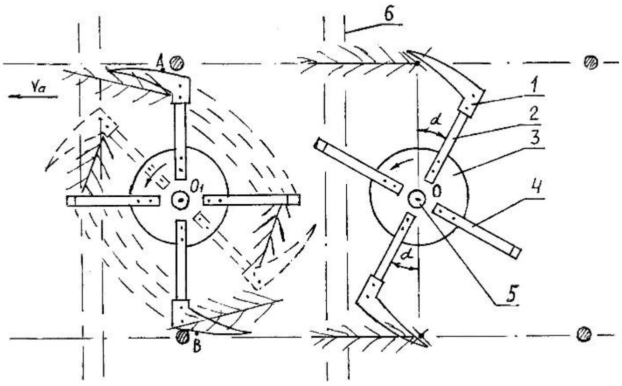

Fig.2. Scheme of the working process of the disk working unit of the cotton stem chopper: 1-knife (scythe-cast); 2-hanger; 3-disc; 4-knife "G" shaped; 5-vertical rotation shaft; 6-front beam of the shredder frame.

The equations and the shape of the trajectory of the knives (scythes and the "G"shaped knife) are identical. Therefore, to draw up the equations of motion, consider the motion of the extreme point ***A*** of the scythe-litovka.

In the process of work, the scythe makes a complex movement: it rotates together with the disk of the working unit (angular velocity **ω**) and moves at the speed ***Va*** of the movement of the unit.

The cutting speed of the stem is characterized by the trajectory of the scythe, which is an elongated cycloidu-trochoyda (Fig. 3). According to [4], the coordinates of any of its points are expressed by the following equations:

$$X_A = V_a t + R\sin\varphi; \quad (1)$$

$$Y_A = R\cos\varphi. \quad (2)$$

where: R is the radius of the circle described by the scythe when the disk working unit rotates; $\varphi = \omega t$ is the angle of rotation of the scythe from the initial position; ω is the angular velocity of the disk working node; t is the time of rotation of the scythe by the angle *of* φ; Va is the translational velocity of the unit.

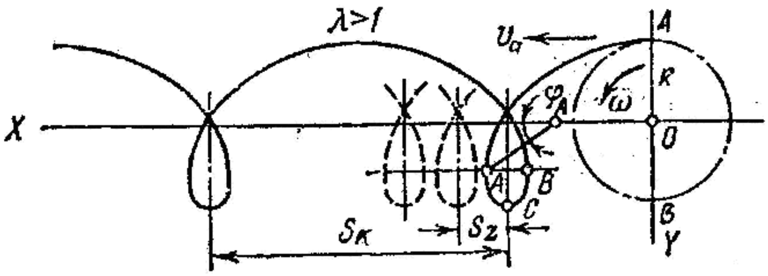

Fig.3.The trajectory of movement of the extreme point of the knife (scythe-litovka) of the chopper.

The cutting speed is equal to the absolute velocity of the outer point ***A*** of the scythe:

$$V_c = \sqrt{V_x^2 + V_y^2}, \quad (3)$$

where: Vx and Vy are projections of the velocities of this point on the axis of coordinates, which can be obtained by differentiating equations (1) and (2) over time:

$$V_x = \frac{dx}{dy} = R\omega\sin\omega t + V_a = V_p\sin\omega t + V_a; \quad (4)$$

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$$V_y = \frac{dx}{dy} = R\omega\cos\omega t = V_p\cos\omega t, \quad (5)$$

where: *Bp=Rω* is the circumferential velocity of the disk working unit with the scythe."

After putting *Vx* and *Vy* in equation (3), we get:

$$V_c = \sqrt{V_a^2 + 2V_aV_p\sin\varphi + V_p^2}. \quad (6)$$

Equation (6) shows that the cutting speed is a variable value and varies depending on the angle of rotation of the scythe.

At two positions *φ=0* and *φ=π* its absolute velocity is equal to the algebraic sum of the velocities *Bp* and *Va* and is directed tangentially to the circumference of the disk working node. Consequently, at the cutting site of the stems, the speed of the scythe-casting during the direct rotation of the working node reaches the maximum value:

$$V_{c1} = V_p + V_a, \quad (7)$$

and on the reverse rotation section, the minimum value:

$$V_{c2} = V_p - V_a. \quad (8)$$

One of the main technological parameters of the stem grinder is the length of cutting the stems, which determines the degree of grinding of cotton stalks.

The length of cutting stems with knives rotating in one plane is equal to the relative displacement of their trajectory:

$$S_\kappa = V_a t_z, \quad (9)$$

where: $t_z = \frac{\varphi_z}{\omega}$ tz is the time during which the knife is rotated at an angle equal to the angle between adjacent knives. If there is a z of knives in the plane of rotation of the disc working unit , then the angle $\varphi_z = \frac{2\pi}{z}$.

Then time a (10) $t_z = \frac{2\pi}{z\omega}$, $S_\kappa = \frac{2\pi V_a}{z\omega} = \frac{2\pi R V_a}{z V_p}$.

Analysis of the expression (10) shows that the length of stem segments depends on the radius of the disk working unit *R*, the number of knives set in the plane of rotation, and the ratio of the translational speed of the unit to the circumferential velocity of the disk working unit.

If the value of the critical cutting speed *Vc* is known, then at a given value *Sk* equation (10) allows you to determine the basic design and mode parameters of the disc working unit of the stem grinder. Replacing it with *the* speed *of Vc1* from the expression (7) we find the diameter of the circumference of rotation of the disk working unit:

$$D_p = \frac{S_\kappa z(V_c + V_a)}{\pi V_a}, \quad (11)$$

and the shaft speed of the disk working node will be

$$n_p = \frac{60(V_c + V_a)}{\pi D_p}. \quad (12)$$

Findings.

The results of the study of the working process of the cotton shredder allow you to find its basic structural and kinematic parameters.

Guzapoyany maidalagychnyng iszhayeny isertléý natyzhasy uning asosy constructiv-kinematik parameterlarin anaklashiny imkonin berady.

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