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Influence of Eccentric Pulleys on Increasing the Efficiency of Cleaning Cotton from Small Garbage

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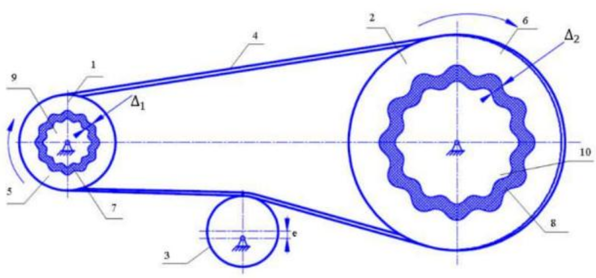
ABSTRACT

The article carried out a lot of scientific research on cleaning cotton from large and small impurities, but increasing the cleaning efficiency by changing the angular speeds and rotational speeds of the working bodies of cotton ginning machines is a new direction. The article carried out a theoretical study of the interaction of the drive shaft coming out of the engine of the cotton gin and the eccentric installed between the drive shafts connecting the drive shafts on the cleaning efficiency.

Introduction. In mechanical engineering, the role of eccentric pulleys is incomparable, as an element of transmissions of various machines and mechanisms that ensure the rotation of shafts at the same speed and at different angular speeds, especially in light and textile machines.

We use eccentrics to ensure the necessary absorption of the complex values of torques and angular velocities of the driving and driven shafts of the pulleys in the transmission of the cotton gin, and thereby provide the required oscillations of the angular velocities of the pulleys with the required amplitude and frequency. To do this, consider a belt drive consisting of a driving and driven pulleys, a belt encircling them and an eccentric tension roller placed under it.



The belt drive contains composite drive 1, driven pulleys 2, eccentric tension roller 3 and belt 4. Composite drive 1 and driven pulleys 2 contain rims 5 and 6, elastic elements (rubber) 7,8, the inner and outer surfaces of which are made wavy. At the same time, the corresponding surfaces of the rims 5 and 6 and the hubs 9 and 10 are made of fibrous.

Fig.1. General scheme of the proposed design of the belt drive

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The thickness Δ_2 of the elastic element 9 of the driven pulley 2 is chosen greater than the thickness Δ_1 of the elastic element 7 of the drive pulley 1 and the following ratio is fulfilled: $e=\Delta_2-\Delta_1$; e-eccentricity of the tension roller.

Belt drive works as follows. The drive pulley 1, receiving rotational motion from the drive motor (not shown in Fig. 1), transmits the movement to the driven pulley 2 through the belt 4, and then, in contact with the belt 4, to the eccentric tension roller 3. The driven pulley 2 is directly connected to the working organ of the technological machine. When performing the technological process, a variable load (resistance) can be transferred to the driven pulley 2, and the eccentricity of the tension roller leads to fluctuations in the torque and angular velocity of the shaft and the hub 10 rigidly connected to it. The peak values of the torque fluctuations of the hub 10 will be absorbed by the elastic element 8 and accordingly, the rotation of the rim 6 in the pulley 2 will rotate with the required more unevenness. Some part of the uneven rotation of the pulley 2, due to the variability of the technological load to the eccentricity of the idler, will be absorbed by the belt 4, and the rim 5 of the pulley 1 will rotate with the required unevenness. Further, fluctuations in the angular velocity CO and the torque of the rim 5 of the pulley 1 will be additionally absorbed by the elastic element 7 and the rotation of the hub 9, thereby the drive shafts and the rotor of the electric motor will also rotate with the necessary unevenness. In this case, the choice of ratio will be

$=\Delta_2-\Delta_1$ (1)

provide the necessary uneven rotation of the pulleys 1 and 2. In this case, the greater the torque, the greater should be the deformation of the elastic element. This determines the choice of thicknesses Δ1 and Δ2 of the elastic elements 7 and 8. This ensures a large absorption of peak values of load fluctuations due to the large deformation of the elastic element 8 of the driven pulley 2 and, accordingly, less absorption of peak values of load fluctuations due to less deformation of the elastic element 7 of the drive pulley 1. But their difference will be equal to the value of the eccentricity. This ensures the required frequency and amplitude of oscillations of the angular velocities and torques of the transmission pulleys.

The recommended belt drive ensures the repayment of the peak values of fluctuations of the moments to the angular speeds of the transmission pulleys, and also provides the necessary torsional vibrations with the required amplitudes and frequencies, allowing the uniformity of the technological processes [1].

An eccentric is - (Latin ex centro - from the English - "from the center"), a disk (cylindrical surface) or a disk sector mounted on a rotating shaft so that the axis of rotation of the disk is parallel, but does not coincide with the axis of rotation of the shaft, to convert rotational motion into translational. The distance between the axes is called the eccentricity.

Eccentricity is a numerical characteristic of a conic section, showing the degree of its deviation from a circle. Usually denoted .

The eccentricity is invariant under plane motions and similarity transformations Fig.2.

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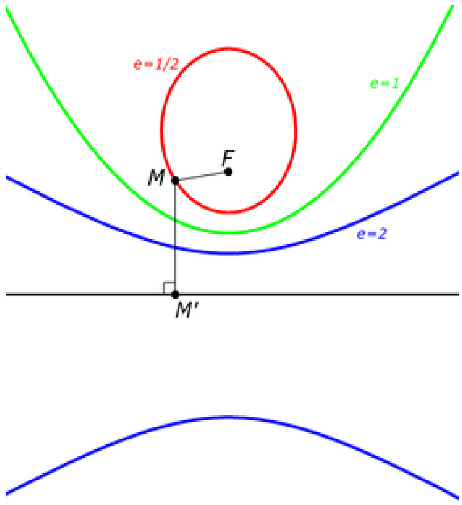

Fig.2. The eccentricity model. Ellipse (e=½), parabola (e=1) and hyperbola (e=2) with fixed focus F and directrix: *FM=e MM′*

All non-degenerate conic sections, except for a circle, can be described in the following way: we choose a point *F* and a line *d* on the plane and set a real number >0; then the locus of points *M*, for which the ratio of the distances to the point *F* and to the line d is equal to , is a conic section; that is, if *M′* is the projection of *M* onto *d*, then

FM=MM′ (2)

This number *e* is called the eccentricity of the conic section. The eccentricity of a circle is by definition 0.

Where, the point *F* is called the focus of the conic section;

the line *d* is called the directrix.

The conic section, one of the foci of which is located at the pole, is given in polar coordinates by the equation:

$$r = \frac{l}{1 - e\cos\varphi} \qquad (3)$$

where *e* is the eccentricity and *l* - is another constant parameter (the so-called focal parameter).

It is easy to show that this equation is equivalent to the definition given above. In essence, it can be used as an alternative definition of eccentricity, perhaps less fundamental, but convenient from the analytical and applied points of view. In particular, it clearly shows the role of eccentricity in the classification of conic sections and in a certain way further clarifies its geometric meaning [4, 5].

It is worth noting that, depending on the eccentricity, it will turn out:

for *e*>1 it is a hyperbola. The greater the eccentricity of the hyperbola, the more its two branches look like parallel straight lines;

for *e*=1 it is a parabola;

for 0≤*e*<1 — ellipse;

for a circle, *e*=0.

We have =Δ_2-Δ_1, where Δ_2 and Δ_1 are the thicknesses of the elastic elements [6]

In Fig.3. the test area (a) and the kinematic diagram of the drive of the first section of the CUCG (combined universal cotton gin) unit are shown. A feature of the CUCG unit is the combined cleaning of raw cotton in several repetitions [7].

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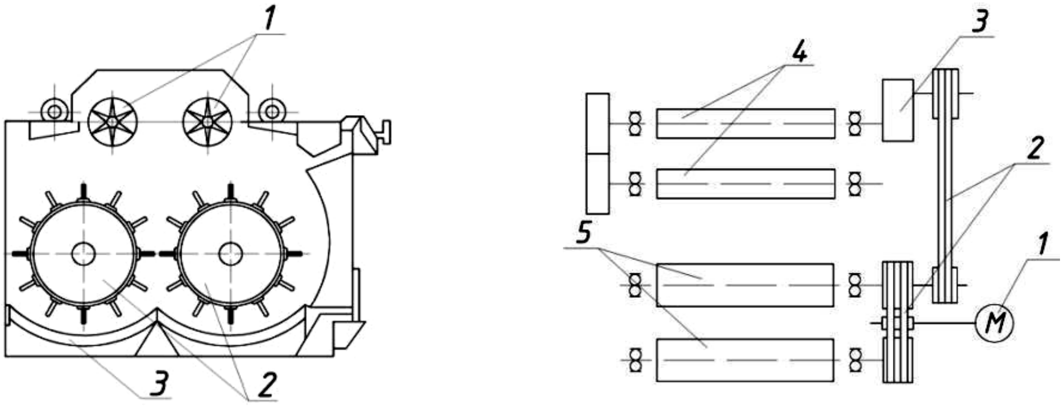

a

1-feed rollers; 2 peg drums; 3 mesh surface

b

1- electric motor; 2- belt drives; 3-variator; 4- feed rollers; 5 peg drums

Fig.3. Test area (a) and kinematic diagram of the drive of the first section of the CUCG unit (b)

In conclusion, we can say that the results of comparative production tests of the design of the belt drive in the USK cleaner from small impurities are made in the recommended design with a drive pulley and a belt bushing. The tension roller is also made with a belt element. Production tests were carried out on the 1st and 2nd production lines for cleaning cotton raw materials in the UCC cleaner. The tests were carried out using hand-picked cotton raw materials of the 2nd grade "Namangan-77" and "Porlok". It has been observed that the contamination of cotton raw materials strongly affects the cleaning efficiency [8].

In the course of tests, the design of the belt drive of the UHK brand lint drum cleaner of cotton raw materials showed high reliability and stable operation. The test results showed that the cleaning efficiency increased by an average of 7.05% compared to the current version of the peg drum.

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