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SUMMARY. KEYWORDS

MECHANICAL
AND THEORETICAL ENGINEERING**V. G. Khomchenko****Kinematic synthesis of non-clutch mechanical press based on lever mechanism of the third class****Omsk State Technical University, Omsk, Russia**

The article discusses the kinematic scheme of the lever crank-slider mechanism of the third class, on the basis of which the executive mechanism of a mechanical non-clutch press is proposed under the patent for the invention (RF patent No. 2752399). Switching mode of operation of the press is carried out by moving the control slider from one stationary position to another. The kinematic parameters of the lever mechanism are assigned in such a way that in operating mode the law of motion of the working body of the press is close to the law of motion of the output link of the four-link central crank-slider mechanism, and in the idle mode — the working body makes small movements (approximate stand) at full rotation of the crank. The analytical dependencies necessary for calculating the mechanism and the corresponding example are given.

Keywords: mechanical gearless press, lever mechanism of the third class, approximate stand, control slider, calculated dependencies.

L. Yu. Volkova**Development of universal device for determining the needle stroke in diesel and marine diesel sprayers****Kaliningrad State Technical University, Kaliningrad, Russia**

The main malfunctions of diesel and marine diesel injectors with an increase in the needle stroke by more than 50 % of the standard value are described — an increase in the temperature of the nozzle of the sprayer, a breakthrough of cylinder gases into the cavity of the sprayer and the formation of coke, a decrease in the pressure of the injected fuel. A method is proposed for determining the maximum stroke of the needle by measuring the length of the needle shank and its conditional reduction when the needle is placed on the saddle. The device and the principle of operation of the device for determining the maximum stroke of the spray needle are shown. Drawings of the main parts of the universal device for determining the needle stroke of sprayers with a diameter from 8 to 18 mm of diesel and marine diesel engines have been developed, a prototype is made. The method of determining the

motion (stroke) of the needle of the spray nozzles of diesel engines using the developed device is given.

Keywords: diesel and marine diesel injectors, sprayer, needle stroke, malfunctions, sample device, methodology.

E. B. Mazurin, E. V. Savenko**Mechanism of equipment selection for different types of production****Bauman Moscow State Technical University (National Research University), Moscow, Russia**

Companies engaged in production of products have a high uncertainty in the choice of technological equipment. The production facilities of an enterprise can consist of both its own technological equipment and equipment taken on lease. In addition, you can use a subcontract for the production of products. The criteria for choosing technological equipment can be: characteristics of the products and the expected premium to the production cost. The development and further use of a mechanism for selecting technological equipment for a single type of production can increase the efficiency of production processes.

Keywords: production capacity, unit production, costs, production costs, production planning, production organization.

V. V. Ryndin¹,**Yu. P. Makushev²,****T. A. Polyakova², L. Yu. Volkova³****Calculation of cams with concave profile in the MATHCAD system****¹Pavlodar State University named after S. Toraiyrov, Pavlodar, Republic of Kazakhstan****²Siberian State Automobile and Highway University, Omsk, Russia****³Kaliningrad State Technical University, Kaliningrad, Russia**

The article shows the features of the cam with concave profile, the method of kinematic calculation of the pusher when it moves along a concave and rounded surface. The formula for determining the magnitude of the pusher velocity on the concave surface of the cam is refined. A method for determining the coordinate center for the radius of the concave surface of the cam is proposed. To increase the speed of the plunger and intensify the fuel injection process in high-pressure pumps of low-speed diesel engines, it is recommended

to use cams with concave profile. The calculation is performed using the Mathcad system of the stroke, speed and acceleration of the pusher depending on the angle of rotation of the cam shaft. Using the Mathcad program for cams with a concave profile, graphs of the pusher lift, changes in its speed and acceleration are constructed.

Keywords: engine mechanisms, concave cam, formula output, pusher kinematics calculation, Mathcad program, graphs.

D. T. Safarov¹, A. V. Chekh²

Finding allowance distribution for root and connecting rod necks of crankshaft forging according to coordinate measurements

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The article analyzes various ways to ensure the geometric parameters of forgings in the processes of hot volumetric stamping. The fact of high efficiency of coordinate measurements of geometric parameters of forgings has been established to ensure the identification of negative production factors affecting the geometric accuracy of forgings manufacturing. The designs of common control devices and measurement schemes of geometric parameters of the crankshaft forging do not allow performing coordinate measurements of the crankshaft forging in shop conditions. The coordinate scheme, the design of the control device and the method of determining the size of the parameters of the allowance distribution along the root and connecting rod necks of the crankshaft are considered. On the basis of the methodology given in the article for determining the parameters of the allowance distribution, a technique for controlling the geometric accuracy of hot volumetric stamping has been developed, the accuracy of controlling the output parameters of the geometric accuracy of forgings of crankshafts of heavy-duty vehicles has been improved.

Keywords: forging of the crankshaft, hot stamping, allowance distribution, coordinate measurements, root and connecting rod necks.

L. K. Sirotina

Development of calendar and planning production indicators based on the model of equipment life cycle

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The article is devoted to the problem of substantiation and regulation of calendar and planned production indicators. Estimation of the equipment life cycle cost at the stage of investment in its acquisition and commissioning will make it possible to make decisions on the usefulness period, on the indicators of production capacity and the level achieved, on the permissible values of equipment downtime, the

expediency of working on its maintenance and other indicators related to the use of production equipment.

Keywords: equipment life cycle, calendar standards and indicators, production capacity, production planning automation, organizational downtime, term of efficient use, intensive load, production potential.

ELECTRICAL ENGINEERING

V. V. Sushkov¹, E. E. Revyakin²

Phase angle synchronization system of synchronous generators for parallel operation

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In this paper, the synchronous generator shaft-position control system for synchronization process is explored. When the standard synchronization method is applied closing of a circuit breaker is accompany by the transient effects. This happens due to the voltage frequency of the synchronized generator is not equal to its synchronous value when the phase angle is controlled. The proposed synchronization approach allows to reduce the transient process influence on electrical equipment and improves the maneuverability of the control system in comparison with the standard method. Simulation modelling results are provided to illustrate it.

Keywords: precision automatic synchronization, shaft-position control system, diesel generator speed control system, distributed generation.

B. A. Kosarev^{1,2}, S. V. Krivaltsevich¹,

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Electrical system with distributed generation of radio center with abruptly variable nature of load

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In this work using the example of a radio center the issue of organizing an electrical system with distributed generation of a consumer with a sharply variable nature of the load is considered. The creation of electrical complexes based on distributed energy generation is a promising direction in the development of energy. One of the problems that can be solved using distributed generation is the smoothing the power profile of the consumer. The purpose of the research work is to study the features of the organization of an electrical system with distributed generation of a radio center with a sharply variable nature of the load. When constructing structural diagrams of the power supply system of the radio center, the fundamentals of power supply of industrial enterprises are used. Recommendations on the technical parameters of power plants are integrated based on the results of research in the field of distributed power generation and related regulatory documents and radio communication systems. Based on the results of the research work, the technical characteristics of

power plants are noted, which should be paid attention to when designing an electrical system with distributed generation of a radio center. Variants of the structural diagram of the electrical system with distributed generation of the radio center and the corresponding power distribution schemes are proposed.

Keywords: distributed generation, renewable energy source, grid inverter, radio center, acoustic noise, dynamic stability.

Yu. V. Moskalev

Determination of minimum secondary winding coils turns for transformer three-phase-multiphase phase number converter

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The article has considered an approach to determining the minimum of the secondary winding coils turns of a transformer three-phase-multiphase phase number converter. Each phase of the secondary winding of the considered converter consists of three coils connected in series placed on three different rods of the magnetic circuit. In order to solve the optimization problem, the interior-point method is used. As an example, for a three-phase-five-phase converter has determined the minimum number of turns of the secondary winding, the total power consumed by the coils of the secondary winding is calculated. A vector diagram EMF of the coils of the secondary winding is constructed, explaining the formation of a symmetrical five-phase EMF system at the terminals of the secondary winding. Using the proposed approach, it is possible to design a transformer converter of the number of phases with a three-phase primary winding and a multiphase secondary winding, the number of phases of which is more than two.

Keywords: transformer phase converter, multiphase winding, optimization amount of the coils turns, multiphase symmetric system.

S. A. Gorovoy¹, A. V. Simakov², V. I. Skorokhodov²
Analysis and calculation of higher harmonics of power supply system of plant on basis of packet wavelet conversion

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After analyzing the results of physical tests of the power supply system of the plant, it is found that the values of individual harmonic components exceed the values established by GOST-32144 2013. Based on the data obtained, a simulation model is formed and an analysis of higher harmonics is performed using the packet wavelet transform method. The aim of the work is the analysis and calculation of higher harmonics and additional losses from them in the neutral conductor based on the packet wavelet transform method. The simulation is carried out using the Simulink software package. As a result of the study, it is found that the packet wavelet transform with high accuracy allows to determine the presence of higher harmonics in

the power supply system, the efficiency of using the wavelet transform to calculate additional losses in the neutral conductor is shown.

Keywords: power supply system, higher harmonics, wavelet transform, packet wavelet transform, non-sinusoidal mode.

**INSTRUMENT ENGINEERING, METROLOGY
AND INFORMATION MEASURING EQUIPMENT
AND SYSTEMS**

V. A. Zakharenko, D. G. Lobov,

A. G. Shkayev, A. A. Valke

Pyrometer with video monitoring of measurement area

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A pyrometer with non-parallel sighting is developed, which allows simultaneously with temperature measurement to perform video surveillance of the control object. Pyrometer has optically connected lens, signal meter, thermostat in which radiation receiver is placed, and video camera. The front surface of the thermostat is polished, directed at an angle of 45 ° to the optical axis of the lens and has a hole that acts as a field diaphragm. Video camera is directed to polished surface of thermostat perpendicular to optical axis of lens. Pyrometer operation, its design and functional diagram are described.

Keywords: pyrometer, parallax-free sighting, video surveillance non-contact temperature measurement.

E. V. Leun

The basics of construction of jet-drop optical systems for measuring electric field strength. Part 2

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In this part of the article, the discussion of the construction of jet-drop optical measuring systems (JDOMS) for monitoring the electric field strength continues. The possibilities of increasing the resolution are considered. A variant of the interference JDOMS using triangulation stroboscopic measurements of displacements of charged moving droplets using a pulsed acousto-optic interferometer of transverse displacements of a laser beam is presented. The possibilities of increasing the charge/mass ratio of charged droplets, the features of using liquid metals and their two- and three-component alloys as liquids, the use of inhomogeneous droplets in the form of hollow, hollow microspheres similar to soap bubbles and/or based on a porous (dispersed) material are discussed.

Keywords: drip stream, electrostatic charge, electric field strength, stroboscope, triangulation measurements, acousto-optic modulator, displacement interferometer.