Research Article

ANALYSIS OF THE INFLUENCE OF TENSION ROLLER RADIUS ON THE FORCE OF INTERACTION WITH THE BELT WITH VARIABLE TENSION

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ABSTRACT

The work considers a belt drive with a composite tension roller, where the forces of interaction between the roller and the belt are determined, as well as specific recommended transmission parameters.

KEYWORDS

Driving, driven, pulley, branches, composite, flexible, transmission, force, rigid, angle, speed, belt, technological, acceleration.

INTRODUCTION

Typically, in belt drives with constant belt tension, the gear ratio is constant. In this case, the tension in the leading and driven branches is also constant. But, in technological machines, the load in the belt drive will be variable [1,2]. In this case, the tension of the belt branches will also change. In order to maintain belt tension within certain limits and increase its durability, we recommend a belt drive, the tension roller of which is made integral with an elastic element.

Picture 1-a shows a diagram of the recommended belt drive, from which it can be seen that the elastic bushing 5 to some extent dampens the vibrations of the driven belt branch. The degree of interaction of the belt 3 with the bushing 5 depends on the transmission parameters, especially on the rigidity of the bushing 5 of the composite tension roller 4.

From work [1] it is known that the initial belt tension is determined from the expression:

$$S_0 = \frac{\gamma_p \cdot b_p \cdot h_p}{g} \vartheta^2 \qquad\qquad (1)$$
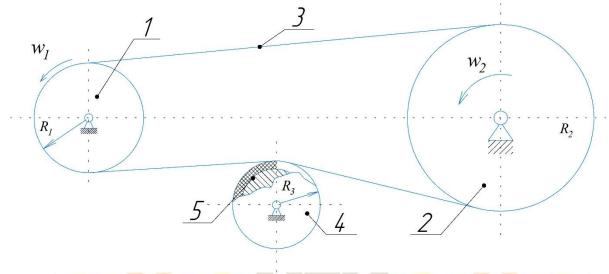
Where, γ_p - specific entire belt, b_p - belt width, h_p - belt thickness, ϑ - peripheral speed, g - acceleration of free fall.

where, 1 is the driving pulley, 2 is the driven pulley, 3 is the belt, 4 is the composite tension roller, 5 is the elastic bushing.

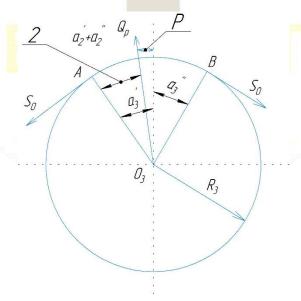Picture 1 a - belt drive with a composite tension roller

Figure 1 b - Calculation diagram of the interaction of the belt with a composite tension roller.
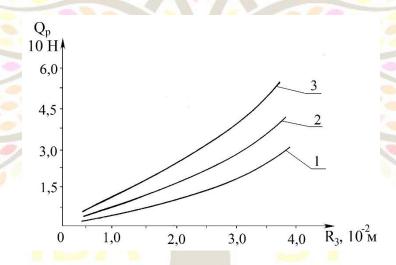
Where, α_3', α_3'' - components of the angle of encirclement of the elastic bushing of the composite tension roller by the belt; Δ_p - angle between force Q_p and the vertical axis of the belt.

Let's consider the design diagram shown in Fig. 1.b. According to this diagram, we determine the force of interaction of the tension composite roller with the belts, taking into account (1):

$$Q_p = \frac{\omega_3^2 R_3^2 \cdot \gamma_p \cdot \theta_p \cdot h_p}{g \cos \Delta_p} \cdot \left(\sin \alpha_3' + \sin \alpha_3'' \right) \qquad (2)$$

When the belt interacts with the elastic bushing of the composite tension roller, the elastic bushing deforms in the vertical direction.

Picture 2 shows graphical dependences of the change in the interaction force of the belt when interacting with the tension composite roller, taking into account the angle Δ_p

Picture 2. Patterns of changes in the force of interaction between the tension composite roller and the belt when the radius of the tension roller varies
where, 1-at

It can be seen from the graphs that an increase in the radius of the tension roller due to an increase in the contact area with the belt according to a nonlinear pattern increases the interaction force. So, with a radius of the tension composite roller of 1.0·10-2 m, the force of interaction with the belt reaches 13.8 N, and when the radius of the tension composite roller increases to 3.5·10-2 m, this force increases to 53.7 N. An increase in force Qp provides the necessary change in the angular velocity of the driven pulley. Therefore, by choosing the radius of the tension composite roller, it is possible to ensure the necessary changes in the angular velocity of the driven

pulley and the associated working body of the technological machine.

In addition, it is important to choose the values of the rigidity coefficient of the elastic bushing at small values of the radius of the tension composite roller and the largest values of the wrap angle. In this case, for the belt drive under consideration, the recommended parameters are:

$$(\alpha_3' + \alpha_3'') = 1{,}1 \div 1{,}3 \text{ rad}, \quad R_3 = (2{,}5 \div 3{,}5) \cdot 10^2 \text{ м}; \quad C = (4{,}1 \div 5{,}3) \cdot 10^2 \text{ Н/м}.$$

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