ROLLING STOCK WITH ASYNCHRONOUS TRACTION ELECTRIC MOTORS

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Currently, the electric drive of the absolute majority of systems can be made on the basis of an asynchronous squirrel-cage motor with a thyristor frequency converter. The development of power semiconductor technology, in particular, the development of manufacturing technologies for power lockable thyristors (GTO - thyristors) and insulated gate bipolar transistors (IGBT - transistors), made it possible to create powerful energy systems with asynchronous drive and control of almost any degree of complexity. Compared with a DC electric drive, the advantages of the frequency converter - asynchronous motor system are ease of operation and relatively low cost of the electric motor; disadvantages - the complexity and high cost of the power part of the frequency converter [1].

Until recently, the main element of the power chain of the locomotive was the DC traction motor, the electro-mechanical characteristic of which satisfies the traction conditions to the best extent. However, collector traction motors are nodes with relatively low reliability indicators, because are among the most intense machines in terms of heating, mechanical strength and switching among electrical machines. Currently, rolling stock with brushless traction motors, mainly asynchronous traction motors, is being widely introduced all over the world. Such a traction electric drive can significantly improve the performance of locomotive power electrical equipment: the cost of repair and maintenance of electric motors is reduced by 2.4 times; their weight and dimensions are reduced; due to the regulation of the moment, it is possible to use the adhesion of the wheels with the rails more efficiently; in the nominal mode of operation, an asynchronous traction motor has a higher efficiency value compared to a collector motor [2].

Efficient use of asynchronous TIM in the power circuits of locomotives requires the development of complex control algorithms implemented using on-board computers. On modern locomotives, frequency-current control systems of the TIM are used, which make it possible to obtain high efficiency of its operation in operation. However, the issue of the influence of operating conditions on the algorithm of rational control of the TIM has not been studied so far, in particular, to what extent the thermal state of the electric motor affects the parameters of rational modes and performance indicators of its operation in the power circuit of the locomotive.

Increasing the energy efficiency of sectors of the national economy are key tasks for the socio-economic development of any state. Resource efficiency, energy efficiency, resource saving and energy conservation are the priority areas of technological development identified in the energy strategy of the Republic of Uzbekistan for the period up to 2030.

Uzbekistan has a large-scale underutilized energy saving potential that can compete with the increase in the production of all primary energy resources in solving the problem of ensuring the country's economic growth.

In order to reduce the energy intensity of the economy and implement an energy-saving policy, Uzbekistan is encouraging the introduction of energy-efficient engines and the modernization of railway transport.

Today, motors with an efficiency of 1-10% higher than those of standard machines are considered energy efficient. Moreover, if we are talking about large engines, the difference is 1-2%, and in low-power machines it can reach 7-10%.

High efficiency in engines is achieved due to:

- increase in the mass of active materials;
- use of materials with improved characteristics;
- design changes in the machine (reduction of the air gap, optimization of the tooth-groove zone of the magnetic circuits and the design of the windings, the special design of the fan);
- use of advanced bearings.

In addition to higher efficiency, motors with increased energy efficiency are characterized by an extended service life. With an increase in the efficiency of the engine, the losses in it decrease, as well as their thermal effect on the machine parts. And heating is one of the main factors determining the duration of operation of the most vulnerable element of the motor winding. At the same time, the increase in the energy efficiency of machines is reflected in other technical and economic indicators. According to statistics [3], the cost of machines with increased efficiency is 10–30% higher than conventional ones, their weight is also slightly larger. An increase in the mass of active materials by 3-6% increases the moment of inertia of the rotor by 20-50%, as a result of which such engines are inferior to conventional ones in terms of dynamic performance.

Directions of development and requirements for traction electric drive. An analysis of the products of manufacturers of drive systems and research materials in this area allows us to note the following trends in the development of a traction electric drive:

1. An increase in the share of drive systems with brushless AC motors and a decrease in the share of drive systems with DC motors, due to the low reliability of the collector assembly and the higher cost of DC brushed motors compared to AC motors.

2. Primary use for traction purposes of controlled drives based on asynchronous motors with a squirrel-cage rotor and static frequency converters.

3. Growing interest in drives based on multi-phase electric machines and machines with permanent magnets.

4. Complication of the structures of control systems and control algorithms of the electric drive, associated with the need to provide a wide range of speed control and high speed.

5. Increasing the operational reliability, unification and improvement of the energy performance of the electric drive.

Among the investment and innovative priorities for the development of railway energy, the creation of a new generation of energy-efficient rolling stock is noted [4,5].

Technical requirements for new generation electric locomotives include:

- increase in locomotive performance by at least 5%;
- reduction of fuel consumption by at least 10%;
- increase in runs between technical inspections and repairs by at least 50%;
- reduction of operating costs for maintenance and repair by at least 25%;
- use of component equipment of Russian production.

It should be noted that the development of our own systems of energy-efficient traction electric drive is of key importance in preventing the country's dependence on imports.

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