

Research Article

New Construction of Rolling Supports of Belt Conveyors

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Abstract: The study presents the results of a study of belt conveyors working in the mining industry and the new design of support rollers is proposed.

Keywords: Admissible angle of obliquity, bearing capacity, belt conveyor, labyrinth seals, rolling support, supporting roller

INTRODUCTION

Belt conveyors are the most common type of continuous machines in industries. Besides, the cost of rollers amounts 25-30% of the total installation cost. Moreover 40% of the total cost of upkeep is the share of rollers that determines efficiency, energy intensity of the belt conveyor and influences on the belt durability.

In addition to belt conveyors, rollers are used in other Machines with Continuous Transport (MCT), for instance, for transportation and packages of piece goods in rolling conveyors and various kinds of storage silos, where the cost of the rollers amounts 50-80% of the cost of continuous machines. Therefore, reliability enhancement and durability of rolling supports of conveyor systems is an urgent task.

METHODOLOGY

Justification of the research direction: At present the lifetime of rolling supports working in hard conditions with a dusty environment and large-sized goods, which is typical for the mining industry averages on linear sections 12000-15000 and 5000 h on loading sites. Allocation of failures is shown in Table 1. As it can be seen from the statistical data of operation of belt conveyors the major cause of failure of rolling supports in a dusty environment is clogging bearing assemblies with dust particles 5-30 μ in size and is abrasive damage of labyrinth seals and insufficiency of lubricant.

Despite the large number of research works and active inventive activity in the world the lifetime of the rollers of belt conveyor for dusty environment is heightened insignificantly. The reasons of this are technological and constructive. It is well known that

Table 1: Statistical data of failures

Causes of failure	Failure frequency (%)	
	Upper branch of the conveyor	Lower branch of the conveyor
Clogged of bearings and their locking because of sealed dusts	38	12
Outflow and shortage of oil in bearing assemblies	37	36
Violation of bearing seat in case hubs	12	10
Violation of bearing seat on non-driving axle	3	3
Circumferential abrasion of shell at overloads	2	30
Unidentified factors in the operation	8	9

permissible angle of obliquity of inner ring relative to bearing cup of (single-row) ball bearing is 0° and 6-8 min (Kolobov *et al.*, 1984). Considering inevitable obliquity of bearing rings after construction associated with manufacturing and assembly error the permitted angle of obliquity is reduced to 0° and 3-4 min depending on the length and diameter of the roller.

It can be concluded that the existing construction of rolling supports, the technology of their production abroad, in Russia and Kazakhstan preliminary obliquities of racers are inevitable that substantially reduces their bearing capacity (Kuznetsov, 1986; Manezhanov *et al.*, 2014).

Most importantly, for dusty environments effective methods to protect bearing assemblies from falling dust particles were not developed.

RESULTS OF THE STUDY

In this research the attempts were made to increase lifetime of rolling supports up to 30,000 h at the expense of new construction of bearing rollers

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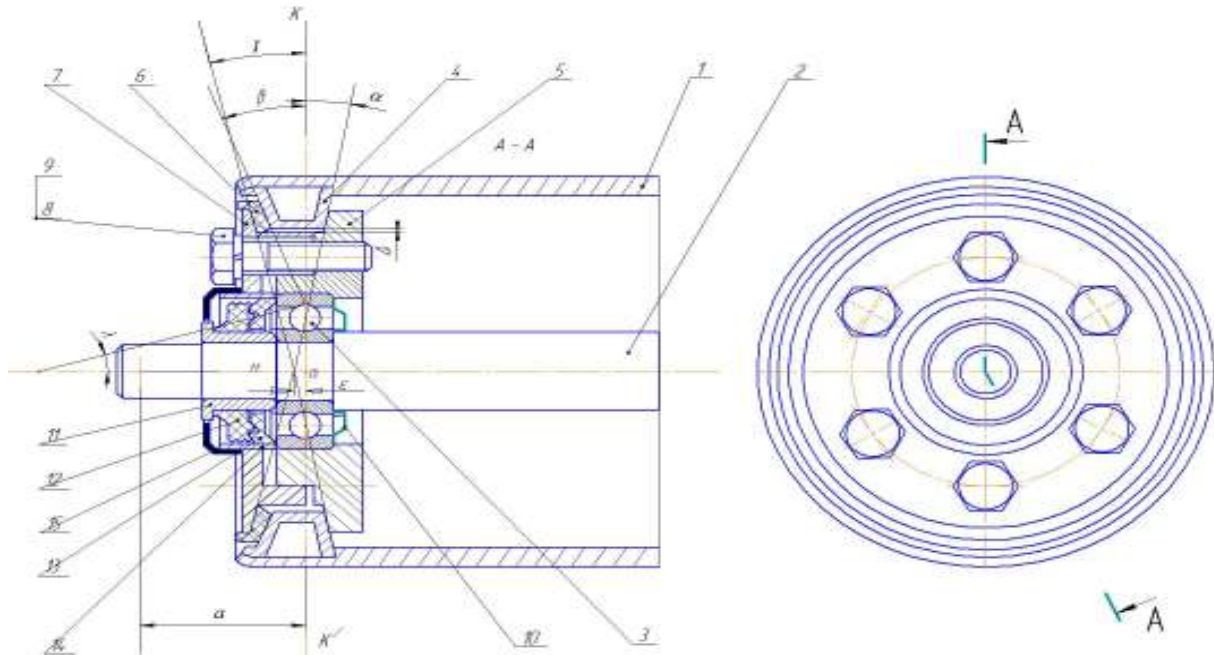


Fig. 1: The roller with amortized rolling support;

- 1: Shell; 2: Axis; 3: Bearing; 4: Thin-walled ring of keystone-shaped section; 5: Internal stepped disc; 6: Rubber gasket; 7: External disc; 8: Screw; 9: Spring washer; 10: Steel shield; 11: Internal sleeve; 12: External sealing element; 13: Internal sealing element; 14: External sleeve; 15: Protective housing

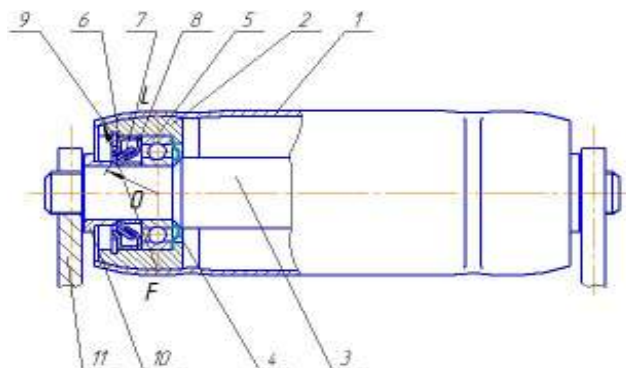


Fig. 2: The roller of second construction;

- 1: Shell; 2: End hub; 3: Axis; 4: Sealing washer; 5: Bearing; 6: External element of labyrinth seal; 7: Intermediate member of labyrinth seal; 8: Internal element of labyrinth seal; 9: Locking ring; 10: Bush; 11: Rack

providing combined obliquities of racers on certain geometric conditions.

In previous inventions (e.g., author certificate Republic of Kazakhstan No. 7G10, 22585, 27735, 28128 and *et al.*) developed on the principle of increasing the bearing capacity of the bearing assemblies, the forced obliquities are implemented at the expense of axial force, but in the following two constructions it is done at the expense of radial load by itself, operating on rollers (Ibraeva *et al.*, 2013; Temirtasov *et al.*, 2014).

The principle of operation of roller number 1 (Temirtasov *et al.*, 2009): Figure 1 shows the roller

with amortized rolling support that includes cylinder course 1 and axis 2, bearing 3, thin-walled ring of keystone-shaped section 4, internal stepped disk 5, rubber gasket 6, external disc 7, screw 8, spring washer 9, steel shield 10, internal sleeve 11, external closure element 12, internal closure element 13, external sleeve 14, protective housing 15.

Such performance of the roller eliminates the appearance of relative obliquities of bearing rings, as by axis deformation together with the internal racers obliquities of bearing cup occurs with assembled hub relatively to the cone in the neutral plane of the shell (e.g., NMN') that is perpendicular to the operating load. Incidentally the general plane K-K' is constant tangent to the trajectory of the point O₂ of axis-part.

The principle of operation of roller number 2 (Temirtasov and Manezhanov, 2004): The roller of second construction shown on Fig. 2, contains cylindrical shell 1, forming together with the end hubs 2 the case of roller.

The outer surfaces of the hubs 2 are spherical with a radius equal to the inner diameter of the shell with centers F and L located through inner surface of the shell at intersection points of a plane passing through symmetry points of the rolling elements of bearing. After installation of the hubs into end interior of the shell it makes performance of subsequent folding with creation by force of pressing of circular groove in the shell to restrict their movement inside.

The case of roller is mounted on the axis 3 by the use of supports placed in the hub 2 of sealing washers 4, bearings 5 and labyrinth seals. The external seals 6, intermediate 7 and internal 8 elements with end walls having spherical surfaces mounted concentrically to each other with common geometrical center in the point of the intersection of the plane passing through symmetry point, rolling elements with axis of roller rotation. The external element 6 presses the internal element 8 to the bearing cup 5 in the hole of the hub 2 and held by locking ring 9. The intermediate sealing element 7 placed on the axis 3 is pressed to the internal racer 5 and held by sleeve 10 pressed on the axis 3. The axis of the roller is mounted on the rack 11 of fabricated metals of conveyor.

CONCLUSION

Thus, in proposed constructions of rollers functional-technical, constructional, ergonomic indicators are improved. The reliability, unification and energy-efficient indices are increased too. It is expected the increase of lifetime of rolling supports up to 25000-30000 h that should compensate the increase of cost parameters at the expense of the use of science intensive technologies, materials of high quality and pipes with extra accuracy for shells of rollers. Its

competitiveness for external and internal market will be provided with such data as high reliability and durability, as well as lower levels of noise and vibration.

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