

MECHANICAL AND THEORETICAL ENGINEERING

I. V. Boyarkina, V. N. Tarasov

Analytical method for determining the forces in elements of pneumatic tire framework

The article gives a generalization of theoretical statements for the dimensional range of pneumatic tires small and large sizes having a diameter of more than two meters, approved by GOST 8430-2003. A method is proposed for the cross-section of the tire carcass by a cylindrical surface along the main parallel of the pneumatic tire, at the same time the carcass of the tire is dissected by a vertical plane along the equator of the tire. Combinations of tire parameters are suggested according to which some signs of tire similarity are fulfilled, taking into account the design features of each tire and air pressure in the tire, which violate the conditions and similarity criteria. Such combinations of parameters are called generalized geometric functions. Dependences of specific meridional and circumferential forces on generalized geometric functions are obtained. Forces in the elements of the carcass of the tire are determined by the Laplace equations with the use of the equilibrium equations for the dissected shell of the carcass of the tire. According to the results of the study, for the first time the equilibrium equations for the tire carcass elements are recorded in the integral and differential forms, along which the meridional and circumferential forces are determined. The method developed by the authors for reducing the specific forces in the framework to one layer of the framework is described and the average values of the forces in the framework filaments for the entire family of pneumatic systems are determined.

Keywords: pneumatic tire, method of sections, strength of the carcass, equator, meridian, specific force.

S. A. Korneyev, V. S. Korneyev, D. A. Romanyuk

Mathematical modeling of the effect of induced anisotropy of deformation of elastic rubber-cord flat coupling element

For construction of load characteristics of the elastic element of rubber-cord flat coupling design FNPC «Progress» protected by patents of the Russian Federation at any misalignment of the shaft ends and the magnitude of the transmitted torque using the phenomenological approach of classical thermodynamics with modern methods of rational mechanics of continuous media, to ensure the independence obtained by determining the ratio of the choice of reference system. In the non-linear approximation of the first order for the free energy describes the effect of the induced anisotropy of the deformation of the elastic element taking into account the effect of temperature.

Keywords: rubber-coupling, shaft misalignment, deformation anisotropy, constitutive relations, load characteristics.

A. P. Morgunov, N. A. Matveev

Process modeling of supply of rubber bonding strength to metal

The enlargement of metallic element bearing area contributes to strength improvement of rubber bonding (connection) to metal provided there are no plastoelastic deformation of asperity, microasperity while contact interaction of rubber and metallic element bearing areas. The filling of depressions, micro depressions with rubber during vulcanization and the following contact interaction is characterized by the radiator share of depressions, micro depressions. One of the tasks by studying

the process of contact interaction in rubber-metal construction is the enlargement of the bearing area surface when the radiator share may be conditionally taken as equal to the unit.

Keywords: radiator share of depressions, micro depressions with rubber, bearing area surface, rubber-metal construction, bonding strength, finite-element method.

V. I. Surikov, V. R. Vedruchenko, N. S. Galdin, V. S. Scherbakov, I. E. Lobov, V. E. Shcherba, A. V. Grigoriev

The analysis of influence of diameter of exhaust outlet for supply of gas to consumer on working processes of piston hybrid power machine of volume action based on fluctuations of pressure of gas in pressure line

In the article new design of the piston hybrid power machine of volume action based on fluctuations of pressure of gas in a pressure line which allows to lower costs of production of the compressed gas is described. The short description of mathematical model of working processes is provided in cavities of the studied machine. The dependences of working parameters and integrated characteristics on diameter of the exhaust outlet for supply of gas to the consumer constructed as a result of mathematical modeling of working processes are shown. The analysis of the received dependences is provided.

Keywords: hybrid machine, pump, compressor, parametrical analysis.

V. N. Tarasov, I. V. Boyarkina

Theory of load-carrying capacity of pneumatic wheels of land vehicles

In the article features of new theory of load-carrying capacity of pneumatic wheels for ground vehicles in construction and other areas are considered. New rules have been developed and new results of the theory of load capacity of pneumatic wheels based on the application of the method for cutting off contact from the tire shell with a closed surface normal to the reference plane have been obtained. A special feature of the developed theory is the use of the Pascal law to evaluate the role of compressed air inside the tire. The new results are generalization of large number of published data for the parameters of pneumatic systems produced by the domestic industry and foreign firms. The use of the method of cutting off the tire's contact from the carcass is new in Russian and foreign practice. A new concept proposed by the authors of the article is used - the lifting force of the contact and its relation to the carrying capacity for industrial pneumatic wheels is established. There are considered generally accepted criteria for the reduction of pneumatic wheels, on the basis of which new criteria and conditions for the similarity of tires are obtained. The dependence of the load capacity of pneumatic wheel on the contact area of a tire for statistical series of pneumatic wheels of different sizes and load capacities is established. A new dependence of the load-carrying capacity on the combination of the geometric parameters of pneumatic wheels, the dependence of load-lifting on the lifting force of the tire contact is obtained. The reliability of the obtained results is characterized by the equations of regression of these parameters with the correlation coefficient $R^2=0,92-0,99$. The proposed theory makes it possible to increase the reliability of the choice of parameters and the operability of the projected wheels.

Keywords: load-carrying capacity, pneumatic tire, cross-section method, contact area, average pressure.

B. E. Lopaev, A. A. Serbov

Selection of deoxidizers for arc welding of metals taking into account chemical affinity of elements for oxygen

This article deals with the weld pool metal deoxidation various chemical elements in arc fusion welding. By changing the isobaric isothermal potential there is calculated affinity of various chemical elements with oxygen and, thus, determined their properties at temperatures deoxidation of weld pool. There is composed of a series of chemical elements that characterizes their increasing a deoxidation ability.

The results obtained during the study allow to expand the use of different chemical components as deoxidizer during arc fusion welding.

Keywords: Chemical elements, oxides, steel, isobaric-isothermal potential, weld pool, deoxidizers.

D. A. Blokhin, A. G. Koltsov, A. S. Serkov

Methods for changing backlash of turning CNC-machine axis using laser interferometer on basis of experimental research

In the article the problem of calibration in turning machine model Okuma ESL 8II with CNC-system OSP U10L using a laser interferometer. It is about the structure and layout of the CNC-machine. Positioning accuracy is investigated and there are identified main factors affecting the deviation of the actual displacement from the set. Recommendations on the coordinate axis Z calibration with a modern measuring are presented.

Keywords: turning machine, CNC-machine adjustment, laser interferometer, backlash correction.

V. N. Klimov, N. I. Klimov

Promising lubrication and cooling scheme for small resource GTE bearings by air-fuel mixture

The article is devoted to non-traditional scheme of lubrication and cooling of small resource GTE rotor bearings (lubrication and cooling by an air-fuel mixture). The article analyzes the known lubrication schemes for small resource gas turbine engines. A promising lubrication scheme for GTE is proposed, which is distinguished by its structural simplicity, favorable bearing lubrication conditions, reduced specific fuel consumption and fire safety. The results of experimental studies of the performance of a radial ball-bearing under conditions of lubrication and cooling by an air-fuel mixture are presented. Recommendations are given on the introduction of the proposed scheme in the design of GTE.

Keywords: gas turbine engine, lubrication and cooling of bearings, small resource GTE.

O. Yu. Burgonova, K. N. Pantyukhova, E. P. Belozerova

The influence of heat treatment modes on VT3-1 alloy structure to increase ductility before pressure operation

The influence of the chemical composition and thermal treatment regimes on the structure and properties of parts made of BT 3-1 alloy is considered in the article. It is found that an increase in the content of chromium and molybdenum to the upper limit controlled by GOST causes decrease in ductility and increase in the strength of the alloy. A correction of the resulting defect by conducting repeated annealing with a lowered temperature is proposed.

Keywords: titanium alloys, isothermal annealing, β -phase, plasticity, brittleness, thermal stability of the structure.

K. A. Vansovich

The model of growth of fatigue surface cracks per load-discharge cycle

A model of growth of fatigue cracks is proposed, which takes into account the fracture processes occurring directly at the crack tip during the loading cycle. The change in stresses at the crack tip is studied when the samples are loaded to maximum stress and then unloaded to zero. Formulas are obtained for calculating the rate of growth of fatigue cracks developing as normal detachment under uniaxial and biaxial loading of metal in the crack region.

Keywords: surface crack, biaxial loading, cyclic stress, rate of a crack growth, coefficient of change the average stress.

ELECTRICAL ENGINEERING. POWER ENGINEERING

K. V. Khatsevskiy, A. D. Umurzakova, Yu. N. Dementyev

The algorithm and method of indirect control of electromagnetic torque and angular velocity of the asynchronous electric motor

The algorithm and method are presented for the control of three-phase asynchronous motor coordinates. In functional schemes, implementing the algorithm, when measuring output coordinates there is controlled changing the temperature of the stator winding and the frequency of the supply voltage. The developed algorithms and methods have high precision, and different from the well-known ease of implementation of the circuit realization.

Keywords: asynchronous electric motor, angular velocity, electromagnetic torque, indirect measurement.

E. V. Ptitsyna, D. V. Ptitsyn, A. B. Kuvaldin

Development of methods of modeling of devices for automatic regulation of frequency spectrum and the amplitude of the voltage units with current supply of complex shape

In electrotechnological units the current complex form obtain positive technological and energy effects and is an important way of improvement, but requires the development of new principles of management, introduction of additional channels control the frequency and voltage. Development of methodology for the study of dynamical systems, which are the automatic control system of objects of electric technology with the current supply of complex shape, it is the aim of the present work. The results of the literature analysis of the selected method of modeling with the use of expansion packs visually-simulation of Simulink and Stateflow event-driven programming mathematical system Matlab allowing to achieve the goal to solve the task of designing various logic structures control machines and to detect errors in operation of automatic control systems of any complexity. For example, electrolysis, the power of the FCA presents step-by-step application of the developed methodology to check for the absence of a failure of the logical circuit controlling the machine.

Keywords: electrotechnological installation, current complex forms, the theory of finite state machines, Stateflow charts, and truth table.

S. S. Busarov, V. K. Vasiliev, A. Yu. Gromov, A. V. Nedovenchany, M. A. Chizhikov

Technique of experimental research of working processes of low-speed long-stroke lubricating piston compressor stages

Theoretical work on the modeling of work processes of slow-moving long-stroke compressor units is carried out by the authors in sufficient volume, which makes it possible to speak of the prospects of using slow-speed long-stroke reciprocating compressor units to obtain medium pressures in one stage. In this connection, an experimental stand with a linear hydraulic drive is developed and manufactured. Experimental studies are carried out and data are obtained on the change in the instantaneous parameters of the gas in the working chamber.

Keywords: long-stroke reciprocating compressor, work processes, measurement of instantaneous gas temperature and pressure, experimental studies of reciprocating compressors

A. V. Ded

Calculation of Simulink-model parameters for power three-phase transformer for research of the long asymmetrical modes

Results of the solution of a task of calculation of parameters of the power three-phase transformer for creation of his Simulink-model are presented in article. The transformer as a nonlinear element of systems of power supply during the modeling and the analysis of the operating mode at various parameters of loading defines need for the accounting of parameters of the characteristic of parameters of a magnetic conductor. This need is caused by what presented as standard (demonstration) transformers in a Matlab package of model the magnetization curve parameters set by default without indication of a source of these data have. In the work settlement expressions for definition on the basis of catalog these Simulink-models parameters of transformers are compiled. The values of the Simulink-models parameters for transformers of the TM series of various capacities received as a result of calculations are given.

Keywords: quality of electric energy, asymmetrical loading, calculation of parameters, transformer, Simulink, Matlab.

S. V. Terebilov, A. G. Mikhailov, E. N. Slobodina, A. V. Vasiliev

The formation of foulings on fire-tube boilers heating surfaces

The main types of fouling on boiler heating surfaces are discussed. There are shown main regularities of the fouling formation on the heating surfaces. It is proposed an expression for the velocity dependence of scale formation of hardness salts on heating surfaces of the fire-tube boiler.

Keywords: fouling of heating surface, alkaline earth deposits, fire-tube boiler.

A. O. Shepelev, S. S. Girshin, V. N. Goryunov, E. A. Kuznetsov, E. V. Petrova, V. O. Kropotin

Development of algorithm for calculating power losses in overhead transmission line of distribution networks taking into account the regime and climatic factors

In the article there is proposed algorithm for calculating power losses in electrical networks taking into account the regime and climatic factors. The calculation of power losses is carried out with the joint solution of the equations of electric and thermal conditions of overhead transmission lines. This algorithm allows calculating power losses in the distribution network based on known calculation

methods. Calculation of the thermal regime is carried out on the basis of mathematical models developed at the Energy Department.

Keywords: algorithm, heat balance equation, power losses, temperature.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

S. V. Biryukov, A. V. Tyukin

Constructive errors of three-coordinate electric field strength sensor

In the given article the question of increase of accuracy of transformation of a three-coordinate sensor of intensity of electric field due to their constructive execution is considered. Previously, this issue was not addressed. There are analyzed instrumental (constructive) errors characteristic for three-coordinate sensors. The error of the resultant sensitivity of the three-coordinate sensor, the parallel error of the pairs of sensing elements and the error caused by the non-orthogonality of the coordinate axes of the sensor are subjected to analysis. It is shown that the error of the resultant sensitivity can be reduced to the desired minimum due to coordinate-wise calibration of the sensor, the parallelism error of the pairs of sensing elements is directly proportional to the square of the deflection angle and for a deviation of $\Delta = 4^\circ$ it is only 0,25% and in most cases it can be neglected. The error in the orthogonality of the coordinate axes can be significant and can reach percentages (1,75% / deg). This error can only be reduced by strict observance of the orthogonality of the coordinate axes of the sensor.

Keywords: three-coordinate sensor, design errors, sensitivity error, non-parallel error, non-orthogonality error.

S. S. Kolmogorova, A. S. Kolmogorov, S. V. Biryukov

Features of construction of sensor models of three-coordinate measurement of tension of electric field

The article deals with the constructive development of the basic model of the electroinduction spherical single-component and multicomponent sensor with sensitive electrodes in the form of hollow spherical segments, taking into account the industrial measurement conditions. The implementation of sensor models is done in CAD SolidWorks. The practical purpose of the study is to obtain a substantiation of the optimal and permissible geometric shapes of sensitive electrodes that provide the best metrological characteristics of electric field strength meters in various conditions with a wide measurement range for more rational use of the production potential.

Keywords: electric field, tension, spherical sensor, sensor, sensitive electrode, primary converter, measurements, electrometry.

E. V. Leun, A. V. Shulepov

Analysis and design of sapphire measuring tips for active control devices of dimensional parameters of products

The article presents the results of experimental studies of the mechanical contacting sapphire rod with a rotating five-cogs cutter similar to the active control of its diameter. It is shown that a sapphire rod can withstand such cyclic shock loads and wear of its surface corresponds to the plastic regime of material removal. There are local zones of metallization from contact with the cutter. To improve the

wear resistance of there is proposed construction with compound measuring tip with protective coating. There are discussed modern high-strength materials for this coating.

Keywords: measuring tip, active control device, contact measurements, sapphire, zirconia, crack resistance.

D. V. Sapozhnikov

Mathematical model of frequency discriminator

This article offers the set of equations that helps to estimate output voltages of microwave frequency discriminator which depends on planar elements of MFD. The graphs, shown in this paper, make it possible to estimate deviation of characteristics from ideal. The results of computing can be used to define the length of delay line.

Keywords: mathematical model, frequency discriminator, quadrature power divider, signal detection.

P. I. Stepanov, V. V. Zakuraev

The algorithm for prediction of residual life of electro mechanical equipment on the basis of analysis of current and vibration signals

The work has solved one of the main tasks of non-destructive inspection that is prediction of the state of the electromechanical equipment at future time. As the object of control there is used asynchronous drive with gear reducer. Prediction of the residual life is based on the analysis of vibrational signals (with gear reducer) and signals of the current consumption of the asynchronous motor. A prediction algorithm has been developed and tested in the laboratory.

Keywords: non-destructive inspection, prediction, residual life, diagnostics, drive equipment.

INFORMATION TECHNOLOGY

V. N. Zadorozhnyi, E. B. Yudin, M. N. Yudina

Calibration of preferred binding graphs by distributions of vertex degrees and clustering coefficients

A method is developed for the complex calibration of random graphs of the preferred binding simultaneously with respect to the distributions of the degrees of connectedness of vertices and the clustering coefficient. In methods of the theory of random graphs with a nonlinear rule of preferred binding, a new technique is introduced - the use of complex stochastic increments (modules) consisting of several interconnected vertices for growing graphs. We derive mathematical relationships that make it possible to carry out a complex calibration of the graph grown by module attachments. The obtained results demonstrate the principal possibility of developing a new class of random graphs with a nonlinear rule of preferential binding-random graphs with complex stochastic increments.

Keywords: random graphs, distributions of degrees of connectedness of vertices, nonlinear rule of preferential binding, coefficient of clustering.

T. R. Zakharenkova

On loss probability in fractal multiserver queueing systems

The method for determining of loss probabilities in fractal multiserver queueing systems with an approximation of them using steady-state probabilities and tails of steady-state probability distributions of relating queueing systems with infinite number of servers is developed and considered. The efficiency of the approach to loss probabilities determination is justified theoretically and by means of simulation modeling. Approximations claim enable to significantly accelerate and simplify the process of forming an optimal channel distribution over nodes in fractal queueing networks.

Keywords: loss probabilities in multiserver systems, fractal traffic, queueing theory, telecommunication networks.

N. L. Knyazev

Processing of navigation parameters on basis of fuzzy clustering algorithm

The article describes the task of distribution of aircraft on groups (clusters) on the basis of processing of navigation parameters. It is hereby recommended that the algorithm of distribution of aircraft on clusters on the basis of methods of cluster analysis and a fuzzy logic. The developed algorithm gives an opportunity to create quantity of clusters during the processing. In conclusion is shown efficiency of the offered algorithm for exact cluster analysis of the found aircraft aims.

Keywords: cluster analysis, metric, fuzzy logic, and radiolocation.

M. A. Kornach

Optimization of transport networks in the mode of low load road

The problem of the optimal distribution of the resource along the roads of the transport network in the regime of free movement is considered. The method of Lagrange multipliers is used to find the solution. An example of optimization is described. The optimization results are checked on the simulation model of the transport network using the TraffOpt software product.

Keywords: simulation, transportation network, road repair.

U. N. Kulbida, A. V. Zykina

Information systems and technologies in advertizing activities

In the article there are considered expert systems, means of support of decision-making, information and analytical systems and services in the field of advertising, media and PR technologies from the point of view of the use of the advertising information obtained from the general marketing activities of the enterprise. Depending on the set goals of advertising campaign there are highlighted the functions of advertising management. On the basis of the analysis of the modern literature on marketing activities there is proposed the expanded plan for the advertising campaign, for each item of this plan are formulated the tasks of advertising strategy set in accordance with the specified functions of advertising management. The conducted research allows to draw a conclusion that modern information systems don't solve the problem by determination of the advertising idea (advertising positioning) of a product. It is an essential shortcoming as on the basis of the advertising idea is built the concept of all advertising campaign. The absence of advertising positioning of the product calls into question the efficiency of attachment of financial means in advertising activities.

Keywords: software, information technologies, advertising management, Internet advertising, media planning, advertising positioning.

S. V. Semenikhin

Learning rank method based on Parallel Genetic Algorithm

There is considered the problem of ranking documents in search engine result page by informational retrieval systems and learning to rank task. There is proposed method applying Parallel Genetic Algorithm based on Cooperative Coevolution. There is compared the method with baseline learning to rank algorithms on LETOR test data sets. A significant increase in performance is shown.

Keywords: information retrieval, learning to rank, optimization, genetic algorithm, parallel algorithms, coop.