INSPECTION OF THE TECHNICAL CONDITION OF TRACTION ELECTRIC MACHINES IN ELECTRIC ROLLING STOCK

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Abstract: The article discusses the causes of failure, repair and test methods after repair of asynchronous electric motors that are in the electric rolling stock. Electric motors used in rolling stock are used in unfavorable conditions: frequent overloads and constant presence of the electric motor in working condition while driving. Therefore, the operating conditions of these motors are very different than those of common industrial electric motors. The analysis of the causes of failure and their duration of operation after repair has been carried out.

Key words: tests of an asynchronous electric motor, height of the axis of rotation, performance, tests, repair enterprises, electrical equipment of rolling stock, recuperation of electrical energy

Introduction. The increase in the number of failures is primarily due to the fact that most of the asynchronous motors installed on the rolling stock have practically reached their end of life and have already been repaired several times. In addition, electric motors are used in unfavorable conditions: these are frequent overloads and the constant presence of the electric motor in working condition while driving [1, 3, 4, and 5].

According to the above analysis, due to insufficient quality of repair work, 15-20% of electric motors fail during the first two months of operation, which is unacceptable in the conditions of electric transport.

Method (Methods). The issues of testing an asynchronous electric motor after repair have been studied. Testing is a special process after the repair of each electric motor and many parameters depend on it according to the nominal data of the electric motor [1, 3, 4, 5].

The most effective test mode for electrical machines is the mode that is closest to the operational one. At the moment, there are no specialized stands that allow testing a wide range of asynchronous electrical machines under load, differing in overall and connecting parameters, power, height of the axis of rotation. Existing stands for testing electric motors under load are often made directly at the enterprise and have a large number of shortcomings [3, 5, 7, 8].

The most complete picture of the operability of a repaired electrical machine, together with mandatory measures for monitoring the state of an electrical machine, can only be given by testing the machine under load [2, 4, 5, 12, 18]. Obviously, such operations as measuring the vibration level or the condition of bearings are best measured under conditions corresponding to their operating conditions, namely under load [15, 17, 21].

Results and Discussion. Complex stands for checking the technical condition of electrical machines have not found wide application at repair enterprises, not only due to the complexity of such devices in operation, but also due to the lack of organizations producing them. The existing problem has not yet found a worthy solution - in different shops for the repair of electrical equipment of the rolling stock, various methods of additional tests of asynchronous motors after repair under load are used, which generally do not correspond to the required level of test reliability [7, 12, 19, 22].

Several electric motors are powered by a common active rectifier and DC link. Since the power of the frequency converter can be several times higher than the power of AR, this solution can significantly simplify the system [4, 16, 21].

Just like a stand-alone inverter, an active rectifier inverts the DC voltage of the filter capacitor into a pulsed voltage at its AC terminals. These clamps are connected with the supply mains through the BR buffer reactors [8, 9].

In systems for testing asynchronous motor, it is important that the operating frequency of the voltage at the terminals of the alternating current active rectifier is constant and equal to the frequency of the supply network. The difference between the instantaneous values of the sinusoidal voltage of the supply network and the impulse voltage at the AC terminals AR are perceived by the buffer reactors, which are integral elements of the system, the inductance provides an increasing mode of operation of the converter [15, 18, 23].

At present, on the territory of many electric machine repair organizations, it is prohibited to recover electrical energy at enterprises in order to preserve its quality. In this case, it is possible to use a load device with the accumulation and circulation of electrical energy within the circuit, which is shown in Figure - 2.

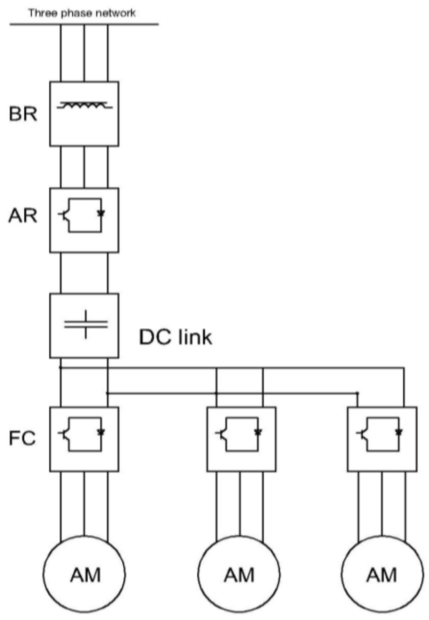

Figure 1. – Scheme of a stand for testing AM with the use of AR for electrical energy recovery

This circuit solution provides for the return of electricity not directly to the network, but its accumulation in the DC circuit. The transition to direct current is possible with the help of a rectifier [14, 19, 23]. Energy can be stored in a capacitor for immediate use in the DC link of the proposed system. It is also possible to use and charge an additional battery or supercapacitor.

A frequency converter with a DC link includes a three-phase rectifier and an inverter for converting direct current into a three-phase alternating current with a given frequency [16, 19, 22]. A capacitor is used to store DC energy, and a DC voltage converter is used to stabilize the voltage. With the help of the rectifier 5, the current is converted [16, 18]. The inverter and inverter are controlled by a microcontroller.

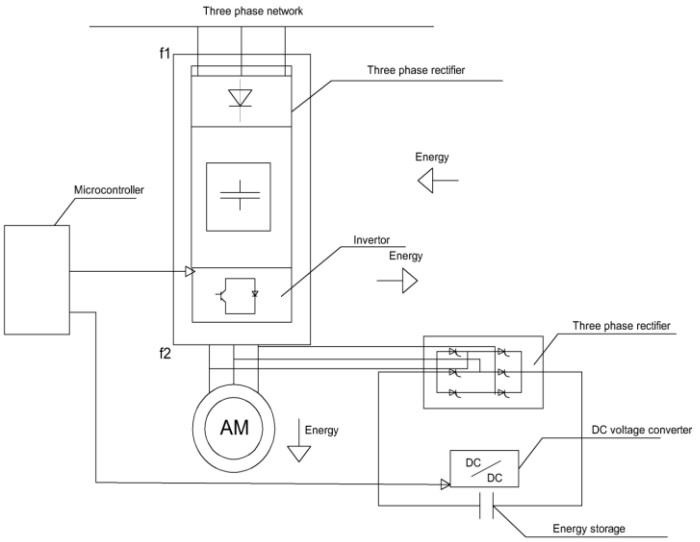

Figure 2 - Diagram of a loading device with electrical energy circulation

The scheme works as follows. The frequency converter is supplied with a three-phase voltage with a frequency of 50 Hz. Further, with the help of a controlled inverter and a microcontroller, a sharp decrease in frequency occurs. The asynchronous motor goes into the regenerative braking mode with the return of electrical energy to the network. With the help of a microcontroller and a DC-voltage converter, the charge voltage of the capacitor is maintained through a three-phase rectifier.

In order to artificially load the machine by changing the control signal of the microcontroller to the inverter, the voltage frequency is changed to the nominal value. After the ADT acceleration, this cycle is repeated again [18, 19, 23]. The capacitor is discharged to the DC link of the frequency converter at the time of acceleration of the machine and feeds it with the energy stored at the time of recuperation. This results in significant energy savings for the testing process.

Conclusion. The diagram shown in Figure-2 allows saving electrical energy without recuperating into the network. But when evaluating the results obtained given up a three-phase asynchronous motor energy with artificial loading, this decision may be ineffective. The expediency of using a circuit with the conversion of alternating current energy into direct current energy and its accumulation can be justified when testing a three-phase asynchronous motor of significant power. The return of electrical energy to the network or return within the same circuit when testing a three-phase asynchronous motor of low power is economically impractical.

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