APPLICABILITY OF VIBRATION METHODS CARRIED OUT BY ROBOTRON M1302 FOR CONTROL OF THE STATE OF MINING MACHINES OPERATION

ПРИМЕНЕНИЕ ВИБРАЦИОННЫХ МЕТОДОВ ДЛЯ КОНТРОЛЯ СОСТОЯНИЯ ПРИВОДА ШАХТЕРСКИХ МАШИН РЕАЛИЗИРОВАН С ROBOTRON M1302

Ass. Prof. Dr. Eng. Pojidaeva V. ,
University of Mining and Geology
"St. Ivan Rilski" – Sofia, Bulgaria
E-mail: vpojidaeva@abv.bg

Ass. Prof. Dr. Eng. Vucheva R. ,
University of Mining and Geology
"St. Ivan Rilski" – Sofia, Bulgaria
E-mail: wus@mail.mgu.bg

Abstract

Subject of comments in this article are vibration methods used by Robotron M1302 apparatus that are applicable at vibration diagnostics of operation machines' defects in the open-cast coal output.
KEY WORDS: MINING MASHINES, TRANSMISSIONS, VIBRATION CONTROL

1. Introduction

The practice of repairs according to the necessity in Bulgarian mining companies bulks large recently which fact gives rise to a need of equipment resource qualification to be undertaken. The ISO standards for vibration control of mining equipment's state could hardly be applied directly due to the heavy geomorphologic conditions they are working under and their specific construction. This is why a standardized approach for vibration control including concrete vibration indices and their admissible values for concrete meetings and aggregates has to be developed.

Present work comments the applicability of vibration control methods of rubber belt transporting operational system at Bulgarian operation station at Mines Maritsa East Joint-Stock Company (Fig. 1) based on Robotron M1302 apparatus that is available at the groove.

2. Preconditions and means for resolving the problem

The above-mentioned apparatus allows measurement of the following parameters: vibration acceleration – effective ($\bar{a}$) and peak ($\hat{a}$); vibration velocity - effective ($\bar{v}$) and peak ($\hat{v}$) and diagnostic index $K(t)$ rendering an account of the state of antifriction bearings. Frequency filters incorporated in the apparatus allow measurement of vibration velocity and vibration acceleration within various ranges of frequency.

Standardization of the vibration indices' values is based on theoretical calculations approbated and consisted with experimental investigations. Experimental tests are carried out in points 1 to 9 (Fig. 1) both on the electric motor and the gear and comprise the following control stages:

2.1. *Control on floating electric motor with non-joined gear after the overhaul.*

In this case prior to the measurement the electric motor is put on a horizontal platform and the control procedure begins after it gets to the nominal revolutions. In this state rotor misbalance is examined in frequency range 10 Hz to 100 Hz (filter HP3-TP1) [2] during fixed measurement time period of 7s. After great number of experiments carried out values of the parameters given in Table 1 for admissible values of rotor's misbalance were calculated on the base of measured vibration velocity.

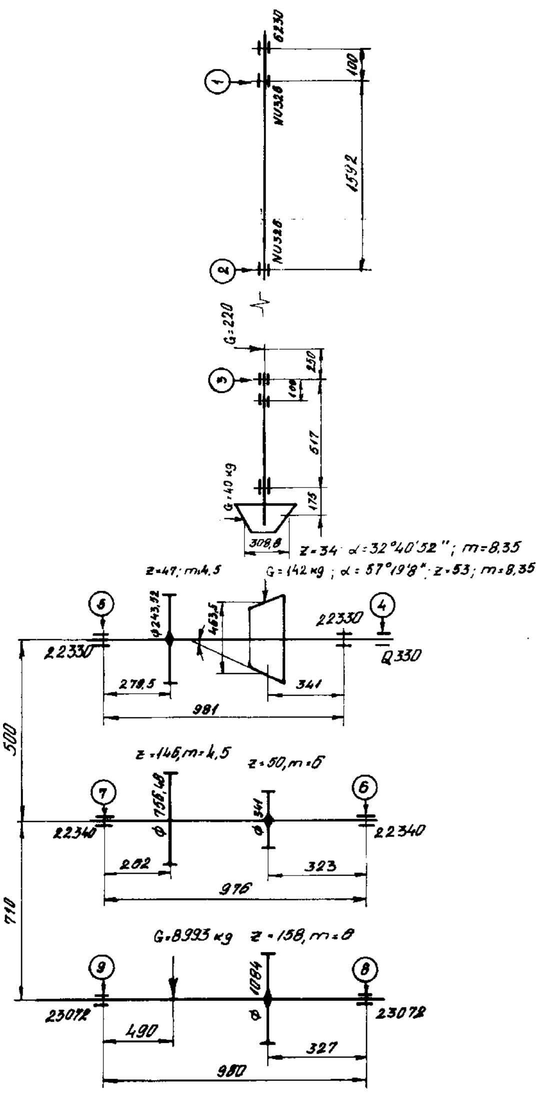

Fig. 1

Table 1

Measurement Point No	Sensor orientation	$\bar{v}_1$ [mm/s]	e [μm] min - max
1	V	5,58	103,2-129
	A	3,25	50,12-75,4
2	V	4,30	79,55-99,7
	A	2,13	39,4-49,41

Antifriction bearings' state is controlled under the same conditions. The tests are implemented in the frequency range 1000 Hz to 10000 Hz (filter HP8-TP7) [2] during fixed measurement time period of 8s. Under control are the parameters peak vibration acceleration and mean quadratic acceleration and they are used for CREST factor P_a calculation [1,3]. The standardized values obtained are shown in Table 2.

Table 2

Measurement Point No	Sensor orientation	HP8 – HP7		$P = \hat{a}/\bar{a}$
		$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]	
1	V	11,7	50,3	4,29
	H	16,5	61,8	3,74
	A	16,5	51,4	3,11
2	V	37,7	194	5,14
	H	16,7	91,7	5,49
	A	31,75	250	7,93

2.2. Control on the electric motor mounted on its working place.

In this case test measurements are taken in the following sequence:

After joining the gear to the electric motor the later is let floating (no load on the transporting belt). Mounting quality is checked by taking again the values of parameters $\bar{a}(0)$ and $\hat{a}(0)$ so that the index $K(t)$ could be calculated for further diagnostics.

Sensor is positioned in point 1 or 2 (according to the mounting modification) and point 3. Measurements are taken in vertical direction first. Apparatus is adjusted at the whole frequency diapason 2 Hz – 20 kHz and measurement time period of 0.5 s and lag vibrations generation is checked. Afterwards values of the parameters $\bar{v}_2$, $\bar{a}$ and $\hat{a}$ are taken consequently in vertical (v) and axial (a) directions at filter tuning HP3 – TP1 [2] and measurement time period 8 s. The standardized values obtained are shown in Table 3.

Table 3

Measurement Point No	Sensor orientation	2 Hz–20 kHz	HP3 – HP1		
		t = 0.5 s $\bar{a}$ [m/s²]	$\bar{v}_1$	$\bar{a}$	$\hat{a}$
1	V	↑	2,03	O,7	2.13
	A	↑	6,20	2,3	11,2
2	V	↓	6,20	2,3	11,2
	A	↑	2,03	o.7	2,13

↑↓ not in step ↑↑ in step

The next mounting quality check is made in measuring point 1 or 2 only (according to the mounting modification). Values of the parameters $\bar{a}(0)$ and $\hat{a}(0)$ are measured without frequency filters (2 Hz – 20 kHz) [2] and their product is compared to the product of the values of the same parameters measured at the same frequency range before the electric motor being mounted on its working place (from Table 2). The standardized values obtained are shown in Table 4.

Table 4

Measurement Point No	Sensor orientation	2 Hz – 20 kHz		$\bar{a}(0).\hat{a}(0)$
		$\bar{a}(0)$	$\hat{a}(0)$	
1 or 2	V	13,1	60,8	796,48
	H	19,5	110	2145,0
	A	23,4	150	3510,0

Comparison of the values stated in Table 2 and Table 4 allows mounting quality to be evaluated as follows:

$$M = \frac{\bar{a}(0).\hat{a}(0)\,(\text{values from Table 4 - after electric motor mounting})}{\bar{a}(0).\hat{a}(0)\,(\text{values from Table 2 - before electric motor mounting})}$$

<< 25

The mounting quality could be evaluated as good if $M \le 5$. If M > 25 it means that mounting deviation is too large.

Under these conditions control on the antifriction bearings and cogwheels should be carried out. The experimental data are shown in Table 5.

Table 5

Measurement Point No	Antifriction Bearings					Cogwheels		Mounting Quality				Aggregate vibration state					
	HP8 – TP7		P_a	2 Hz – 20 kHz		HP6 – TP3		HP1 – TP1				MS(HP3 – TP4)				2 Hz – 20 kHz	
	$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]		$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]	$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]	$\bar{v}$ [m/s]	$\hat{v}$ [m/s]	$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]	$\bar{v}$ [m/s]	$\hat{v}$ [m/s]	$\bar{a}$ [m/s²]	$\hat{a}$ [m/s²]	$\bar{v}$ [m/s]	$\hat{v}$ [m/s]
1	14	40	< 5	15,0	70,0	-	-	5,5	16	1,5	5,0	7,5	25,0	15,5	70	8,0	25
2	14	40	< 5	15,0	70,0	-	-	5,5	16	1,5	5,0	7,5	25,0	15,5	70	8,0	25
3	14	40	< 5	15,0	70,0	2,5	13,0	5,5	16	1,5	5,0	7,5	25,0	15,5	70	8,0	25
4	10	30	< 5	11,0	55,0	1,5	9,0	2,5	10	0,6	2,5	4,5	15,0	11,0	48	5,5	18
5	10	30	< 5	11,0	55,0	1,5	9,0	2,5	10	0,6	2,5	4,5	15,0	11,0	48	5,5	18
6*	12	35	< 5	13,0	60,0	2,0	11,0	3,5	11	0,7	3,0	5,0	18,0	13,0	50	6,5	20
7*	12	35	< 5	13,0	60,0	2,0	11,0	3,5	11	0,7	3,0	5,0	18,0	13,0	50	6,5	20
8*	14	40	< 5	15,0	70,0	2,5	13,0	5,0	15	0,8	3,5	6,5	20,0	15,0	70	8,0	25
9*	14	40	< 5	15,0	70,0	2,5	13,0	5,0	15	0,8	3,5	6,5	20,0	15,0	70	8,0	25

*- Data for points 6, 7, 8 and 9 are obtained completely experimentally

2.3. Control on the operating systems during the exploitation period between two overhauls

It is recommended the tests to be carried out on floating operation station (without any load on the transportation belt) at time periods of three months. Control on the mounting quality and the gear's pinions is to be implemented according to the above said instructions.

For antifriction bearings' state's control index $K(t)$ is applied. Values of the parameters $\overline{a}(0)$ and $\hat{a}(0)$ measured within the range 2 Hz - 20 kHz right after the overhaul are introduced as initial ones. Wear process's monitoring is carried out according to the diagram shown on Fig. 2

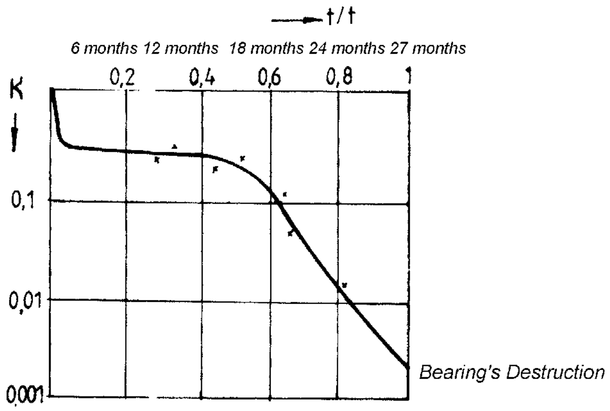

Fig. 2

3. Conclusion

The present investigation could be considered methodology for non-dismantling control implementation and values' standardization could be taken into consideration when monitoring systems are to be designed eventually.

4. Literature

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