AJSIHD
GLOBAL RESEARCH NETWORK

AMERICAN Journal of Science on Integration and Human Development
Volume 2, Issue 6, 2024 ISSN (E): 2993-2750

Analysis of Functional Connections of Components of Mechanical Components Affecting the Process of Current Collection of the Temp of Main Locomotives

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Abstract: This article provides an analysis of the functional connections of the parts of the wheeled motor unit that influence the process of current collection of locomotive traction motors.

Keywords: assessment of the state of the BMP, gear tooth, Oscillogram, malfunction.

Introduction

Increasing the reliability and service life of the wheel-motor unit (WMU), which accounts for about 45% of all failures, is one of the main conditions for increasing the efficiency of locomotive use.

One of the directions for solving this problem is the introduction of in-place technical diagnostics, which makes it possible to determine the optimal amount of work when delivering locomotives for repairs [1-4].

The optimal amount of work for locomotive repairs can be determined only on the basis of a reliable assessment of the technical condition of various components and parts.

To obtain reliable information about the state of a node, there are two ways:

the first is to increase the number of measured parameters. However, an increase in the number of measured parameters is not always justified, because otherwise, the costs will begin to exceed the cost of winnings associated with the diagnosis;

the second is to collect maximum information about the state of the BMP using a minimum number of measured parameters. It is based on the fact that in complex systems many parameters are functionally interconnected. In this case, by observing some, it is possible to determine others related by functional dependence.

The KMB is a multi-level system, the ordered structure of which consists of a set of mechanical, electrical and other devices that, in their functional unity, provide the necessary traction properties.

The influence of all of the above factors primarily affects the current collection state of the TED, causing additional processes in the form of voltage distribution around the circumference on the collector, leading to a high probability of arcing, independent of switching processes. The degree of influence of these factors on the operation of the electric motor varies and depends on the design features and operating conditions.

Therefore, the quality of current collection of TED can serve as the main parameter for assessing the technical condition of TED.

Experience in operating TEDs shows that at certain moments mechanical factors have a much greater impact on the operation of the engine than the switching process.

The reliable operation of the engine is affected by wear of the commutator, lifting of individual plates, the condition of the bearings and traction gear, vibrations and runout caused by armature imbalance and other reasons.

Of the listed factors, the most common in practice are: wear and lifting of individual collector plates, wear and chipping of the teeth of the traction mechanism gears. These failures account for about 8-10% of the total number of TED failures.

The dynamic force arising in the presence of mechanical factors, accordingly, acts on the brush directed at an angle α tangential to the armature commutator. This force can be decomposed into two components: directed along the brush axis (in continuation of the commutator radius) and directed perpendicular to the brush axis.

The greatest influence on the quality of current collection is exerted by the component line of action which coincides with the static pressing of the brush on the commutator.

The value of the force depends on the dynamic inertial acceleration and the weight of the brush and the weight of the brush holder pressing device. The main variable is the dynamic inertial acceleration. Consequently, all mechanical factors will be functionally related by this value.

If there is a development on the surface of the collector with a height and total angular extent of radians, the brush at the moment of passing this surface will experience additional acceleration, the passage of time.

Let's consider the acceleration that occurs from wear or chipping of teeth in the traction gearbox; if there is wear in the gear teeth of the traction gearbox, a lateral gap appears. Due to the increase in lateral clearance, the dynamic load, which is of an impact nature, increases sharply.

It is assumed that this impact occurred at the meshing pole of the two teeth. Increase through gears and gears located to the main circles of the corresponding gears.

It follows that the process of current collection of the traction motor, in addition to the switching process itself, can be influenced by the amount of wear on the commutator and the gear tooth and wheel of the traction gearbox, which are associated with frequency.

Thus, the quality of current recording of TED can serve as a parameter for assessing the state of the BCM, since it is ensured in the functional unity of the electrical and mechanical parameters of the machine.

The influence of the state of individual elements of the KMB on the state of commutation of the traction motor, in particular the gears of the traction reducer, was recorded by a device for assessing commutation at the technical diagnostic point of the Tashkent depot. The principle and method of operation of this device are described in work [6-7].

When the TED switching conditions were diagnosed, chips and one-sided wear of the traction reducer gear were recorded. These faults were then confirmed by examining the gearbox with the casing removed.

A characteristic sign of a chipped tooth is a sharp spike in the oscillogram, which repeats at regular intervals. Examples of oscillograms are shown in Figures 1, 2.

Unilateral wear of the gear, as shown by operational observations, is manifested by a change in the commutation value when the TED armature rotates in different directions. Moreover, the commutation score can fluctuate within 1-2 classes. Examples of oscillograms are shown in Figures 3, 4.

Oscillogram of a chipped tooth in the traction gearbox of the TEP-10-132 6TED diesel locomotive.

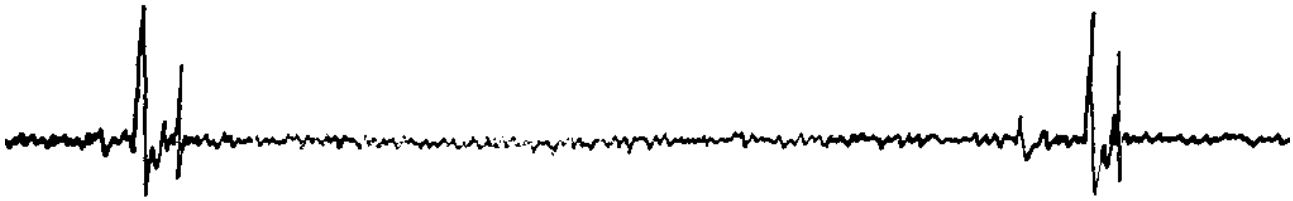

Figure 1. - Oscillogram of a chipped tooth in the traction gearbox of a diesel locomotive UZTE16M.

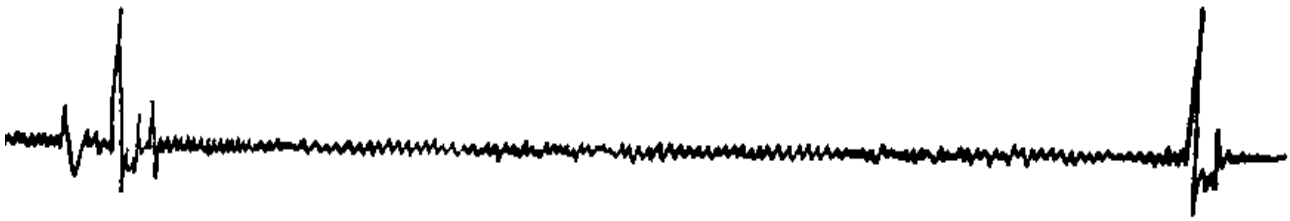

Figure 2. - Oscillogram of one-sided wear of the gear of the traction gearbox of the diesel locomotive TEP70-114, 4TED: a) right rotation, gear ½,

a) right rotation, UZTE16M 2 points

b) left rotation, scale 2.

Figure 3. - Oscillogram of one-sided wear of the gear of the traction gearbox of the UZTE16M diesel locomotive:

Figure 4.- Oscillogram of one-sided wear of the gear of the traction gearbox of the UZTE16M diesel locomotive: b) left rotation, 3 points.

Conclusion

However, it should be noted that in the presence of other malfunctions of various components of the KMB, the picture on the oscillogram is distorted and does not make it possible to clearly determine the malfunction.

The solution to this problem is the use of a computer, which allows you to quickly analyze the spectrum of the signal transmitted by the device and identify existing faults.

References:

1. Mamaev, S., Anna, A., Tursunov, S., Nigmatova, D., & Tursunov, T. (2023). Mathematical modeling of torsional vibrations of the wheel-motor unit of mains diesel locomotive UZTE16M. In E3S Web of Conferences (Vol. 401, p. 05014). EDP Sciences.
2. Файзибаев, Ш. С., Авдеева, А. Н., Мамаев, Ш. И., Турсунов, Ш. Э., & Нигматова, Д. И. (2022). Моделирование крутильных колебаний колесно-моторного блока тепловоза UZTE16M. Universum: технические науки, (4-5 (97)), 24-29.
3. Балицкий, Ф.Я. Виброакустическая диагностика зарождающихся дефектов / Ф.Я. Балицкий, М.А. Иванова, А.Г. Соколова, Е.И. Хомяков. М.: Наука, 1984 г. 118 с.
4. Гиоев, З.Г. Основы виброакустической диагностики тяговых приводов локомотивов.: Дис... докт. тех. наук. - Ростов-на-Дону, 1998.-261с.
5. Биргер, И. А. Техническая диагностика / И.А. Биргер. - М.: Машиностроение, 1978. - 240 с.
6. Заболотный Н.Г. Тепловозы ТЭ10М. Механическое оборудование: Учебное иллюстрированное пособие.- М.: Маршрут,2006.-58с.
7. Техническое обслуживание и ремонт тягового электродвигателя ЭД-118А. Технологическая инструкция ПКБ ЦТ.25.0082. Проектно-конструкторское бюро локомотивного хозяйства (ПКБ ОАО «Российские железные дороги»), 2009.-137 с.