

CONTENTS

MECHANICAL AND THEORETICAL ENGINEERING

- V. F. Mukhin, E. N. Eremin, Yu. O. Filippov.** Pulsed technology for manual arc welding of thin-walled structures by coated electrode 5
- V. I. Grishchenko, A. A. Tumakov, M. S. Poleshkin, M. S. Kilina, D. D. Dymochkin.** Modeling automatic horizontation system of steep-sloping mobile machine with hydraulic sensor roll 11
- M. I. Biserikan, S. V. Petrochenko, K. V. Averkov.** Experimental study of fatigue life of wagon wheel of increased hardness when interacting with rail 18

ELECTRICAL ENGINEERING

- A. V. Bubnov, A. N. Chetverik, A. N. Chudinov.** Development and research of generalized computer model of electric drive with pulse-phase control of angular velocity 23
- A. A. Kuznetsov, A. Yu. Kuzmenko, M. A. Kuznetsova, A. V. Simakov.** Threshold values determination in high-voltage equipment diagnosis insulation by registration methods of partial discharges 30
- E. V. Ptitsyna, D. V. Ptitsyn, A. B. Kuvaldin.** Heating elements of flexible tape in current mode power supply of complex form 36
- M. V. Glazyrin, I. A. Aleinikov.** Development of rotor flux control laws for high-speed asynchronous electric drive 45
- B. A. Kosarev, G. A. Koschuk, V. K. Fedorov, L. G. Polyntsev.** Power supplies dynamic redistribution's for electric system with dispersed generation 50

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

- I. A. Kirovskaya, R. V. Ekkert, A. O. Ekkert, E. V. Mironova, I. Yu. Umansky, A. I. Blesman, D. A. Polonyankin, L. V. Kolesnikov, E. N. Kopylova, V. B. Goncharov.** New materials based on InP-ZnS system for semiconductor gas analyzers 56
- A. A. Novikov, D. A. Negrov, A. R. Putintseva, V. Yu. Putintsev, A. A. Krutko, D. D. Sidorenko.** Ultrasonic vibrations in liquid medium in flexible polyamide tube of small diameter 62
- E. V. Leun, A. E. Shakhanov, A. V. Nickel.** Possibilities to improve accuracy of contact measurements by using corundum tips and video recording of contact area 68

SUMMARY. KEYWORDS

MECHANICAL AND THEORETICAL ENGINEERING

V. F. Mukhin, E. N. Eremin, Yu. O. Filippov
Pulsed technology for manual arc welding of thin-walled structures by coated electrode

Omsk State Technical University, Omsk, Russia

The article presents the results of work on the study of the use of a single-phase rectifier with an additional unit for obtaining pulsed modes for manual arc welding with thin-walled construction by a stick electrode. The proposed scheme of an additional block allows by selecting the parameters of the welding mode to ensure a stable quasistationary process of melting and transfer of the electrode metal. Thus, it becomes possible to weld thin-sheet structures without reducing the diameter of the coated electrode.

Keywords: welding by coated electrode, thyristor single-phase rectifier, pulsating current, electrode metal transfer, oscillograms.

**V. I. Grishchenko, A. A. Tumakov,
M. S. Poleshkin,**

M. S. Kilina, D. D. Dymochkin
Modeling automatic horizontation system of steep-sloping mobile machine with hydraulic sensor roll

Don State Technical University, Rostov-on-Don, Russia

The article is devoted to modeling the leveling system of a mobile machine using a hydraulic sensor that controls a hydromechanical system. The review of modern leveling systems for mobile machines made it possible to determine the criteria for assessing the quality of such systems and to prepare a circuit solution based on a membrane hydraulic sensor. The developed mathematical model made it possible to investigate the leveling process under changing conditions of operation of a steep-sloping mobile machine using the example of the «Don-1200K» combine. A generalized mathematical model of the leveling system with a submodel of the control roll sensor has been developed. A computational experiment is performed in the Matlab Simulink software environment based on the modules of the Simscape subroutine using numerical methods, which allowed to identify processes under varying loads on the chassis of mobile machine. The efficiency of the proposed solution is proved by the example of the hydromechanical system of the Don 1200 steep-slope combine, the working ranges of the hydromechanical leveling system and its dynamic qualities were determined. The found patterns reveal the dependencies of: angular and linear displacements of the leveling system; pressure changes in membrane chambers of the roll sensor; fluid flow through the throttle and the displacement of the control valve spool; loads on telescopic chassis hydraulic cylinders; speeds of movement of plungers of hydraulic cylinders of a leveling system. The results obtained can be used to upgrade existing mobile machines, as well as to create new steeply technological and transport machines with improved characteristics. Using the developed mathematical and computer models will reduce the time and cost involved in designing mobile equipment leveling systems, developing prototypes and commissioning.

Keywords: leveling systems; hydraulic roll sensor; steep slope machines; math modeling; Matlab Simulink; dynamic characteristics.

M. I. Biserikan, S. V. Petrochenko K. V. Averkov
Experimental study of fatigue life of wagon wheel of increased hardness when interacting with rail

Omsk State Transport University, Omsk, Russia

The analysis of the processes occurring during the interaction of the wheel with the rail. Studies of the processes occurring in the interaction of the wheel with the rail by the method of similarity were carried out. The occurrence of contact fatigue surface defects is visually monitored. It is concluded that the maximum height of the waviness on the surface of the roller is related to the speed of damage to its surface. The dependence is constructed, which allows to determine the number of cycles of impact applied to the surface of the roller load, depending on the macrogeometric parameters of its surface. Conclusions about the acceleration of the development of contact fatigue defects with increasing macrogeometrical deviations are made.

Keywords: contact-fatigue phenomena, wear, fatigue defect, wheel of increased hardness, interaction of wheel and rail, machining.

ELECTRICAL ENGINEERING

A. V. Bubnov, A. N. Chetverik, A. N. Chudinov
Development and research of generalized computer model of electric drive with pulse-phase control of angular velocity

Omsk State Technical University, Omsk, Russia

The article presents a generalized computer model of electric drive with pulse-phase control of angular velocity. The model is created on the basis of the pulsed frequency-phase discriminator model with additional functionality that allows to investigate the most effective, from the point of view of improvement of dynamic indicators of quality of regulation, ways of management of the given electric drive. This significantly reduces the simulation time, which accelerates the study of synchronous-common-mode electric drive and phase-locked electric drive in the high speed areas.

Keywords: speed error, phase-locked speed, electric drive, phasing, synchronization, pulse frequency-phase discriminator.

**A. A. Kuznetsov, A. Yu. Kuzmenko,
M. A. Kuznetsova, A. V. Simakov**
Threshold values determination in high-voltage equipment diagnosis insulation by registration methods of partial discharges

Omsk State Transport University, Omsk, Russia

The paper presents theoretical information diagnosing insulation parameters of high-voltage transformers. The results of experimental studies on high-voltage transformers in the normal, pre-emergency and emergency states are shown. The comparison was made with the data of chromatographic analysis to determine the threshold values according to the results of acoustic control.

Keywords: high-voltage transformers, traction power supply, gas chromatography, insulation parameters diagnostics of high voltage transformers, acoustic method, partial discharges.

E. V. Ptitsyna¹, D. V. Ptitsyn¹,
A. B. Kuvaldin²

Heating elements of flexible tape in current mode power supply of complex form

¹Omsk State Technical University, Omsk, Russia

²Moscow Power Engineering Institute, Moscow, Russia

The paper presents the results of studies of energy and technological parameters of the elements of heating flexible tape at different electrical modes: when powered by alternating current of 50 Hz; constant (rectified) current; current of complex form with a constant component and without it. The purpose of the work is to study the influence of electrical modes on the energy and technological parameters of heaters to develop recommendations for the selection of effective modes of operation of such heaters when powered by a complex form of current to develop automated control systems, involving the use of two control channels: the amplitude of voltage (current) and the frequency spectrum.

Keywords: heating element flexible tape, current type (variable, constant, complex form), active power loss.

M. V. Glazyrin, I. A. Aleinikov
Development of rotor flux control laws for high-speed asynchronous electric drive

Novosibirsk State Technical University, Novosibirsk, Russia

The article analyzes the overload capacity of asynchronous variable frequency drives with orientation on the rotor flux linkage vector at rotational speeds higher than nominal. Marked and mathematically taken into account factors limiting the magnitude of the motive electromagnetic moment of an asynchronous electric drive in the entire range of values of shaft speed. The division of this region of values into three working zones is substantiated, for each of which there is defined its own individual law of formation of the driving force modulo of the resulting rotor flux-coupling vector.

Keywords: asynchronous machine, autonomous voltage inverter, vector control system, torque overload capacity, control of the rotor flux linkage.

**B. A. Kosarev, G. A. Koschuk,
V. K. Fedorov, L. G. Polyntsev**
Power supplies dynamic redistribution's for electric system with dispersed generation

Omsk State Technical University, Omsk, Russia

The article concerns design of electric system with dispersed generation, more precisely, functional location of energy generation units — transmission losses relationship. Electrical load centers are the optimal locations of energy generation units, but time-varying loads shift them and transmission losses increase.

The purpose of the article is development of an algorithm and the program of power supplies dynamic redistribution's for the electric system with dispersed generation that reduce transmission losses. Power supplies dynamic redistribution's is achieved by the creation of a virtual electric system with the possibility of redistribution over electrical load centers of energy generation units. Virtual electric system is organized on the basis of cellular communication and central computer (smart grid).

The algorithm is realized in the computer-aided design MathCAD. Using this program, the calculation of the electric system of an industrial microdistrict of the city with distributed generation was performed. As a result of the calculations, cartograms of electrical loads are constructed and the loss of electric energy in distribution lines is estimated. The calculation results show a significant reduction in losses in

distribution lines when using distributed generation with dynamic redistribution of power sources.

Keywords: distributed generation, electric load center, electrical system, electrical load cartogram, energy generation unit, potential function method, electric load.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

**I. A. Kirovskaya¹, R. V. Ekkert¹,
A. O. Ekkert¹, E. V. Mironova¹,
I. Yu. Umansky¹, A. I. Blesman¹,
D. A. Polonyankin¹, L. V. Kolesnikov²,
E. N. Kopylova¹, V. B. Goncharov³**
New materials based on InP-ZnS system for semiconductor gas analyzers

¹Omsk state technical University, Omsk, Russia

²Kemerovo State University, Kemerovo, Russia

³Federal Research Center Boreskov Institute of Catalysis Siberian Branch of Russian Academy of Science, Novosibirsk (SB of RAS), Russia

According to the developed methodology, based on the isothermal diffusion of the initial binary compounds (InP, ZnS), their physical and physicochemical properties, solid solutions of different composition ((InP)_x(ZnS)_{1-x}) have been obtained. X-ray examinations have been conducted which allows to certify them as substitution solid solution with sphalerite structure and acid-base properties studies (pH isoelectric state — pHISO). The consistent patterns of changes in the composition of the studied (bulk and surface) properties, which are of predominantly smooth nature, have been established. A correlation between theoretical calculated crystal density and acid sites strength (pHISO) has been found which served as the basis for recommending a less labour-consuming way to search for the advanced materials for semiconductor gas analyzers.

Keywords: solid solutions, advanced materials, new materials properties, consistent patterns and correlations, semiconductor gas analyzers.

**A. A. Novikov, D. A. Negrov,
A. R. Putintseva, V. Yu. Putintsev,
A. A. Krutko, D. D. Sidorenko**
Ultrasonic vibrations in liquid medium in flexible polyamide tube of small diameter

Omsk State Technical University, Omsk, Russia

The purpose of this article is to study the characteristics of the passage of ultrasonic oscillations in a liquid medium through an extended plastic tube of small diameter. The article presents the design of the research stand and the results of studies of the characteristics of the passage of ultrasonic vibrations in a liquid medium through polyamide urological stents of small diameters. The tasks solved here are the determination of the influence of such factors as the density of the medium and the size of the cross section of the tube on the level of intensity of ultrasonic vibrations in the tube.

It is shown that in this case the speed of propagation of an ultrasonic wave in a liquid medium decreases sharply. In addition, along the length of the tube, the wave nonuniformity of the intensity of ultrasonic vibrations is formed, which must be taken into account when using the ultrasonic cleaning of the internal surfaces of such tubes.

Keywords: ultrasonic wave guide instrument, urological stent, ultrasonic cleaning, sound speed in the medium, sound intensity, density of the medium.

E. V. Leun¹, A. E. Shakhanov¹, A. V. Nickel²
Possibilities to improve accuracy of contact measurements
by using corundum tips and video recording of contact area

¹Lavochkin Association, Moscow region, Khimki, Russia
²Joint Stock Company «Russian Railways», West Siberian
Railway, Omsk, Russia

The article deals with the basics of a new approach to contact measurements of the size of products with the possibility of compensation of contact elastic deformations due to the measurement of the size of the contact zone and determine its center. The combined use of corundum measuring tips and a built-in measuring microscope allows this to be achieved by video recording of the contact area.

The expressions for the dependency of the contact elastic deformation of the contact areas for the three options of contacting the spherical terminal are obtained for: flat, convex and concave surfaces of products. The possibility of determining the coordinates of the center of the contact zone is discussed. There are analyzed the experimentally obtained images of contact zones in the coverage of non-coherent optic flow.

The possibilities of improving the quality of registration of images of the contact zone are considered.

Keywords: video recording of the contact zone, calculation of deformations, compensation of deformations, super wide angle lens, sapphire tip, center of the contact zone, rotation of the matrix of the recorder, contact measurements.