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TO THE QUESTION OF THE VOLTAGE STABILITY ENSURING FOR COMPLEX MONITORING SYSTEMS OF METAL'S STATUS

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ABSTRACT

The paper considers one of the tasks that need to be solved when developing complex monitoring systems of metal's status, which is to ensure the stability of the supply voltage, and the results of compensatory voltage stabilizer development are given. The analysis results of the adopted circuit solutions correctness are shown and the conformity of the stabilized power supply parameters to the given conditions is proved.

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Introduction. The creation of new and improvement of existing high-tech control systems requires the rapid receipt of objective and most accurate information about the large number value of physical quantities, which characterize the state of the metal in the stressed state. Such approach implementation will increase the probability of metal's status monitoring in operating conditions. Today, integrated multichannel information and measurement systems are used to ensure the required accuracy and speed of measurements. A number of requirements are set for such systems, starting from ensuring the stability of their power supply. This work is devoted to solving this issue.

The results of research. The analysis peculiarities of building systems for metal products integrated monitoring based on the simultaneous use of two or more methods showed, that such tools should have a simple technical implementation, high informativeness and satisfactory speed of the control object technical condition information.

Based on the results of previous studies [1], we concluded this problem can be solved by combining the ultrasonic method and thermal control, which allows to record changes in energy flows which are generated in metal, and the values of the obtained informative parameters from contact microelectronic sensors high-speed and high-frequency ultrasonic transducers to establish the moment of the microcracks formation and its development.

Works that have to be done in order to improve the means of control [2] require addressing a number of new issues and approaches that will radically improve the characteristics of the existing system control of stress-strain state metal structures. The task of creating new measuring channels in the system requires making informed decisions on the structural, circuit and mathematical support of the control, which will further determine the reliability and the system metrological characteristics as a whole.

In the most modern information and measurement systems (IMS) measurement processes is based on the use of processes for transferring the values of measured physical quantities to change the voltage or current amplitude, frequency or phase of electrical signals. Therefore, the accuracy of measurements in such IMSs is determined not only by the perfection of these transfer processes technology, but also by the accuracy of the obtained changes measurements in the electrical signals parameters [3].

Analyzing the possible computerized system architecture for comprehensive monitoring in the light of finding approaches to ensure reliability and accuracy of control, among the first tasks is to provide the system with a stable power supply that prevents overload and surges or high voltage pulses. To date, a number of stabilized power supplies are known, which are used to reduce interference when turning the power on and off, as well as to increase the life of the connected equipment.

This paper presents the research and study results of the main characteristics of the developed stabilized power supply, which was performed in scope of student research.

In the solving problem of providing a control system with a reliable stabilized power supply, it was necessary to analyze fundamentally different methods of voltage stabilization: parametric and compensatory. In the parametric method, the destabilizing factor acts on the parameter of the nonlinear element, which in some way weakens the effect of the destabilizing quantity. Stabilizers of this type use elements with a nonlinear relationship between current and voltage. The principle of stabilization here is based on the change in the resistance of the nonlinear element that is part of the circuit, when changing the applied voltage or current flowing through it. As a result of currents and voltages redistribution between the individual circuit elements the stabilization of the output voltage is achieved. The advantage of the parametric method of stabilization is the scheme simplicity, which consists of a small number of elements. The main disadvantages are low efficiency and low stabilization factor [4].

The compensation stabilization method involves comparing the stabilized output voltage with the reference voltage. The voltage difference after comparison acts on the regulating element of the stabilizer so that it compensates the change in output voltage that occurred. The adjusting element of the stabilizer can operate in continuous (analog) or pulse (key) mode. Basing on this, stabilizers of the compensatory type are divided into continuous and pulsed.

Compensatory stabilizers have a significantly higher stabilization coefficient compared to the parametric and higher efficiency, reaching 70% (parametric not more than 40%) [5]. That is why the compensatory stabilization method was preferred.

The parameters of the stabilized power supply circuit calculations were performed basing on the following requirements: rated voltage in the network U_{nom} = 220V; network frequency f_m = 50 Hz; pulsation coefficient K_p = 0.1%.

To confirm the efficiency and evaluate parameters of the developed unit and voltage stabilizer of the compensatory type and the compliance of its characteristics with the initial requirements, its main parameters were determined using the circuit modeling program Micro-Cap.

Using main features of the Micro-Cap 9 program, the transients in the circuit when applying the supply voltage and the corresponding actions of arbitrary shape were analyzed, followed by plotting the variable states of the circuit.

Conclusions. The correctness analysis of the circuit solutions allows us to conclude that the parameters of a stabilized power supply based on a compensating stabilizer that works as a closed automatic control system with feedback and a sufficiently high stabilization factor (≈30%) and an efficiency of about 70%. The compensation stabilizer is mounted as separate unit. It is powered by a rectifier mounted also as a separate unit. Therefore, the developed stabilized power supply can be used in a computerized system for complex monitoring of metal products condition status in a stress-strain state.

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