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RESEARCH ON ELECTROMAGNETIC PROCESSES IN A HIGH-VOLTAGE ASYNCHRONOUS ELECTRIC DRIVE

The application of an automated, regulated electromechanical system is considered the most relevant and effective means of energy conservation. The main energy losses (up to 90%) occur in the energy consumption sector, where the primary efforts for the rational use of electricity should be concentrated. Electromechanical systems in all developed countries consume up to 70% of the total electricity produced. The most significant energy savings can be achieved by using regulated electromechanical systems in combination with the automation of technological processes. For example, one of the most energy-intensive electromechanical systems is the main ventilation fans in coal mines. The average installed capacity of electromechanical systems for fans ranges from 1000 to 1600 kW, while the most powerful installations reach up to 4000 kW. As a drive motor in such systems, asynchronous motors with a wound rotor (AMWR) are used. Therefore, electromechanical systems with AMWR are of particular interest today, as they are widely used in hoisting and transport mechanisms, as well as in conveyor systems. The use of smooth regulation in modern electromechanical systems significantly reduces electricity consumption, mechanical loads, and wear of mechanism components, which substantially increases system reliability.

The aim of this work is to study the electromagnetic processes in the circuit of the phase rotor of a high-voltage induction motor connected to the network through a step-up converter, to determine the parameters of the converter and their relationship with the voltage gain to ensure the optimal level of energy efficiency of the electromechanical system.

As a result of the conducted research, a methodology has been proposed for determining the gain coefficient of the converter and the parameters of the rotor circuit of the electromechanical system. This methodology allows for the determination of the transformation ratio of the matching transformer at the optimal gain coefficient for voltage. The proposed approach can be applied in modeling complex high-power high-voltage electromechanical systems, particularly for stationary industrial fan installations. The conditions for the fault-free operation of the inverter at the startup moment of the electromechanical system have been determined. Achieving these conditions is ensured by determining the delay of the control signal to the power switches of the boost-type converter inverter. A relationship has been established between the voltage gain coefficient and the equivalent resistance of the rotor circuit of the electromechanical system, which ensures the matching of the rotor's electromotive force (EMF) with the supply network voltage while maintaining a high level of energy efficiency in the electromechanical system.