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COMPARATIVE ANALYSIS OF RHEOSTAT-CONTACTOR AND MICROPROCESSOR CONTROL SYSTEMS FOR HIGH-VOLTAGE ELECTRIC DRIVES

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Annotation: Increasing the level of automation of domestic electric locomotives through the use of digital control subsystems for electromechanical devices will reduce the failure rate by using a highly reliable contactless element base and expanding the functional and diagnostic capabilities of the control system as a whole.

Keywords: power circuit, electric drive, asynchronous motor

In accordance with this goal, the following tasks were set and solved in the article:

1) a digital subsystem for automatic control of brake switches and switching devices for switching on traction and braking modes of an AC electric locomotive has been developed on the basis of a traditional functional scheme, equipped with feedback circuits and characterized by the use of digital contactless devices and high-performance network technology;

2) the organization of a digital subsystem for automatic control of traction electrical devices is proposed using the principles of a multichannel majority system, characterized by high safety indicators and allowing to prevent dangerous failures in case of hardware and software defects.;

3) advanced algorithms have been developed to control the preparation and activation of traction and regenerative braking modes

The development of the production of electric motors and control systems for electric drives makes it possible to modernize the equipment of the metalworking industry by replacing the traditional electric drive with an electric drive with high control and energy characteristics in a wide range of angular velocities. The paper compares the electric drives of metal-cutting machines: an electric drive based on a DC motor (DCT) with excitation from permanent magnets and an electric drive with a valve motor (VD). The mechanical, adjustment, and energy characteristics are analyzed, and the operating features of two types of electric drives are noted. The issue of modernization of metal-cutting machines by replacing the traditional electric drive based on DPT with an electric drive with VD is considered.

Electric drives are the main consumer of electricity (up to 60%) and the main source of mechanical energy of industrial equipment. Electric drives of industrial machines must ensure set speeds of movement at working and idle speeds when exposed to external loads, the accuracy of movement of working mechanisms, as well as high reliability and ease of maintenance. In traditional machines, electric drives based on a DC motor (DCT) are responsible for moving the working bodies, the control circuit of which is a two-circuit control system for rotation speed and current or reverse EMF of the armature. A thyristor converter with blocks of pulse transformers is used as a power circuit. Electric drives of this type have a wide range of speed control. They hold high torque at low speeds and are characterized by simple reversing. However, due to the design features and control scheme, DPT-based electric drives have the following disadvantages: - brush collector assemblies create sparking inside the machine, which reduces the reliability of operation and requires periodic maintenance of the electric drive.; - when using thyristor converters, the power factor for voltage regulation is low, it requires doubling the elements during reverse control, and it becomes more difficult to control the locking moment of the thyristors.

Despite their high technical properties, direct current is in many ways inferior to asynchronous motors in terms of economic and operational performance. A comparison of the technical and economic indicators of DC motors of the general industrial P series and

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asynchronous motors of the unified A series shows that with the same power and rotation speed, DC motors are 1.2- 1.5 times heavier in weight, 3 times more expensive than asynchronous motors, and their torque is 1.5—2 times greater. The dynamic properties of DC motors are also less favorable; for example, the ratio of the stepping torque to the rated torque of DC motors is 2-2.5 times greater than that of asynchronous motors. DC motors are structurally more complex, require significantly higher consumption of non-ferrous metal, and are more labor-intensive to manufacture. The presence of a collector in a DC motor, an element that requires constant and careful maintenance— complicates operation and reduces reliability. It should be noted that the efficiency of even very large drives in the system does not exceed 0.75—0.80, and in some cases drops to 0.6—0.65 and even lower.

Rheostatic control of a phase-rotor asynchronous motor is often used for smooth start-up and speed control.However, with the rheostatic engine control method, smooth start-up is ensured only by increasing the number of starting stages, which forces the use of bulky relay-contactor panels with a large number of heavy switching equipment. A constant permissible heating moment is provided over the entire control range. Speed control by introducing an active resistance into the rotor circuit has the following disadvantages:

a) the mechanical characteristic acquires a significant steepness;

b) the speed control limit depends on the degree of engine load, and it narrows as the load decreases.;

c) when idling, speed control is almost impossible;

d) the energy consumption in the secondary circuit of the engine during speed control is determined by the range of change of the latter and the nature of the dependence of the static torque of the driven mechanism on speed.

In many cases, good control performance can be achieved in an open-loop system. With increased requirements for the electric drive, it is necessary to use one or another feedback, i.e. the use of a closed control system. The resulting speed control range in open systems is 5-10, and in closed systems its value can reach 1000 or more. The frequency control method is currently becoming more widely used. Moreover, it is possible to name cases where the use of a frequency-controlled asynchronous electric drive is the only possible one, for example, the drive of high-speed electric spindles, electric turrets, fans of high-speed wind tunnels, various test benches, etc.

The most suitable electric drill drive system for the UBSH 501 AK drilling rig was the IF-AD system, which includes a frequency converter with a direct current link and an asynchronous motor with a closed-loop rotor. This system allows you to adjust the rotation speed of the drill in the range from 0 to 970 rpm, depending on the hardness of the rock, so that you can achieve maximum drilling speed.

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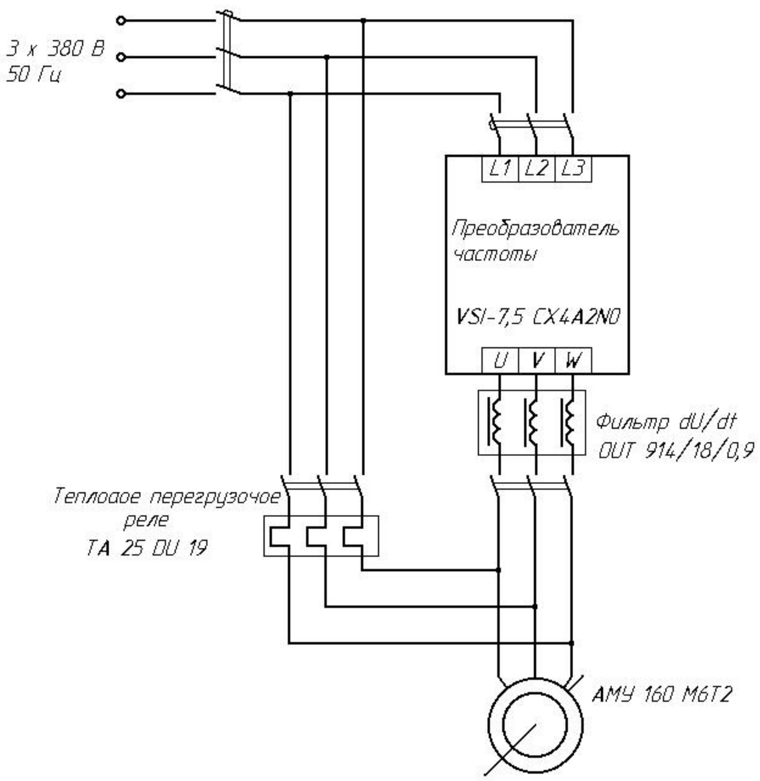

Structural diagram of the drive power unit

The most suitable for use in a drilling rig is an explosion-proof asynchronous motor with a closed-loop rotor of the AMU 160 M6T2 type.

The motor interface and control unit is based on a programmable microprocessor. The microprocessor controls the electric motor based on the received measurement data, set parameters and control signals coming from the control panel and I/O. In turn, the interface and control unit control the SIFU circuit, which outputs the required control pulses to IGBT transistors. The amplifier amplifies the control pulses coming from the SIPHON to the IGBT transistors.

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