

MECHANICAL AND THEORETICAL ENGINEERING

A. V. Borodin, Yu. A. Ivanova, D. B. Grits

Freight car axle unit with increased rigidity of axis neck

The reasons for decrease in loading capacity of freight car axle box unit are considered. Ways of modernization of axle box unit with the increased rigidity of a neck of an axis are offered as follows: application of the axis with step neck with increased diameter of the step for placement of the back bearing; axes with reduced console part and the bearing of new design. Calculation of deflections and angles of rotation of sections of the modernized axes is executed by method of final elements. Suggested constructions reduce values of angles of rotation of roller bearings.

Keywords: freight car, axle box unit, axle, rigidity, roller bearing.

I. V. Boyarkina, E. V. Tarasov

The patterns of load distribution on rolling elements of bearings for centrifugal pump units in oil refining

There is developed new method calculating radial loads on rolling elements of the bearings of centrifugal pumping units with a small number of rolling elements. There are obtained laws of distribution of radial forces to the rolling element bearing pump units.

Keywords: rolling bearing, roller bearing, ball bearing, laws of distribution of radial loads, the geometric characteristics of bearing, centrifugal pump unit.

I. V. Boyarkina, E. V. Tarasov

New method calculating radial loads on rolling elements of bearings of centrifugal pumping units in oil refining

There is completed development of modern method of calculation of radial loads on rolling element of bearings. New scheme and method of calculation increases the accuracy of determining the radial force on rolling elements of bearings of pumping units in oil refining.

Keywords: bearing, roller bearing, ball bearing, radial load, the geometric characteristics of the bearing, dynamic load capacity, centrifugal pump unit, the number of rolling elements.

Yu. A. Burian, V. N. Sorokin, A. F. Zelov

Development and research of mathematical model of combined system of vibro-protection on the base of pneumatic resin-cord devices

The modern measuring devices and precise technological equipment often need effective protection from vibrations. The simplest, accessible and widespread vibroprotective facilities are passive elements. However, its application quite often appears ineffective. In a number of cases active vibroprotective devices are more effective means of protecting from vibrations.

Taking into account these circumstances it appears expedient to connect dignities passive and active systems for creation of the vibroprotective system possessing the best descriptions, i.e. to work out the combined system.

Keywords: vibroprotection, resin-cord shell (RCO), vibrations, system.

E. N. Eremin, T. V. Kovalyova

Determination of thermal characteristics of shell molds of sand-resin mixtures

There is considered heat conduction process in the sand and resin mixture. The calculated and experimental dependence of the amount of heat from the heating time is obtained. It is shown that the optimum for sand and resin shell technological thickness of 8–10 mm is the heating time to 25–30 sec.

Keywords: casting, mold, thermal conductivity, mixture, resin.

E. N. Eremin, A. S. Losev, S. A. Borodikhin, A. E. Matalasova, D. O. Mashanova

Effect of protective environment on properties of high-chromium deposited metal for valves coatings

There are presented the results of studies on the structure and hardness of metal coating by solid wire 20X13 in a variety of protective gas atmospheres. There is determined that a nitrogen-containing protective surfacing environment provides high-chromium metal with stable structure and properties instead of widely used gas mixture Ar + CO₂.

Keywords: protective gases, surfacing metal, hardness, nitrides, valves.

B. A. Kalashnikov, N. N. Rasskazova

Stability of automatic systems with discrete switching of elastic elements with straight-line characteristic of position force

There is determined the stability of the system of amortization with discrete switching parts of elastic elements in the considered parameter range. There are obtained the frequency characteristics of the exponent in the exponential solution of the differential equation for the deflection amplitude at a fixed ratio of the masses and limit perturbation. There is reviewed the work of positional power systems amortization with discrete switching parts of elastic elements. It is established that work of position force is multiple-valued function of the generalized coordinate and therefore work on the closed way will not be equal to zero.

Keywords: stability of stationary amplitudes, communication surface, work of position force, potential energy, an exponent, frequency characteristics.

V. I. Kuznetsov, B. A. Kalachevskiy

The bypass degree in bypass turbojet engine

The problem of calculating the actual parameters of the air at the inlet to the first and second contours of a bypass turbojet engine (turbofan) is considered. It is shown that the degree of bypass turbofan engines of less than 1.5 is necessary to take into account the change in height of the fan blades of air parameters. We obtain different values of total pressure and total air temperature at the inlet to the first and second loops and bypass ratio turbofan engines.

Keywords: bypass ratio fan, total pressure, the total air temperature, the first and second loop turbofan.

A. V. Zhdanov

Mathematical model of control valve of position hydraulic drive of road and construction machines

The article presents a solution to the problem of functioning of road construction machinery in cramped conditions by increasing the positioning accuracy of the driven element. The article gives a mathematical description of the main subsystem of the position hydraulic drive: hydraulic control valve with a dosing hydraulic machine, which is included in hydraulic negative feedback signal. Elements described hydraulic drive systems of differential and algebraic equations, input and output parameters are connected according represented with structural schemes.

Keywords: Road and construction machines, hydraulic control valve, negative feedback signal, differential equations, structural schemes.

K. V. Kostin, P. V. Petunin, R. B. Bayazitov, I. A. Kudryavtsev

The influence of complex alloying on increase of mechanical properties and strength titanium alloys

A method for estimation of efficiency of the influence of various elements of complex alloys on the performance of alloys in relation to the products of long-term and short-term resource is presented.

Keywords: alloying elements, strength of alloys, phase components, martensitic polymorphic transformation, stabilizers, plastic deformation.

N. S. Artemenko, D. S. Rechenko, Yu. V. Titov, A. O. Lila, A. I. Lopatko

Analysis of blade workability on hard materials based on nickel

The article deals with hard materials based on nickel and using these materials. The results of the experiments (the hardness of materials, surface roughness, wear plates) are obtained. The results can be used for the selection of tools for machining hard materials based on nickel.

Keywords: hard materials based on nickel, cutting inserts, hardness, roughness.

V. A. Taran, G. S. Russkikh, Z. N. Sokolovskiy

Modeling static deflection and natural frequency vibrations of sound insulating mesh-plate panel

The interaction of the support mesh and external components into the mesh-plate panel ZP-U manufactured by FSUE "NPP" PROGRESS" and modeled the static deflection of the first natural frequency in a horizontal position is presented. The adequacy of the simulation is verified by comparing the calculated deflections and natural frequencies with the results of the work ZP-U test in the FSUE "NPP" PROGRESS" and FSUE "CRI" named by academician A. N. Krylov.

Keywords: mesh-plate panel, woven metal mesh, elastic modulus, the frequency of oscillation, the static deflection.

ELECTRICAL ENGINEERING. POWER ENGINEERING

A. A. Lyashkov, D. S. Osipov, D. S. Satpaev, N. N. Dolgih, A. Ya. Bigun

The use of wavelet-transformation for decomposition of zero sequence currents at single-phase earth fault in networks with isolated neutral

The article describes the method of identification of single-phase earth fault in networks with isolated neutral on harmonic composition of currents of zero sequence. The method of the discrete wavelet transform to determine reliable information about the level of higher harmonics during the transition process occurs when single-phase earth fault.

Keywords: single-phase earth fault, high harmonics, zero-sequence current, Wavelet transform, insulated neutral, electrical transmission lines.

V. V. Kharlamov, D. I. Popov, M. F. Baysadykov

The impact of the DC machine profile collector on work of sliding contact

This article contains the results of research of the brush of DC machine interaction with the collector during operation of DC machines. There is developed design scheme and the mathematical model of motion of the brush in the brush holder box with rotating collector. The article includes the analysis of the calculated graphs for the brush moving.

Keywords: DC machine, electric brushes, brush wear, collector-brush assembly.

V. V. Kharlamov, D. I. Popov, A. P. Afonin, A. S. Ognevskiy

The increase in reliability of diagnosing of collector-brush unit of electric machines under condition of identical switching cycles

The article presents bipartite graphs of matching of defects and diagnostic parameters of collector-brush unit of DC machines. On the basis of the experiments, there is obtained regression equations to analyze the influence of various factors on the intensity of the arcing, as well as the nonidentity commutation at the same section from the turnover to the turnover of the armature (the nonidentity in time) and in various sections in one revolution of the armature (the nonidentity along collector). Recommendations to increase reliability of diagnosing mechanical problems are given.

Keywords: electric machine, diagnostic parameters, the collector-brush unit, the nonidentity of commuting cycles, standard deviation of intensity sparking.

S. N. Chizhma, A. V. Sklyar, D. A. Elizarov

Slot harmonics estimation method with stator current analysis of asynchronous motor

This study shows an algorithm that allows the automatic search of slot harmonics in the spectrum of the stator current signal. It gives an example of the algorithm and recommendations for improving its work. This method can be used to develop a device for sensorless estimation of rotor speed induction motors.

Keywords: slot harmonics, stator current spectrum, stator voltage spectrum, slot harmonics estimation, FFT.

D. V. Batulko, K. I. Nikitin, L. V. Vladimirov, A. Ya. Bigun

The use of special zero sequence current transformers with devices for ground shortcut protection

The article describes the characteristics and methods of measurement of zero sequence current during single-phase ground shortcut in medium voltage networks. The classification of the zero sequence current transformers is submitted. The analysis and results of experiments on the use of various types of special transformers of zero sequence current to determine the damaged accession at single-phase earth fault in medium voltage networks are obtained. Recommendations on application of transformers of zero sequence current with different protection types are given.

Keywords: current transformer zero sequence, single-phase ground fault, devices for protection of ground fault, distribution networks.

D. S. Osipov, S. Yu. Dolinger, D. G. Safonov

Development of algorithms for automatic calibration of compensation for capacitive currents by existing methods

The article provides an overview of existing methods of setting compensation of capacitive currents when changing the network configuration. As best practices for pre-compensation settings in normal operation it is proposed to use a phase or amplitude (extreme), and to adjust to the ground in the circuit mode – the phase, frequency. For automatic tuning arc suppression coil developed a new algorithm using wavelet transform circuit voltage waveform zero sequence.

Keywords: arc suppression coil compensation of capacitive current, automatic adjustment, single-phase ground fault, wavelet transform.

D. S. Osipov, D. V. Kovalenko, B. Yu. Kiselyov

Calculation of energy losses in cable transmission lines in the presence of nonlinear loads by method of wavelet packet decomposition

The article considers the power supply system under non-stationary mode of power consumers. Nonlinear loads are sources of higher harmonics. The calculation of currents, power losses and energy separately for each harmonic using different methods: at current values of currents separate harmonics over the known period of time and the method of wavelet packet decomposition of a signal current. The results are compared with the values of energy losses obtained by different methods and calculated the values of errors determining energy losses.

Keywords: power supply system, higher harmonics, Fourier transform, wavelet decomposition, wavelet coefficients.

A. A. Tatevosyan, V. S. Mishchenko

Simulation of magnetic field of synchronous generator with permanent magnets

The paper describes an approach to modeling the magnetic field of synchronous generators with permanent magnets. High interest in low-energy construction of independent power supply makes the actual task of designing energy-efficient designs of synchronous magnetoelectric generator. The central place is occupied by the study of the magnetic field and determining the optimum law inducing changes in the working gap with subsequent calculation of the induced electromotive force (EMF) in the phase windings of the generator. The technological complexity of assembly of synchronous generators with high-coercivity permanent magnets caused great attraction forces between the

structural elements of the armature and the inductor, requires additional manufacturing equipment and making personnel security measures during the assembly work. In the above article, a study of the magnetic field of the synchronous generator with permanent magnets using the method of finite element analysis in Elcut 6.0 software complexes and ANSYS Maxwell, and proposed a method for calculating the induced voltage in the phase windings of the synchronous generator. The results of calculation of EMF phase windings of the synchronous generator are compared with experimental data obtained in the laboratory bench.

Keywords: magnetoelectric machine, the electromotive force of the synchronous generator phase winding, finite element analysis of the magnetic field.

A. V. Demin, R. N. Khamitov

Researching electromagnetic stiffness compensator force changes depending on its design

This article associated with researching the influence of various designs damping devices on the resulting force, namely the effect of the separation of the electromagnetic coils and the addition of sections on the magnetic force exerted on the various passages of the solenoid's core. A mathematical model is developed and a simulation of device in free vibration mode is produced in the software package Matlab Simulink. Calculation of force developed by the solenoid depending on the design, carried out with the help of a software package Quickfield Professional. The article describes a model of compensator in the form of a solenoid and estimated the force exerted by the solenoid for different types of its design. It is revealed that, when added an external magnetic circuit and magnetic field concentrator, the force exerted by the solenoid increases. In the splitting of coil the maximum force of the coil decreases, but increases the force exerted by the solenoid at large moves. It is concluded that it is appropriate simultaneous application of advanced design of compensation coil of stiffness for improved damping characteristics.

Keywords: electromagnetic stiffness compensator, Simulink, QuickField, a simulation model, mathematical model.

E. V. Petrova, S. S. Girshin, A. Yu. Bigun, V. N. Goryunov

The temperature of wires into account when selecting devices for reactive power compensation in power transmission lines with high-temperature and self-supporting insulated wires

The work shows the results of the comparative analysis of the influence of the temperature dependence of the active resistance wires of increased bandwidth, traditional not insulated wires and the insulated self-supporting wires of measures for reduction losses of electric energy. Results of calculations of economic efficiency of application of reactive power compensation, as measures to reduce losses in the electricity system, taking into account and without taking into account the temperature dependence of the elements of the energy system are obtained. There are formulated individual patterns of the payback period compensating devices depending on the load, wire type, cross section and line length.

Keywords: wire increased bandwidth, measures to reduce energy losses, temperature, reactive power compensation, insulated self-supporting wires.

D. A. Polyakov, D. A. Yurchuk, G. A. Koshchuk, K. I. Nikitin

Determination of destruction rate in power line polyethylene insulation under influence of temperature

The paper considers the influence of temperature on the polyethylene insulation of power lines. The known dependence of the reaction rate constant of temperature determines function of destruction rate of temperature. The service time of insulating material of temperature is calculated. The results of the investigations demonstrate that in the range of operating temperatures of insulation (up to 90 °C) influence of temperature is insignificant and service time is hundreds of years. If temperature exceeds 90 °C service time considerably reduces. In real conditions at operating temperatures service time is considerably less. This is explained by effect of electromagnetic field and other destructive factors.

Keywords: electrical insulation, influence of temperature on polyethylene insulation, polyethylene, polyethylene insulation, service time of insulation, residual life of insulation.

A. V. Sklyar

Analysis of induction motor electromagnetic system faults influence on the stator current slot harmonics

The study shows the results of analysis of influence of the common electromagnetic faults on the spectrum of the stator current, in particular, depending the depth of defects on slot harmonics. The results of analysis can be used to develop sensorless speed estimation device.

Keywords: slot harmonics, induction motor faults, spectrum of stator current, rotor faults, stator faults.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

V. V. Bolotov, K. E. Ivlev, V. E. Kan, E. V. Knyazev

The formation of multi-layer structures on insulator, based on porous silicon: scanning electron study

Scanning electron microscopy and energy-dispersive x-ray analysis are used to study the formation kinetics and morphology of multi-layer «Por-Si-On-Insulator» structures involving layers of macroporous and mesoporous silicon, and also insulating SiO₂ layers. The features of the formation of the buried layers of mesoporous silica under macroporous silicon layer and oxidation characteristics of multilayer structures are investigate. The formation of conductive regions of single crystal silicon in buried dielectric SiO₂ layer is shown.

Keywords: porous silicon, scanning elector microscopy, SiO₂, energy dispersive analysis.

V. V. Bolotov, P. M. Korusenko, S. N. Nesov, S. N. Povoroznyuk, Yu. A. Stenkin

The influence of pulsed ion beam on electronic structure of nitrogen atoms in multi-walled carbon nanotubes doped with nitrogen

The changes of the chemical state of nitrogen atoms in the structure of nitrogen-doped multiwalled carbon nanotubes (N-MWCNTs) after impact of pulsed ion beam at various parameters of the beam (energy density, number of pulses) have been investigated with the use of X-ray photoelectron spectroscopy (XPS). It has been established that irradiation leads to a reduction of the total amount of nitrogen in N-MWCNTs. The single pulse irradiation of ion beam at the energy densities of 0,5; 1; 1,5 J/cm² leads to restructuring of the nitrogen from pyridinic and pyrrolic configuration to graphitic state.

Keywords: Nitrogen-doped multiwalled carbon nanotubes, N nanotubes, X-ray photoelectron spectroscopy, Pulsed ion beam.

E. V. Leun

Development of advanced active control devices of dimensional parameters MIC products, aerospace industry, instrument making, mechanical engineering and machine-tool with using sapphire measuring tips

There are considered the three families of high-precision and multifunctional active control devices (ACD) product size using laser interferometers high- and low-coherence and fiber optic transducers (FOT) and measuring tip with optical sapphire windows. There is determined the carrying capacity of sapphire windows and the possibility of mechanical contact with the products with discontinuous surface.

Keywords: sapphire measuring tip, sapphire window, active control device, laser interferometer, fiber optic transducer.

I. A. Lobov, N. A. Davletkildeev, D. V. Sokolov

Features of morphology formation of polyaniline and polyaniline/carbon nanotubes composite films doped with dodecylbenzene sulfonic acid

In the work we propose a new method of forming a developed surface morphology of doped polyaniline (PANI) and polyaniline/carbon nanotube composites (PANI/CNT) films doped with dodecylbenzene sulfonic acid (DBSA). The essence of this method consists in exposing the polymer film in the form of emeraldine base with a mixture of the solvent and the dopant. The morphology of the obtained films is investigated by atomic force microscopy (AFM). It is shown that PANI and PANI/CNT composite films doped with DBSA have a different morphology. Based on the analysis of AFM images there is suggested a qualitative description of the processes occurring in the PANI and PANI/CNT layers when doped with DBSA in the presence of a solvent.

Keywords: polyaniline, carbon nanotube, composite, doping, atomic force microscopy.

INFORMATION TECHNOLOGY

V. N. Zadorozhnyi, M. N. Yudina

Methods for rapid calculation and parametric optimization of highly reliable structurally complex systems

The approach to significantly speed up the calculation and optimization of reliability of large networks, containing tens of thousands of items, is being developed. The proposed approach combines in the use of the accelerated methods of calculating structural reliability for complex systems and topological methods to identify groups of critical elements.

Keywords: complex systems, the reliability of large networks, the calculation of reliability, optimization, accelerated Monte Carlo methods.

A. A. Kolokolov, N. A. Rubanova, I. A. Tsygler

Research and solution of some small groups formation problems based on discrete optimization

The article considers the problems of small groups formation, considering logical, resource and other restrictions, with applications in economics and management, construct and investigate the model of discrete optimization, proposed algorithms for their solutions based on the cutting planes, the method of branch and bound, and other approaches, the results of computational experiments for developed algorithms and software suite.

Keywords: discrete optimization, integer programming, the task of forming small groups, human resource management, algorithms.

V. I. Potapov

Development of mathematical models for computer research of characteristics of reliability of a hardware-redundant technical system involved in conflict situation

In the article the algorithms to develop a new mathematical model of the hardware-redundant technical system involved in a conflict situation, which, in contrast to the known models that more adequately reflects the actual processes of replacement of a failed main block and a backup account for the final control system reliability and diagnostics failed during conflict blocks of the technical system are presented. This enables to more accurately calculate the reliability characteristics of the technical system, to investigate its behavior in the process of the conflict and solve the problem of optimum distribution of blocks between the main backup to maximize its reliability in the process of conflict.

Keywords: mathematical model, technical system, algorithm, reliability, hardware redundancy, conflict situation.

N. A. Verzun, M. O. Kolbaney, A. V. Omelyan

Controlled multiple access in wireless network of smart things

The object of study is Personal Area Network (PAN). PAN is the most specific element of the Internet of things. They provide the data transfer between the terminal devices of the Internet of things –smart things. The paper proposes procedure priority an adjustable network multiple access smart things to the ethereal medium. This procedure allows to take into account the heterogeneity of the requirements for acceptable delay to the delivery of information from the different types of devices. The mathematical model of the wireless network and the methods of calculating the probability-time characteristics of data transmission in it is developed.

Keywords: the Internet of things, smart thing, wireless network, multiple access, priority service, service system, regulation of access, probability-time data transmission characteristics.

S. I. Ultan, N. V. Abramchenko, E. A. Meshcheryakov

Adaptation of parametric theory of profits to planning and analysis of multiproduct manufacturing using intelligent computer components "Economy"

The article is devoted to the general requirements to the intelligent computer components "Economy" triple purpose. It deals with questions about the theory of parametric profit adaptation planning and analysis of multiproduct manufacturing, as well as the use of a parametric model of profit "Economy" in smart computer components.

Keywords: Intelligent computer component, modeling of economic systems, parametric theory of profit-house planning, diversified manufacturing, education, internet, U-requirements.

K. A. Koroleva, S. S. Gritsutenko

The optimal interpolation of narrowband signal in sense of minimizing of round mean square error

The optimal interpolation for signals with band equal to the one half of the sampling frequency is discussed within this paper. The minimum of round mean square error is chosen as the criteria of optimality. The proposed method is provided for different signal bands. There are simulated results for filters of different orders and bands.

Keywords: interpolation, narrowband signal, filter, RMSE.

M. N. Yudina

The nodes of social networks: measures of centrality and role in network processes

Homophily subnet "Vkontakte" social network is studied in the article. The condition that the network user specified location as OmSTU serves as a criterion for the subnet mining. The measures of node centrality are considered such as the degree centrality, closeness centrality, relationship centrality, eigenvector centrality. Most important nodes in the subnet are found. There is also considered how each centrality measure is correlated with known models of network processes as "Simple complement" and "Coordination game".

Keywords: coordination game, pure strategy, nodes centrality, social networks.