STUDY OF GEAR RATIO INCREASE IN LEADING STAR CHAIN TRANSMISSION

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Abstract
Formula is brought in article for determination of unevenness transmission relations chain issue with adjuster device and component driven member by asterisk, graphic dependencies and recommended importances a parameter.

Keywords: Chain drive, star with flexible element, tension, kinematics, deformation, angle of rotation, transmission ratio, transmission ratio coefficient no uniformity, movement coefficient.

Introduction

In chain transmissions, the transmission ratio is determined by the ratio of the angular speeds of the leading and driven sprockets [1,2].

The driving star is structurally prepared, in which the belt element is subjected to rotational deformation, according to Fig. 1:

$$\varphi_2 = \varphi_2' \pm \Delta\varphi_2 \text{ or } \omega_2 = \omega_2' \pm \Delta\omega_2 \quad (1)$$

here, φ_2, ω_2 - actual yaw angle and angular velocity of the driven star, φ_2', ω_2' - turning angle and angular speed of the driven sprocket without taking into account the belt element, $\varphi_2, \Delta\omega_2$ - change of angle of rotation and angular speed due to deformation of belt element. Angular velocity of the driven star:

$$\omega_2 = \frac{\omega_1 r_1}{r_2} \cdot \frac{\cos\varphi_1}{\cos(\varphi_2' \pm \Delta\varphi_2)} \quad (2)$$

If we differentiate the resulting (2) with respect to time, the expression for determining the angular acceleration of the leading star is obtained:

$$\varepsilon_2 = \frac{d\omega_2}{dt} = \frac{\omega_1^2 r_1}{r_2 u_{12}} \cdot \left[\frac{tg\varphi_2' \cos\varphi_1 - u_{12} \sin\varphi_1}{\cos^2(\varphi_2' \pm \Delta\varphi_2)} \right] \quad (3)$$

here,
$$u_{12} = \frac{\omega_1}{\omega_2' \pm \Delta\omega_2}$$

So the maximum and minimum gear ratios for the chain drive in question are as follows:

$$u_{12}^{\max} = \frac{\omega_1}{\omega_2' - \Delta\omega_2}; \quad u_{12}^{\min} = \frac{\omega_1}{\omega_2' + \Delta\omega_2} \quad (4)$$

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The average value of the transmission ratio:

$$u_{12}^{o'r} = \frac{\omega_1 \omega_2'}{\omega_2'^2 - \Delta\omega_2^2} \quad (5)$$

The coefficient of unevenness of the transmission ratio of the chain drive:

$$\delta_{u_{12}} = \frac{u_{12}^{\max} - u_{12}^{\min}}{u_{12}^{ўр}} = \frac{2\Delta\omega_2}{\omega_2'} \quad (6)$$

So, the law of motion of the driving link in a chain transmission with a leading star and a tension roller is basically ω_1, U_{12} or $\Delta\omega_2$ depends on. The transmission function of a chain drive is variable and directly depends on the change in the angular velocity of the driven sprocket. For the chain drive considered, Figure 2 shows graphs of the dependence of the angular velocity of the driven sprocket on the angle of rotation of its chain link. Angle of rotation φ_2 with its army ω_2 also increases. In this case, as the radius of the leading star increases, the angular velocity ω_2 decreases. The recommended cut is for the chain drive installed on the grinder ω_2 of $32 \div 35 c^{-1}$ the radius of the leading star to provide the values $0{,}055 \div 0{,}065 м$ It is advisable to do so.

According to the expression (2) given above, the transfer function changes in the range of certain values, that is, it has maximum and minimum values. The main reason for this is due to the change in angular velocity due to the deformation of the belt element in the driven sprocket. Figure 3 shows the maximum and minimum values of the chain drive transmission function depending on the change in angular speed of the star.

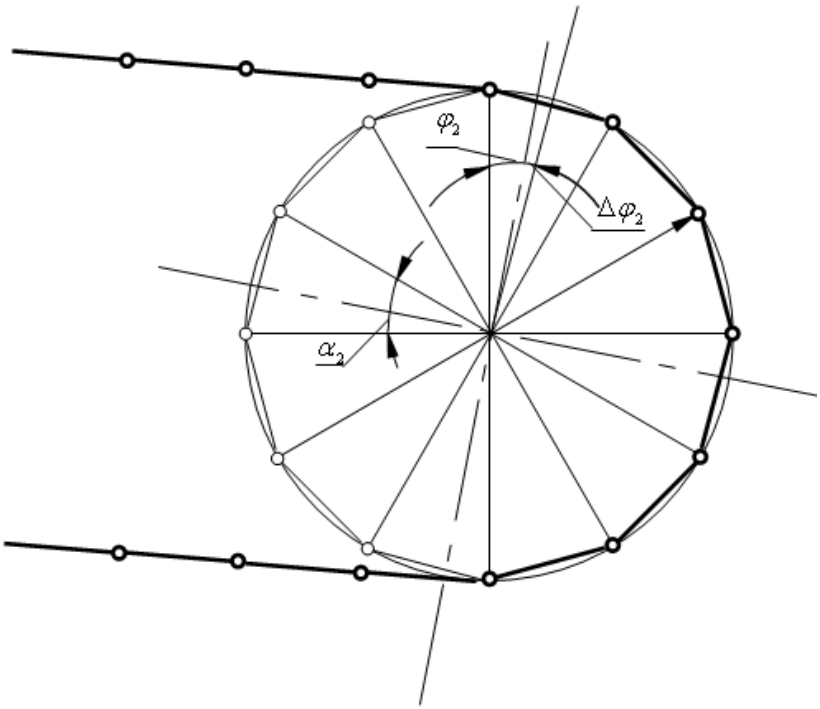

Figure 1. Calculation scheme of the turning angle of the driven star

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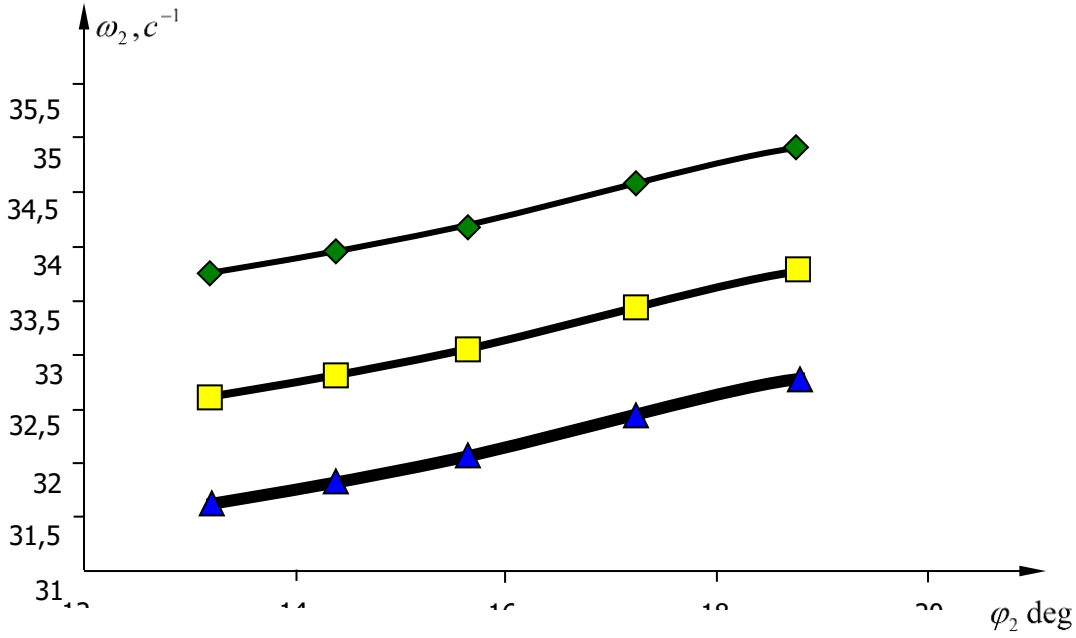
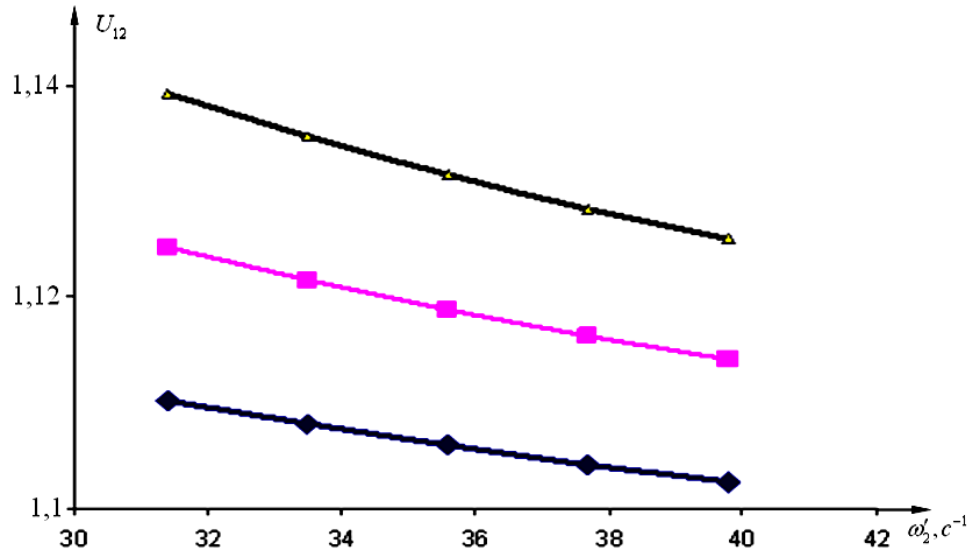


here, - $r_2 = 0{,}05m$; - $r_2 = 0{,}055m$; - $r_2 = 0{,}06m$

Figure 2. Graphs of the dependence of the angular speed of the driven star on the value of the angle of coverage of the chain link.

It is known that small changes in the transmission function ensure the smooth operation of a chain drive, that is, the adaptive meshing of the chain and sprocket teeth (with small values of wear).



here, - $\Delta\omega_2 = 2{,}5c^{-1}$; - $\Delta\omega_2 = 2{,}0c^{-1}$; - $\Delta\omega_2 = 1{,}5c^{-1}$;

Figure 3. Graphs of the dependence of the average value of the transmission function of the chain drive on the change in the angular speed of the leading star

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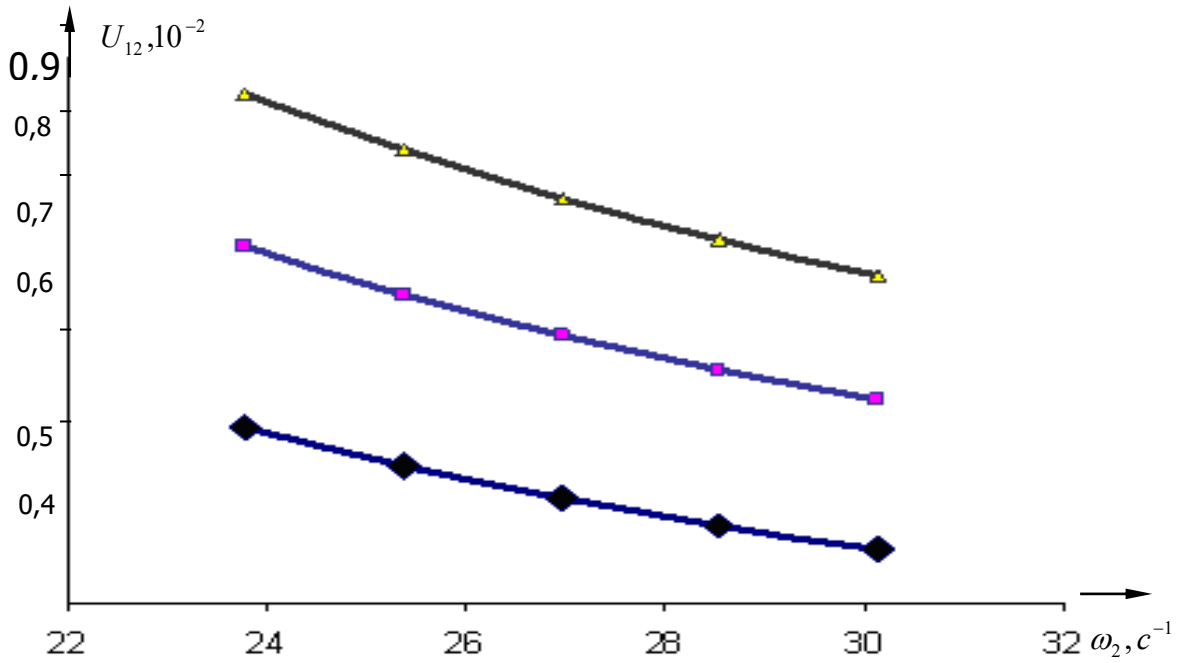

here, - $\Delta\omega_2 = 2{,}5c^{-1}$; - $\Delta\omega_2 = 2{,}0c^{-1}$; - $\Delta\omega_2 = 1{,}5c^{-1}$;

Figure 4. Graphs of the dependence of the chain drive transmission ratio on the change in the angular speed of the leading star.

If the change in the transmission function is large, the sprocket teeth will come to rest on the rollers, which will lead to the mechanism stopping. Therefore, when the average value of the change in the transmission function is $U_{12} = 1{,}1$ (in the working mechanism of the chip crusher), it is advisable that its change be less than 1.25. In this case, the change in the angular velocity due to the driven belt element should not exceed $\Delta\omega_2 = 2{,}0 \div 2{,}2c^{-1}$. The graphs of the relationship between the gear ratio and the unevenness coefficient of the chain transmission and the change in the angular velocity of the driven sprocket are shown in Figure 4. Based on the analysis, it can be noted that in order to reduce $\delta_{U_{12}}$, it is necessary to increase the angular velocity of the driven link, as well as reduce the value of the change in the angular velocity of the driven sprocket due to the belt element by $\Delta\omega_2$.

Conclusion

A formula for determining the coefficient of unevenness of the transmission ratio of a composite driven sprocket chain transmission with a tensioning device has been obtained. To reduce the coefficient of unevenness of the transmission function, it is necessary to increase the angular velocity of the driven link, as well as reduce the change in this velocity due to the elastic link $\Delta\omega_2$ the value of the change in the angular velocity of the driven sprocket.

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