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MECHANICAL AND THEORETICAL ENGINEERING

P. D. Balakin, V. N. Belkov
Theoretical statements for synthesis of conjugate couplings

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The conditions for the synthesis of conjugate couplings are systematized on the basis of a single geometric-kinematic criterion, which consists in the equality of the velocity projections of the points of the active surfaces that make up the higher pair on the common contact-normal to these surfaces. The technology of formation of a family of conjugate couplings by a two — parameter envelope by an involute helicoid or its particular varieties-a circular cone or plane-is theoretically justified.

Keywords: conjugate coupling, the active surface, the transfer function of speed, the two-parameter diffraction.

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Assessment of vibration isolation in «Flexible connector−pipeline−vibration isolators Pendants» mechanical system

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When designing pipeline systems, the question of reducing the vibration load transmitted from vibroactive elements (pumping units, compressors, etc.) through the pipelines to the base almost always arises. In this case, as a rule, when laying pipes, one end is connected to a vibration source through flexible elements (bellows, elastic compensators, pipes). The pipeline is installed on hangers with vibration dampers.
The paper considers the issues of calculating the mechanical resistance of flexible connectors, pipelines and vibration isolators of suspensions, as well as analytical dependences and the results of numerical calculation of the forces transmitted to the base and the radiated power depending on the frequency.
The graphic materials show the frequency characteristics of the forces on the base and vibration power, depending on the considered mechanical system parameters.

Keywords: mechanical system, vibroactive unit, power, pipeline, mechanical resistance, vibration isolator.

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V. S. Serdyuk, E. V. Bakiko
Human factor parameters influence scaling on professional risk level at engineering facilities

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The article deals with the workplace safety issues in the machine-building industry taking into account the human factor influence. The significance and quantitative assessment of the human factor influence on the occupational risk level is shown. An integral criterion for assessing the human factor influence on the occupational risk level is proposed, which can be used by specialists in their work. Rating scales «Perception of information», «Decision-making» and «Actions performing» are developed for practical calculations. The empirical and weighted coefficients of the integral criterion parameters reflecting the dependence of the human factor influence on the occupational risk level are determined. A logarithmic dependence between the human factor and the occupational risk level is established.

Keywords: occupational risk, human factor parameters influence scaling, scaling, human factor integral criterion, quantification, expert method, risk.

E. M. Zimin, V. V. Martishkin
Determining quality of technologies taking into account main production and organizational measures

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The article presents the list of singular indicators of technological support of technologies and the method of determining their actual values and their quality levels. According to the results of determining the quality level of technological processes, one of three management decisions can be made. The paper describes singular quality indicators that are directly related to the quality of technological processes in the machine-building industry, at the stage of design and preparation of technical documentation. And also presented are complex quality indicators, based on which determine the generalized indicator of quality of the evaluated technological process. As a result of the work the features of conformity assessment of technological processes and related mandatory requirements are formed. Also described is the process of obtaining a qualitative and quantitative assessment of the quality of the technological process with a detailed description of all necessary formulas.

Keywords: input control, mathematical models, parameters for detail quality calculation, quality index, circuit diagram, technological equipment, technological process, technological support of technologies, quality management, management decisions.

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Problems and prospects of development and application of risk management software from point of view of quality management systems

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The article deals with the development and application of software (software) «Solomka» for risk management of quality management systems (QMS). The problems and prospects of its application from the standpoint of management systems are highlighted. This topic will be of interest to specialists in the field of standardization and certification. The characteristic features of the application of the process and risk-oriented approaches in the construction and maintenance of management systems are highlighted and described. This article provides an analysis of user requirements for QMS risk management software, as well as a market research of proposals for similar software with a description of the advantages and disadvantages of each. This article provides an analysis of user requirements for QMS risk management software, as well as a market research of proposals for similar software with a description of the advantages and disadvantages of each. As a result of the work, the terms of reference for the development of software for risk management of QMS processes were substantiated, and user requirements for software were identified.

Keywords: quality management system, process, process approach, risk, risk-oriented approach, software, risk management, requirements of software users.

ELECTRICAL ENGINEERING

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Identification of parameters of mathematical models of nonlinear components of electrical complexes and systems in their deep interaction

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The article offers a method for identifying parameters of mathematical models of electrical complexes and systems. The method is designed to create a system for monitoring the influence of nonlinear components of electrical complexes and systems in their deep interaction on the quality of electrical energy in the load node. The application of the coefficient of variation of parameters as a criterion for evaluating the reliability of identification of parameters of mathematical models is justified. As the initial information, digitized data of the voltage at the point of common connection and the currents of individual components of the analyzed complex are used. The mathematical apparatus of identification is based on a modification of the Marquardt method. A series of computational experiments confirms the main theoretical provisions of the article. It is shown that it is possible to identify the parameters of models of complex components with a significantly nonlinear form of stress at the point of common connection.

Keyword: electrotechnical complex, point of General connection, quality of electric energy, optimization, Marquardt method, identification of parameters of mathematical models.

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Experimental study for determining parameters of pulse conducting electromagnetic interference in vehicle's onboard network KAMAZ 5350

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The widespread introduction of high-tech electronic products designed to work on military vehicles establishes the need to strictly meet the requirements for their electromagnetic compatibility for conductive interference in on-board networks. The article analyzes the sources of electromagnetic interference in the vehicle's onboard network. The paper presents the results of experimental studies to determine the parameters of pulsed conductive electromagnetic interference in the on-Board network of the KAMAZ 5350 car and determine their compliance with the requirements for electromagnetic compatibility.

Keywords: on-board power network, conductive interference, electromagnetic compatibility, noise immunity, noise emission, static analysis.

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Features of practical application of electric power system's stability estimation methods

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Timeliness of the topic is conditioned by the need to keep up ample of static and transient stability margins in modern electrical power systems. The article object is to give a determination of present methods of evaluating damping of systems with synchronous machines, in the context of their effectiveness. And also to estimate the effectiveness of these methods in the performance of the task concerned with selecting best settings of automatic excitation regulators of synchronous generators. This analysis led us to the conclusions, in particular, about possibility to apply the root locus methods in estimating stability of electrical power systems, and also about genericity of the matrix method with the use of QR-algorithm, which is widely used in practice of calculating stability

Keywords: stability, damping, quality of the transition process, root, integral and frequency methods, D-decomposition, QR-algorithm.

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Research and calculation of magnetic system of built-in axle-box generators of freight cars

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The article deals with the issues of providing communication, as well as diagnostics and telemetry of freight cars. The growth of rail traffic is currently placing increased demands on the levels of safety, automation and an increase in the average speed of freight trains. These requests can be solved through the introduction of modern GSM communication systems and geolocation. At the present time, a system for detecting the descent of a freight car has been developed and is being tested, which makes it possible to record the descent within a few seconds and transmit a signal to the train driver via a radio channel. The systems for monitoring the location of wagons and locomotives are no less important. However, one of the current problems is the lack of autonomous power supplies for communication and diagnostic systems. Since wired power systems have a number of disadvantages, the article discusses the creation of a power source based on an alternator with permanent magnets. This generator is driven by energy from a wheelset. The article presents the results of a numerical experiment on the magnetic system of axle-box generators using the ElCut software.

Keywords: autonomous source, geolocation; diagnostics; generator; freight car.

O. V. Arkhipova, N. N. Dolgikh,
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V. Z. Kovalev, D. S. Osipov

Wavelet transform algorithm of daily load graphs for choosing parameters of hybrid energy storage

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The paper presents an algorithm for frequency decomposition of daily load graphs based on a discrete wavelet transform. This algorithm makes it possible to choose the optimal type of wavelet function, optimal level and wavelet decomposition tree. The inverse wavelet transform (recovery) along a single branch of the approximating coefficient allows obtaining the low-frequency component of the power graph for selecting the optimal mode of the hybrid energy storage battery. The detailing branch of the wavelet coefficients determines the operating mode of the supercapacitor. A numerical experiment is built on the basis of data obtained using certified equipment.

Keywords: wavelet transformation, isolated electrical complexes, hybrid energy storage, supercapacitor, isolated power supply systems.

D. A. Polyakov[1], N. A. Tereschenko[1],
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Investigation characteristics of partial discharges in artificial defects of power transmission lines

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The article describes the study of the characteristics of partial discharges (PD) in various types of artificial defects in cable lines. A total of 13 types of insulation defects are considered. The PD measurements are carried out using a high AC voltage source and a commercial PD recorder. For each type of defect, diagrams of the amplitude-phase distribution of PD (APDPD), the average value of the apparent discharge, and the PD intensity are obtained. The results of the study show that most of the defects of insulators of overhead power lines have a relatively high intensity of partial discharges with a small average apparent charge. In the samples of cable lines, relatively high values of intensity and average apparent discharge are recorded in the presence of a defect in the end seal and a defect in the ground electrode in the form of a needle. The results obtained can be used in the development of devices for detecting defects, as well as for expanding the base of diagrams (APDPD).

Keywords: partial discharge, apparent charge, artificial defect, insulation breakdown, insulator, insulation fault recognition.

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Mathematical modeling of service life of cables polymer insulation

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The studies of the service life and residual life of various insulating materials are described. The known mathematical models of insulation aging applicable to AC power cable lines are considered. Based on the models and the previously proposed approach, the service life and residual life of cables with XLPE, EPR and PVC insulation are estimated. The assessment is carried out using the data from monitoring the voltage and current of a 6 kV cable transmission line laid at one of the electric power enterprises. Air temperature obtained from open sources. The results showed the applicability of all models for estimating the residual life due to the small difference in the predicted life. In real conditions, the service life of the listed types of insulation can be different due to their dielectric and design features.

Keywords: electrical insulation, cross-linked polyethylene insulation, ethylene-propylene rubber, polyvinyl chloride insulation, residual insulation resource, insulation service life.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

V. I. Panteleev, A. V. Maleev
System monitoring intensity of glaze-clear ice generation on wires of overhead transmission lines

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Improving the reliability and efficiency of power supplying by reducing accidents in electrical networks caused by intense ice and wind loads is an important comprehensive task. The solution of this problem consists of several mainly stages: timely detection of the onset of ice formation, impact on the device for removing ice and frost deposits and efficiency of removing of ice monitoring. This article discusses a system for detecting ice formation based on a fundamentally new technique using the technology of «machine vision». The developed system of ice formation makes identify the thickness of ice wall and indirectly, by the angle of deviation of the wire relative to the horizontal position, to determine the mass of ice deposits and wire sag. Considered monitoring system is located on support in close proximity from the wire and consists of the following mainly elements: an electronic unit, an optical sensor, a solar panel and GSM antenna.

Keyword: the icing monitoring system of overhead transmission lines, machine vision, early detection of glaze-clear ice generation.

N. A. Davletkildeev, I. A. Lobov,
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Structural, capacitive and energy characteristics of electrochemical electrodes based on polyaniline/multi-walled carbon nanotube nanocomposites

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Polyaniline nanocomposites with nitrogen-doped multi-walled carbon nanotubes, initial and functionalized argon ions are prepared by the in-situ chemical oxidative polymerization of aniline. The morphology of obtained nanocomposites are studied by microscopic methods. The capacitive and energy characteristics of electrochemical electrodes formed by pressing nanocomposites have been studied by cyclic voltammetry. It is shown that an electrode based on a nanocomposite with functionalized nanotubes has the highest specific capacity and energy due to the high porosity of the surface. However, the low mechanical strength of this electrode leads to a decrease in its cyclic stability.

Keywords: polyaniline, carbon nanotubes, nanocomposites, cyclic voltammetry, specific capacity, cyclic stability.

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Electron work function in individual multi-walled carbon nanotubes doped with nitrogen and boron

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Multi-walled undoped and doped with nitrogen and boron carbon nanotubes have been synthesized by chemical vapor deposition. Based on the analysis of images obtained by electrostatic force microscopy at various tip voltage, the value of the external contact potential difference between the tip and individual carbon nanotubes is determined. Using the obtained value of the contact potential difference, the electron work functions for undoped and doped with nitrogen and boron individual carbon nanotubes are calculated, which amounted to 4,7; 4,6 end 5,75 eV, respectively.

Keywords: doped carbon nanotubes, electrostatic force microscopy, contact potential difference, electron work function.