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DEVELOPMENT OF A NEW CONSTRUCTION OF STRAP ELEMENTS CONTAINED IN INCREASING THE PERIODICAL PERIOD OF THE BEARING INSTALLED IN MACHINE MECHANISMS

Jumaev Akbarjon Sayfullaevich
Almalyk branch of Tashkent State Technical University
Doctor of Philosophy in Technical Sciences (PhD), Associate Professor
E.mail: akbarjon.jumaev@mail.ru

Jurakulov Ikhtiyor Choriyevich
Assistant, Almalyk branch of Tashkent State Technical University
E.mail: joraqulovixtiyor3@gmail.com

Turabov Ilyos Shukhrat o`g`li
Assistant, Almalyk branch of Tashkent State Technical University
E.mail: ilesturabov1@gmail.com

Tojiboev Jamshidbek Nizomjon o`g`li
Assistant, Almalyk branch of Tashkent State Technical University
E.mail: jamshidcapitan1604@gmail.com

Annotation: The bearing is the part that makes the rotating movement of machine mechanisms. As a result of external blows, the periodicity of the bearings is reduced. In order to prevent this, it is recommended to use materials with belt elements as a bushing on the outside of the rolling bearing. As a result, due to damping of external shocks, the period of operation of the rolling bearing is increased.
Key words: Bearing, mechanism, tension along axis, dynamic load, shaft, axis, belt element, radial, roller, coefficient, ring, impact.

In the production of mechanical engineering, rolling bearings are installed on the shafts and axles of machine mechanisms, and perform a flat rotational movement. To calculate the load on the rolling bearings, we use the “Dynamic Load Bearing” reference. If the load applied to the bearing corresponds to the dynamic bearing capacity, the load is always in a straight direction. As a result, the load on the bearing moves radially or axially relative to the shaft. Rolling bearings in many cases, that is, as a result of external influences, lead to a decrease in the periodicity of operation. In order to increase the periodicity of the bearings, we use a material with a variable composition of belt elements as a coating for the outer ring. This, in turn, leads to an increase in the operating cycle of machine-mechanism bearings (Figure 1) [1-3].

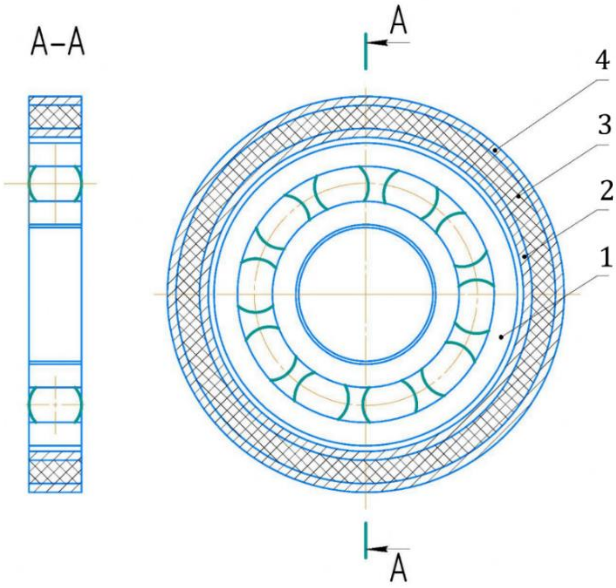
Bearings in machinery are often subjected to simultaneous radial and axial loads. If the direction of the load magnitude is constant, the load P on the bearing is perpendicular to the axis, and the dynamic load along the axis can be calculated according to the general formula [4,5].

$$P = XF_r + YF_a \tag{1}$$

where, P – dynamic load [kN]; F_r – real radial load [kN]; F_a is the real shot load [kN]; X – is the radial load factor for the bearing; Y – is the bearing axis coefficient.

As can be seen from the formula, the additional load on the bearing affects the dynamic load P on the rolling bearing if the F_a/F_r ratio exceeds a certain limiting factor. Rolling, roller, needle and sliding bearings can only withstand axial loads, i.e. $P = F_a$.

In most cases, the magnitude of the load on the bearing is variable, resulting in a decrease in the performance of the bearing. As a result of the rotational pressure of the bearing, uneven movement is formed on the outer and inner surfaces. If the speed, direction, operating conditions and load value of the bearing are constantly changing. In this case, it is necessary to determine the average load. This is determined by the following formula [6-8].



1-rolling bearing, 2-inner ring, 3-belt element (rubber), 4-outer ring

Figure 1. Rolling bearing with belt element support of new design

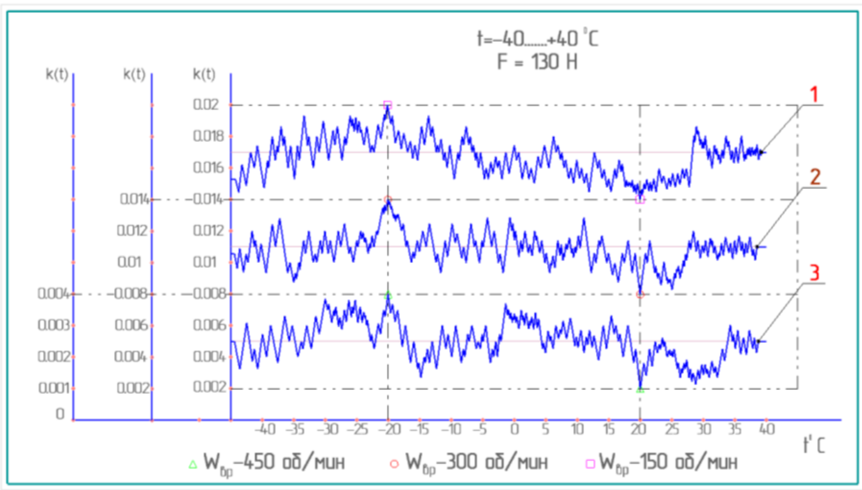
$$F_m = \frac{F_{min}+2F_{max}}{3} \tag{2}$$

If the bearing load has a constant value and direction of F_1 (for example, the weight of a drum or roller) and the rotating load is constant F_2 (for example, an unbalanced load), then the formula for the mean load and the value of the coefficient F_m is depicted in the diagram [9, 10].

$$F_m = f_m\,(F_1 + F_2) \tag{3}$$

The loads acting on the bearing are calculated according to the laws of mechanics using known calculated working forces, external forces such as gravity or inertia. In actual working conditions, the loads acting on the bearing may differ from each other. At this time, it moves simultaneously in the radial and interaxial directions and depends on other factors, which require complicating or in some cases simplifying the calculations [11,12].

Experimental study, the loads depending on the rotation resistance of the first existing belt conveyor guide roller mechanism (bearing 60306 GOST 7242-81) F_r = 130 *N*, rotation frequency f = 150, 300, 450 *rev*/*min* and experimental test results for Litol-24 lubricant were studied.



F_r = 130 *N*, f = 150, 300, 450 *rev*/*min* and «Litol-24» oils

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Figure 2. Diagrams of loading depending on the rotation resistance of the belt conveyor roller mechanism, dependence on the rotation frequency

Analysis of test results:

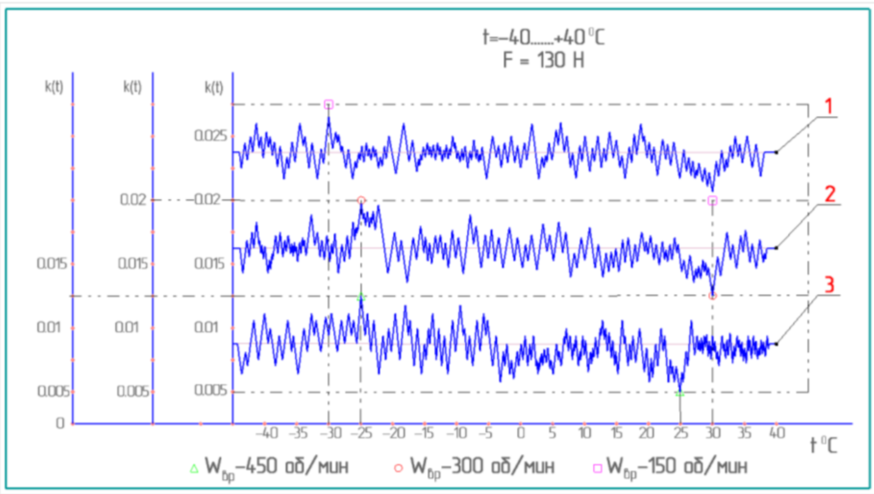
Based on the results obtained during the experimental studies, a graph showing the change in resistance to the rotation of the guide roller mechanism depending on the external temperature was made. which reduces the drag coefficient by *k*(*t*). This coefficient is determined using linear approximation.

Table 1.

Load depending on the rotation resistance of the belt conveyor guide roller mechanism F_r = 130 *N* and rotation frequency *f* = 150, 300, 450 *rev*/*min* and for «Litol-24» oils

p/p	Characteristics	Values		
1.	Upload – F_r, *N*	130	130	130
2.	Rotational frequency – *f*, rev/min	150	300	450
3.	Change in temperature coefficient – *k*(*t*)	0,0152	0,0189	0,005
4.	Temperature coefficient upper and lower indicators	0,02 – 0,014	0,14 – 0.008	0,004 – 0.001
5.	Due to the effect of ambient temperature, the recommended temperature indicators for the operation of the mechanism are ^{0} C	–20 to +20	–20 to +20	–20 to +20

The results of the next experimental study showed that a new sliding support detail (standard product) was installed instead of a rolling bearing (60306 GOST 7242-81) performing a flat rotational movement in the guide roller mechanism prepared on the basis of an improved design. the analysis of the results is reviewed [13, 14].



F_r = 130 *N*, *f* = 150, 300, 450 *rev*/*min*, «Litol-24» oil and rubber (7IRP13-48)

Figure 3. Diagrams of loading depending on the rotation resistance of the belt conveyor roller mechanism, dependence on the rotation frequency

Table 2.

Load depending on the rotation resistance of the belt conveyor guide roller mechanism F_r = 130 *N* and rotation frequency *f* = 150, 300, 450 *rev*/*min* and for «Litol-24» oils

p/p	Characteristics	Values			
1	2	3			
1.	Upload – Fr,N		130	130	130
2.	Rotational frequency - f, rev/min		150	300	450
3.	Change in temperature coefficient – k(t)	*a*)	0,017	0,011	0,0025
		b)	0,016	0,010	0,002
		c)	0,024	0,016	0,008

4.	Temperature coefficient upper and lower indicators	*a)*	0,02 – 0,014	0,14 – 0.008	0,004 – 0.001
		b)	0,02 – 0,014	0,14 – 0.008	0,004 – 0.001
		c)	0,27 – 0.021	0,20 – 0.0125	0,013 – 0.005
5.	As a result of the effect of ambient temperature, the recommended temperature indicators for the operation of the mechanism are 0C	*a)*	– 25 to + 25	– 25 to + 25	– 20 to + 30
		b)	– 25 to + 25	– 25 to + 25	– 20 to + 25
		c)	– 30 to + 30	– 25 to + 30	– 25 to + 25

Test results analysis indicators:

Based on the results obtained during the experimental studies, a graph showing the change in resistance to the rotation of the guide roller mechanism depending on the external temperature was made. which reduces the drag coefficient by $k(t)$. This coefficient is determined using linear approximation [15].

The general summary of the experimental results can be analyzed based on the above table. Based on the results obtained during the experimental studies, based on the diagrams showing the change of the resistance to the rotation of the guide roller mechanism depending on the external temperature, the experimental study, that is, the coefficient was determined using linear approximation.

Summary. Load depending on the rotation resistance of the belt conveyor guide roller mechanism F_r = 130 *N* and rotation frequency f = 150, 300, 450 *rev*/*min*, rubber (7IRP13-48) and «Litol-24» as the best indicator for oils, load F_r = 130 *N*, rotation frequency f = 150 *rev*/*min* found. Litol-24 indicators are the change of the temperature coefficient in relation to the rotation resistance of the mechanism $k(t) = 1 – 0.16 (t + 30)$, determined from the formula, the upper and lower temperature coefficients are from 0.27 to 0.021 was seen at intervals. Therefore, it should be concluded that it is recommended to use the belt conveyor guide roller mechanism at an ambient temperature of – 30 + 30 °C, and the temperature coefficient $k(t)$ = 0.16 under conditions of $t \geq 30$ °C takes the form and it can be concluded that this indicator is the best indicator.

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