

MECHANICAL AND THEORETICAL ENGINEERING

K. A. Vansovich, I. P. Aistov, A. A. Nakhlestkin, D. S. Beseliya

The analysis of bearing capacity of main pipeline in presence of corrosion defects

A mathematical model is presented that allows modeling fatigue defects of corrosion origin on main pipelines. A method for assessing the crack resistance of the main pipeline wall with a corrosion defect is proposed. The fracture simulation is performed using the finite element method in the framework of elastic fracture mechanics and implemented in the ANSYS Workbench program.

Keywords: corrosion defect, surface crack, finite element method, ring stresses.

V. A. Konovalov, Yu. A. Chugunova

Assessment of factors limiting technological capabilities crimping conical die blanks from thick-walled pipes

The results of an experimental study of the formation of thickwalled hollow products compressed with conical matrices are presented. The influence of the characteristics of the tool and the size of the blanks on the technological capabilities of crimping is established. The quantitative evaluation is made in the form of graphs, which make it possible to predict more accurately the final configuration and dimensions of the stamped product.

Keywords: crimping, conical matrix, thick-walled pipe, inlet, technological capabilities.

V. B. Masyagin, R. L. Artyukh

Compensation of defective workpiece based on adaptive calculation of technological dimensions

Dimensional analysis of technological processes is a key method in terms of reducing the probability of defecting and compensating for the resulting reject associated with dimensions, allowances and tolerances. On the basis of the general method of calculating technological dimensions with adaptation, the problem of compensating the resulting defect is first solved by means of dimensional analysis. The article discusses an example of the calculation of linear technological dimensions with adaptation in order to compensate for defect, according to the results of preliminary control of a particular workpiece and the implementation of a separate calculation of sizes and allowances. The calculation is carried out using the processing scheme, graph, dimensional chain equations and a computer program. As a result of the study, it is found that the calculation of linear technological dimensions with adaptation allows reallocation of the actual values of allowances at each operation and thereby provide compensation of the defect.

Keywords: dimensional chain, technological size, technological tolerance, total allowance, operating allowance, adaptive calculation.

ELECTRICAL ENGINEERING

T. V. Kovaleva, O. O. Komyakova, N. V. Pashkova

Wave processes in alternating current traction network depending on parameters of power supply system

The article considers a mathematical model of the AC traction power supply system taking into account stationary and nonstationary wave processes. The model allows you to analyze the effect of system parameters on electromagnetic processes at its various points. The time diagrams of currents and voltages on the feeder traction substation at different modes of operation of the electric rolling stock and its distance from the traction substation, obtained using the above mathematical model. When modernizing and creating new power supply facilities, it is possible to use the proposed mathematical model for calculating electrical parameters of traction substation equipment and contact network, coordinating the operation of traction and external power supply systems, evaluating electrical energy quality indicators and electromagnetic compatibility.

Keywords: electric railways, alternating current, electromagnetic processes, distributed parameters line, harmonics.

G. A. Koshuk, I. A. Tikhonov, B. A. Kosarev.

Optimization of PLL frequency synthesizer

The influence of different configurations of phase-locked loop frequency (PLL) with integer coefficients on parameters of the PLL loop of the frequency synthesizer is considered. The possibility of computer prediction of such PLL parameters as power consumption, start-up time, jitter and phase noise level at the choice of the frequency divider from the generator to the circuit output is shown.

Keywords: frequency synthesizer, PLL, voltage-controlled oscillator, reference oscillator.

V. V. Anikin, R. N. Khamitov.

Method for determination of electromagnetic parameters of submersible induction motors

Positive and energy saving frequency control of submersible asynchronous electric motors demands a research of its work as a part of electrotechnical complexes of installations of electrocentrifugal pumps on the basis of modeling. This approach is oriented to development of ways of identification of parameters of its equivalent circuits on experimental data. A research objective is development of a way for determination of parameters of the equivalent circuit of submersible asynchronous electric motors with the use of integral of an attenuation curve of current of a winding of the stator without additional transition to frequency responses. The research of a way is conducted on the basis of the developed installation for identification of parameters of equivalent circuits of submersible asynchronous electric motors. For assessment of reliability of a way and a technique of identification of parameters of the equivalent circuit of the submersible electric motor with integrated conversion of an attenuation curve of current of the stator of the submersible electric motor the experiment which shows the greatest discrepancy between values of parameters of the equivalent circuit — no more than 10 % is made. The developed way of identification of parameters of equivalent circuits of the submersible postrepair electric motor, thus, allows to determine operational parameters and characteristics of the electric motor in conditions of repair service enterprises.

Keywords: submersible asynchronous electric motor, equivalent circuit, electromagnetic parameters, surge characteristic, scheme of inclusion.

A. A. Ibatullin, E. S. Gebel, V. N. Gudinov.

To the question of control of servomotors of automatic welding unit designed for welding of large-sized tanks of launch vehicles

The article discusses the process of servo drive control during welding using the SB-2000 welding unit. On the basis of technological process of welding of large-size tanks of launch vehicles power plants for modernization are revealed. A structural solution is proposed for process control and synchronization of electric drives with the use of servo motors. A technical solution and block diagram of the servo drive control algorithm are developed using the SINAMICS S120 modules of the SIEMENS company.

Keywords: industrial automatic control system, process control system, DCS, PLC, electric drive, servomotor, motor vector control, Park and Clarke transformation.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

S. V. Biryukov, A. V. Tyukin

Theoretical studies of multi-electrode sensor of components of electric field intensity vector in form of square plate of conductive material

The article examines a multi-element flat sensor of the components of the intensity vector of a low-frequency electric field manufactured using new technologies and capable of being integrated into modern gadgets. The sensor is suitable for measuring the intensity of electric fields adversely affecting a person. In this regard, the problem solved in the article is relevant. The research results allowed to create such a sensor evaluate its metrological characteristics and establish their dependence on the degree of homogeneity of the electric field. The established interrelation between the sensor error and the degree of heterogeneity of the electric field allows determining the spatial measurement range by a given error or by setting a sensor for a given spatial measurement range. For example, a 2 % sensor error corresponds to the spatial measurement range a determined by the distance from the field source from 0 M to 7 M ($a = 0,15$), where M is the linear size of the sensor.

Keywords: multi-element flat sensor of the components of the electric field strength vector, uniform field, point electric charge, electric field intensity, sensitive element, error due to field heterogeneity, spatial measurement range, electrometric measurements.

**I. A. Kirovskaya, T. L. Bukashkina, E. P. Surovoy, A. V. Yureva, V. E. Surovaya,
L. V. Kolesnikov, V. B. Goncharov, O. V. Kropotin**

Physical and physicochemical properties of binary and multicomponent semiconductors of CuBr-CuI system

Solid solutions of the CuBr-CuI system of various composition have been obtained, certified according to X-ray and thermographic studies as substitution solid solution with cubic structure of sphalerite. Microscopic, magnetic studies of the obtained solid solutions and binary components of the system have also been conducted. The specific electrical conductivity, forbidden bandwidth, Fermi level position relative to the valence band top and the magnetic susceptibility have been identified. Predominance of diamagnetism in the studied components has been shown. Both linear

and extreme changes in the studied properties with changes in composition have been noted. Preliminary considerations have been made about the potential for use the solid solutions of extreme composition in sensor technology.

Keywords: solid solutions, physical and physicochemical properties, linear and extreme change, potential for in sensor technology.

**I. A. Kirovskaya, L. V. Novgorodtseva, E. P. Surovoi, A. V. Yureva, V. E. Surovaya,
L. V. Kolesnikov, V. B. Goncharov, O. V. Kropotin**
Copper halide-based semiconductor materials. Adsorption properties

The adsorption of hydrogen, acetone, and isopropyl alcohol on solid solutions and binary components of the CuBr-CuI system in wide temperature and pressure ranges using the quartz crystal microbalance method has been studied. The ion-radical (relating to hydrogen) and donor-acceptor (relating to acetone, isopropyl alcohol) adsorption mechanisms with the participation of coordination-unsaturated atoms (mainly copper atoms) and structural defects as active sites have been established. With the change in the composition of the components of the CuBr-CuI system, both smooth and extreme (with regard to acetone, isopropyl alcohol) changes in the adsorption values are observed. The influence of the mechanism of occurrence of hole conductivity of CuBr-CuI system components on the nature of the concentration dependence of adsorption is shown. Recommendations on the use of the most active component of the CuBr-CuI system relating to hydrogen as a material for the manufacture of relevant sensors have been given.

Keywords: solid solutions, adsorption properties, ion-radical and donor-acceptor mechanisms, laws of adsorption and electrical conductivity, semiconductor gas analysis.

L. O. Shtripling, V. V. Bazhenov, Yu. V. Kalinin, N. S. Bazhenova, V. V. Merkulov
Method for determining effectiveness of cleaning devices for PM2.5 and PM10 suspended particles in dusty industrial emissions

The article deals with the issue of determining the fractional efficiency of dust collecting devices for PM2.5 and PM10 suspended particles. The need for the application of this method is indicated due to the increased risk of fine dust for health and more serious hygienic standards in comparison with general dust. The authors determined the composition of dust and the content of PM2.5 and PM10 fractions for dust removal equipment at the inlet and outlet analyzed the actual efficiency of fine dust and compared it with the efficiency indicated in the passport data. It is determined that the actual efficiency for fine dust may differ significantly from the passport data. A method for determining the fractional efficiency of dust collecting devices for fine dust is proposed.

Keywords: fine dust, dust collection, particulate matters, PM2.5, PM10, dust collection efficiency.

L. O. Shtripling, V. V. Bazhenov, Yu. V. Kalinin, N. S. Bazhenova, V. V. Merkulov
The method of preliminary localization of source of excessive air pollution to increase effectiveness of environmental monitoring and supervision in Russia

The problem of air pollution is raised in many cities, despite developing environmental legislation and the introduction of more environmentally friendly and efficient equipment at industrial enterprises. The main problem is reduced to the localization of the source of pollution, emissions of which have led to a violation of the quality of atmospheric air. Our research is aimed at localizing the area of location of the source of excessive pollution and its identification as soon as possible.

The paper presents an algorithm for the preliminary assessment of the location of pollution sources, emissions of which could lead to an excess of permissible concentrations in the air. The results can be used in the work of public authorities in the field of environmental protection.

Keywords: air pollution, excess emissions, monitoring of air pollution, search for a source of pollution, analysis of air pollution, a source of emission of pollutants.

A. I. Blesman, R. B. Burlakov

Influence of terms of fabrication on electrical and photoelectric properties of photocell on base of Schottky barrier contact Pd-*n*-GaAs

Structure and strategy of the fabrication of the photocell on the base of the Schottky barrier contact Pd-*n*-GaAs are considered. There is measured I(V)-features of photocells, their C-V-features, spectrums photovoltage and current of the short circuit, and determined height of the Schottky barrier contacts Pd-*n-n*⁺-GaAs by photoelectric method. There is shown that air annealing of structures *n-n*⁺-GaAs-AuGe under (200–210) °C within 30 minutes before precipitating a film Pd on *n*-GaAs brings: to the reduction on two orders direct I_{dir} and inverse I_{inv} currents (under 0,5 V), to reduction on three orders of density of the current of the saturation J_0 , to reduction of capacities of photocells before values (241– 233) pF under inverse tensions (0,22–0,96) V, reduction of the current of the short circuit of photocells and to increase their photovoltage that connected with formation fine insulator film on *n*-GaAs under air annealing of structures *n-n*⁺-GaAs-AuGe.

Keywords: method of fabricating the photocell, *n*-type gallium arsenide, Schottky barrier contacts.

A. V. Tkacheva, A. P. Pavlov, I. E. Kashchenko

Automatic level control system for telephone communication channels of radio-transmitting devices

This article presents automatic level control system for the HF radio-transmitting devices implemented on the basis of the inexpensive of the audio codec and field-programmable gate array. The presented automatic level control system provides a quick recovery of the output level without significant surge. A compression algorithm based on the Hamming window function is used to correct the spectral mask of the signal and increase the mean-square average power of the radio-transmission path. In conclusion, the results of laboratory tests of the offered of automatic level control system.

Keywords: automatic level control, compression, power amplifier, audiocodec, digital signal processing

D. A. Sedykh, A. A. Novikov, A. R. Putintseva, A. M. Badamshin

Development of ultrasonic waveguide — screw for external fixation device (Ilizarov apparatus)

As a result of the study, an ultrasonic waveguide - screw for the Ilizarov apparatus is developed, designed and manufactured, which serves to directly affect the bone through the surgical wound with the possibility of multiple ultrasound exposure during treatment. The use of a waveguide-screw reduces the time needed to consolidate the fracture and reduce the frequency of complications associated with bone tissue regeneration and infection.

Keywords: ultrasound effect, fracture, bone tissue regeneration, waveguide-screw, external fixation device