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Evaluation of reliability and technical conditions of tunneling machines

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Abstract

This articles describes a way to increase operational reliability of selective heading machines by preventing sudden failures and adjusting the repair cycle based on the results of runtime diagnostics of executive unit drive in terms of technical conditions. Based on the statistical examination of heading machine reliability, the authors have worked out a range of parts and assembly units with limited failure-free lifetime and subject to operational control. There have been developed techniques for expeditious diagnostics of executive unit drive technical condition based on values of engine current with measured data presented in frequency domain, diagnostics being performed without interrupting the technological process of underground development. There have been found identification frequencies in current range corresponding to defects and failures of separate parts of the electro-mechanical drive of the executive unit. There has been developed a microprocessor diagnostic complex that analyses compliance of hardware-obtained amplitude-frequency characteristics with actual technical conditions of the examined heading machine unit.

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Keywords: reliabiity; diagnostics; technical condition; tunneling machines; heading machine with jib-type executive unit; spectral analysis; defect

1. Introduction

Increase in efficiency of building capital developments at mining enterprises, objects of underground city

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infrastructure, road tunnels can't be carried out without tunneling cars, possessing high operational reliability.

Considerable decrease in level of reliability of the equipment after its long-term operation, long equipment downtimes due to imperfection of maintenance system cause unreasonably high maintenance costs [1].

One of the ways to increase operational reliability of tunneling cars by preventing sudden refusals and making their consequences less painful is the use of modern systems of monitoring and diagnostics of their technical condition [2-4].

The importance of diagnosis problem is determined not only by possibility of preventing failure, forecasting remaining lifetime and adjustment of repair cycle, but also by the possibility to manage without repair of faultless units, to reduce expenditures on their restoration. Application of expeditious diagnostics is the cornerstone of solution of the problem of optimizing the operation of tunneling cars.

2. Reliability of KP21 heading machine

For assessment of operational reliability of tunneling cars there are a number of widely approved techniques of collecting and processing statistical information, which can be applicable for driving combines [5, 6, 7]. Production monitoring of operability of selective action combines KP21 was held during the construction of horizontal and slightly sloping preparatory developments with section of 14.5 sq.m. in rock of maximum hardness at monoaxial compression of 100 MPas.

On the basis of statistical researches of reliability of KP21 combines the nomenclature of details and units limiting the period of trouble-free operation, their actual reliability index [8,9] have been defined. Mean mining volumes between refusals (V, m3) for details and units failing during the between-repairs period are presented in Fig. 1.

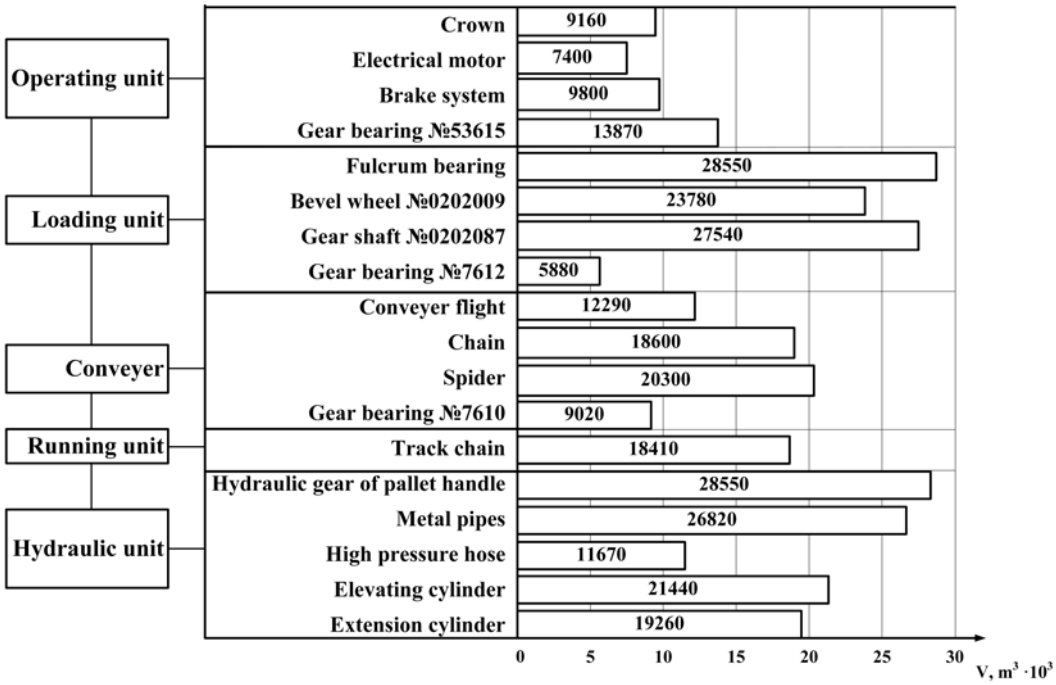

Fig. 1. Mean mining volume between failures for parts limiting heading machine reliability during time between repairs

It should be noted that the majority of characteristic failures of KP21 combines are related to malfunction of bearing units in drive electric motors and elements of transmission. Accordingly these elements have the smallest values of mean mining volume.