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SUMMARY and KEYWORDS

MECHANICAL AND THEORETICAL ENGINEERING

Yu. A. Burian, A. V. Zubarev,S. N. Polyakov, S. P. Bobrov
On possibility of creating waveguide sound insulator based on MR material with metal inclusions

The problem of reducing the emitted vibrational energy through pipeline systems is relevant. The paper considers the fundamental possibility of constructing a waveguide silencer for pressure pulsations and hydrodynamic noise using MR material (metal rubber) with metal inclusions. The problem of evaluating the sound insulation effectiveness and determining the locking sound waves frequency range is posed and solved. The calculation results show that for metal inclusions in the form of lead balls, the decrease in the pressure pulsation amplitude is 10–20 dB in the frequency range of about 300–1000 Hz and depends on the characteristics of the MR material. It is shown that, if it is possible in principle, a change in the parameters of the wave sound insulator (length, bulk elastic modulus, mass of metal inclusions), the frequency range for blocking sound waves can vary over a fairly wide range.

Keywords: waveguide absorber, MR material, bulk modulus, pressure pulsation, hydrodynamic noise.

V. R. Edigarov, B. Sh. Alimbaeva, S. Yu. Anokhin
Improving wear resistance of surface layer of parts combined with electromechanical processing with tempering

The technology of combined electromechanical processing of machine parts with electromechanical tempering of surfaces is considered, which electromechanical processing in two passes with different values of technological factors makes it possible to obtain a modified surface layer having a multilayer structure, an upper thin softened layer, then a «white» layer, then an ordinary hardened layer and underneath is the base metal. The resulting gradient structure provides the required performance of a modified surface, primarily in terms of wear resistance determined by the running process of tribological conjugation.

Keywords: surface layer modification, electromechanical processing, microhardness, electric current density, wear resistance.

I. N. Drozdov, A. Yu. Popov
The increase in efficiency of milling of small-sized grooves of shaped form in hard-to-reach places of molds for rubber- technical products

This article discusses the complexity of machining small grooves and as an option for engraving on hard-to-reach surfaces of parts where it is necessary to use extensions for a cutting tool. The aim of the work is to increase the efficiency of milling small- sized shaped grooves on molds for rubber products using a special conductor sleeve, which allows to reduce runout on the long overhang of the cutting tool and to obtain the necessary geometry and surface cleanliness of the venting grooves. The goal is achieved through the use of a specially designed conductor device with a hydrostatic bearing.

Keywords: rubber-technical products, mold, exhaust grooves, milling, precision, shape, conductor sleeve.

A. Yu. Shevchenko, A. Yu. Popov
Methods of processing of gas venting grooves of angular shape in matrices for rubber technical products

This article discusses the methods of processing gas exhaust grooves on molds for rubber goods planning on a curved surface. The purpose of this work is to improve the efficiency of processing gas-venting grooves of angular shape on molds for rubber technical products on curved surfaces by using the planning method on machines with computer numerical control.

Keywords: planning, venting grooves, mold, rubber-technical products, corner grooves, shaped planning, engraving cutter, cutter.

A. A. Fedorov, D. A. Polonyankin, A. I. Blesman, N. V. Bobkov, A. V. Linovsky, Iu. O. Bredgauer, Yu. E. Zhdanova

Investigation of wire electrical discharge machining modes influences on crack formation and surface layer morphology of the Ti-6Al-2.5Mo-2Cr-0.3Si titanium alloy

The paper presents the results of the investigation devoted to the influence of wire electrical discharge machining modes on crack formation and surface layer morphology of the titanium alloy. The aim of the paper is to obtain interrelation data about processing modes with depth of microcracks penetration, as well as on the influence of processing modes on the morphology of the surface layer, in particular, on the group of parameters Rk. It is shown by using scanning electron microscopy that the depth of microcracks depends of the number of passes and processing conditions. The maximum depth is 12 μm after the first pass, the minimum is 0,9 μm after the fourth pass. The groups of parameters Rk study by the method of profilometry made it possible to conclude that the most favorable oil-retaining microrelief is formed after the third pass.

Keywords: electrical discharge machining, titanium, surface layer, cracks, morphology, oil retention.

ELECTRICAL ENGINEERING

V. V. Kharlamov, Yu. V. Moskalev, S. N. Naiden

Simulation of commutation process DC traction motor of quarry dump truck

The article considers a nonlinear multiple regression model based on which a model of the commutation process of the DC traction motor of a quarry dump truck. The regression model is constructed using experimental data of the traction engine operation obtained from an automated video measurement system for evaluating commutation in operation. The proposed mathematical model establishes a relationship between the values of the armature voltage, armature current, excitation current, and the spark intensity of the collector-brush node. The adequacy of the mathematical model is confirmed by comparing the degree of sparking obtained experimentally and using the proposed model. The relative error value of the experimental and calculated data for different values of the armature voltage, armature current, and excitation current from the model adequacy range does not exceed the allowed values.

Keywords: traction DC motor, collector-brush node, operating mode, commutation, commutation class.

V. V. Kharlamov, D. I. Popov

Analysis of the account of slot harmonics in stator's EMF in mathematical modeling of the process of testing induction motors by the mutual load method

The article presents the results of mathematical modeling of induction motors powered by frequency converters taking into account slot harmonics of EMF and stator current due to corresponding pulsation of magnetic field induction in air gap. The results of calculations for low, medium and high-power engines are presented. It is shown that the spectrum-current analysis method can be used to determine rotation speed of induction machines when they are tested by the mutual load method using various schemes. The method for determining the intervals for searching for slot harmonics is proposed.

Keywords: induction motor, frequency converter, mathematical model of mutual load, slot harmonics, electrical current spectrum, rotation speed.

K. V. Khatsevskiy, A. D. Umurzakova, N. A. Voronina, Yu. B. Icheva
The analysis of method for diagnosing faults of three-phase asynchronous motor

The article deals with issues related to improving the reliability of electrical equipment in industrial enterprises by implementing fault diagnosis systems. A hardware-software complex for diagnosing faults of a three-phase asynchronous motor is proposed.

Keywords: diagnostics, hardware and software complex, motor failures, vibration diagnostics, harmonics, analog-to-digital converter.

N. A. Voronina, A. D. Umurzakova, L. A. Payuk, K. V. Khatsevskiy
Research of the Electric Drive with Intermittent Motion Law

An electric drive with an intermittent law of the shaft motion of the executive motor, which is widely used in various fields of industry, is considered. The aim of the study is to determine the ways of generating supply voltages or currents to the adjustment characteristics of the electric drive. In this work, it is necessary to determine the output parameters: electromagnetic moment, angular velocity and coordinates of the moving element of the working body. The study applied the method of mathematical modeling. The results of the work are the time dependences of the output parameters and the adjustment characteristics of the electric drive with an intermittent law of motion of the shaft of the actuating motor. Based on the results obtained, it can be concluded that with the phase method of generating supply currents or voltages, it is necessary to control the electric motor along one of the windings.

Keywords: asynchronous electric AC drive, electric drive with intermittent motion law of the shaft, output parameters, control characteristics.

N. E. Deryuzhkova, V. A. Solovyev, V. V. Teterin, D. V. Urasov
Comparative evaluation of classic and fuzzy control algorithms for electric drive system of multi-point molding of products of double curvature

One of the methods for manufacturing double curvature parts used in the manufacture of aircraft and ship bodies is the bending of sheet material on a molding machine, which is a complex mechanism. The article discusses the use of various control algorithms for a multi-point molding system. A comparative analysis of the classic and fuzzy control algorithms is performed. Based on the research, it is concluded that it is advisable to use one or another control algorithm.

Keywords: interconnected control system, electromechanical system, fuzzy regulation.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

I. A. Kirovskaya, T. A. Kirovskaya, A. O. Ekkert
New materials and sensors for semiconductor gas analysis

Using the complex of up-to-date methods, the acid-base and adsorption (with regard to NH3, NO2) properties of binary and multicomponent semiconductors of equitably chosen systems InSb-ZnTe, InSb-CdTe, GaSb-ZnTe, GaSb-CdTe have been studied. The nature of the active centers forces (acid, adsorptive) has been determined. The donor-acceptor mechanism of the adsorption processes has been substantiated. The interrelated change regularities with the composition of the studied surface properties allowing to identify the most active semiconductors — the components of systems with respect to gases of a certain electronic nature (basic and acid) have been established. Practical recommendations on their use in order to manufacture corresponding measuring cells and to conduct the gas analysis of the environment have been given and partially implemented.

Keywords: semiconductors, solid solutions, surface properties, regularity, forecasting, measuring cells, semiconductor analysis.

E. V. Leun, A. E. Shakhanov
Improving the accuracy of hybrid scanning 3D fiber-optic measuring heads with an acousto-optic feedback sensor for contact and non-contact coordinate measurements of product sizes

The article presents a method for determining the elastic deformations arising from the mechanical contact of a spherical tip and a product, which makes it possible to exclude the influence of material deformations like «pile-up». Paper discusses the construction of a hybrid 3D scanning fiber-optic measuring head (FOMH) with the formation of scanning laser beam motion within the angular sector of the 180°×180° hemisphere based on a low-coherence interferometer, a spatial light modulator based on a fiber-optic piezoscanner and a «fisheye» lens. The possibilities of high-precision two-coordinate measurements of the scanning laser beam due to the use of an acousto-optic modulator in the FOMH feedback sensor as a space-sensitive transducer are considered.

Keywords: coordinate measurements, measuring head, nanoindentation, «pile-up», low coherent interferometer, piezoscanner, «fisheye», acoustic-optical modulator.

A. V. Ponomarev
Applying computer technologies in electronic devices engineering on example of square wave-form generator creation

The article contains the analysis of computer technologies application for electronic devices designing. There are basic stages of device design on the example of an adjustable square wave-form generator. It contains the description of its operation principles, circuit diagram, features of PCB and shell creation. Acquaintance with design of basic stages on the example of a simple device can help starting design devices for students and young scientist researches.

Keywords: square wave-form generator, electronic devices, Arduino, liquid crystal display, software, modeling, computer technologies.

V. I. Kirnos, A. V. Zubar, V. P. Pivovarov
Model development of estimation of pointing accuracy when carrying out internal target designation and indication on samples of armored weapons

The article reveals a computing sequence at program implementation of the method of the internal target designation and indication for the samples of armored weapons. The authors describe the stages of the model development of an estimation of pointing accuracy on pixalized coordinates of the target image. They present the results of modeling in relation to the tank T-72B3, which is used in the army at present.

Keywords: target designation, model, target indication, sight, accuracy estimation.