ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

ENVIRONMENTAL IMPACT OF PRODUCTION AND USE OF GEOTHERMAL ENERGY IN UKRAINE

page 4–8

General potential of geothermal resources of Ukraine and the possibilities of their use as an alternative fuel are considered in the article. The most promising regions of Ukraine for the development of geothermal energy were determined and the characteristics of the heat-transfer agent were described. Value engineering analysis of modern technologies of extraction of heat was carried out, taking into account a feasibility study. Possibilities of using depleted oil and gas fields were studied, as well as the simultaneous use of wells for the extraction of hot water and hydrocarbons. The factors that affect the extent of the use of geothermal energy were examined. The important aspects of the use of geothermal energy sources, such as renewability, getting a heat-transfer agent of much lower temperature than from firing, combination of the energy use and minimal detrimental impact on the environment were listed. There were also described the disadvantages of use of geothermal resources, such as the need to use at the place of production, the high cost of construction of wells with increased depth, swamping the area, release into the atmosphere of dissolved sulfur compounds, mercury, arsenic and boron. Methods to reduce harmful emissions into the environment of geothermal power plants were proposed.

Keywords: energy, energy conservation, alternative energy sources, geothermal power plants, hydrothermal energy.

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ECONOMIC EFFICIENCY OF NETWORK-BASED SOLAR POWER STATIONS EMPLOYMENT IN PRIVATE HOUSING ESTATES

page 8–13

This paper focuses on the economic efficiency issues and the peculiarities of private network-based solar power stations establishing in Ukraine. There have been determined the possibilities of «green» tariff usage. There have been calculated capitalized and current charges incurred by housing estates in case of network-based solar power stations employment, profit due to the electricity output at the solar power station, payback period upon their employment.

As a result of the research conducted by the authors, they have reached a conclusion that network-based solar power stations return a profit only at sufficiently high capacity and providing their connection to the 'green' tariff. The maximum profits at the minimum payback period are returned by the power stations with the capacity close to the maximum, acceptable for the ones in private housing estates.

It is worth mentioning that the main deterrent restraining the mass employment of solar power stations in Ukrainian private housing estates are sufficiently large initial expenses. Besides, an important factor in successful realization of projects on establishing network-based solar power stations in private housing estates is the support on behalf of the state.

Keywords: network-based solar power station, «green» tariff, economic efficiency, payback period.

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FEATURES OF CONSTRUCTION OF THE TRACTION ELECTRIC DRIVES MOVABLE ELECTRICAL SYSTEMS

page 13–17

The features of construction of systems of traction electric drives for various types and designs of mobile electrical systems. The analysis of practical experience in building systems of traction electric drives and synthesis methods for determining the structure and parameters under the given requirements from the

side of the movable electrical complex. Study of construction of systems of traction drives with different types of engines are relevant from the point of view of achieving the maximum level of energy savings through the implementation of all these requirements. Means of improving energy efficiency and productivity of mobile electrical systems in difficult situation on the market of energy resources allow for greater independence of the domestic transportation industry from a number of economic and political factors that have a significant impact on the basic indicators of work of many enterprises and the budget of private vehicle owners and provide optimal design and more efficient operation in various sectors of the economy. In the result of the analysis has been further development of the method for determining the structure and parameters of traction electric drives of rolling electrical complex by taking into account the specific requirements of the Executive mechanism, whereby the analytical requirements for different groups of mobile complexes on details of construction of the traction electric drives, choice of motor traction drives based on the distribution of energy flows on traction needs and providing for their own needs, which allows to determine the optimal structure of such traction drives. In particular, the analysis of practical experience of building traction systems and generalization of methods of determining the type and parameters of traction motors under the given requirements from the side of the movable electrical complex, which allows for precise selection of the type and parameters of the traction electric drive.

Keywords: Electrical Complex, traction drive, methodology, autonomous system, motion.

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SUPPORT OF TURBOCOMPRESSOR UNIT EQUIPMENT HEAT REGIME BY HEAT INSULATION OF GAS-TURBINE ENGINE

page 18–21

Some problems of fire explosion safety and acceptable thermal state of power units of equipment of turbo-compressor units are considered. Thermal state of the power block equipment in the presence and in the absence of external thermal insulation of body of converted gas-turbine engine is investigated by the methods of aerodynamics. Thickness of the insulation mats placed on different parts of the engine body calculated on the basis of the surface temperature, that are maximum permissible under the terms of fire explosion safety. The results showed that the coating of the engine body by thermal insulation will significantly reduce the temperature of its outer surface and small-sized equipment of power unit with a small decrease in the efficiency of the turbine and engine power, because of the additional thermal expansion of the body. The usefulness of the external thermal insulation of bodies of converted engines working in the cover of power units of turbo-compressor units requires further feasibility study.

Keywords: turbo-compressor unit, gas-turbine engine, fire explosion safety, thermal state, thermal insulation, modeling.

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DEVELOPMENT OF METHODOLOGY FOR ENERGY ASSESSMENT OF OPERATIONAL MODES OF WORK OF POWER EQUIPMENT

page 21–26

Development of scientific and technical proposals in the field of energy conservation, and increase the operational reliability of electrical power is continued in the article. One of the main indicators for assessing technical solutions is, as you know, the annual economic benefit of the development, expressed in national currency. However, due to the instability of the national currency, such estimate can't be objective. It is considered that the weakest element of the design of power equipment is its electrical insulation. The main negative impact on its operating parameter is the temperature of heating, which in turn is a function of electric power losses in it.

Evaluation of electric power losses in the power electrical equipment performed in units of electrical energy, and resource consumption of insulating structure — in units of insulation depreciation. As a result, it is difficult to assess the overall operational modes of electrical power equipment. Therefore, it is developed the technique of the energy assessment of operational modes of power equipment.

In this paper we addressed the scientific and technical problem of estimating the economy of resources in the electrical power equipment by one indicator for which it is conducted research of the loss of electricity, together with the process of thermal deterioration of its isolation, and then their joint assessment. This task is performed by the example of induction motor with squirrel-cage rotor as the most widespread object of the power equipment.

Keywords: motor, losses, specific, load, temperature, optimum, energy-saving, slip, chart, resource.

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ANALYSIS OF METHODS AND MEANS OF IMPROVING THE RELIABILITY OF ELEMENTS OF RELAY PROTECTION

page 26–30

This paper analyzes the methods of selecting the number of sets of relay protection and automation (RPA) and reservation schemes for the protected object. The calculation procedure of parameters of reliability of RPA systems for three types of protecting objects that allow grounding schemes of reservation of RPA systems and providing the required level of reliability of electricity supply facilities.It is developed the model for the RPA functioning of modern element base, which revealed the following components performance of relay protection systems in modern terms as software reliability, security from external electromagnetic and other influences, and the human factor.

It is proposed the scheme of accounting influencing factors (parameter of short circuit flow (SC), the effect of staff («human factor»), uniqueness of recovery), thus allow founding dependence of resulting indicators of reliability from influencing factors and assess the impact of factors on the results of reliability calculations.

The features of the model are taken into account when calculating the reliability of hardware of RPA systems and reliability indexes of relay protection for three objects: power lines, busbars and power transformer. This will allow justifying and choosing the schemes of reservation of RPA systems, which greatly increase the reliability of electricity supply system in general.

Keywords: relay protection and automation, microprocessor terminals, power transformer, power lines.

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ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

PLASMATRON FOR ION-PLASMA SURFACE OF GLASS TREATMENT AT ATMOSPHERIC PRESSURE

page 31–34

Main mass of glass processing research is devoted to vacuum methods and to creation of non-penetrating coatings that are subject to physical and chemical impact. Therefore, the development of plasma devices that improve the efficiency of processing through the organization process at atmospheric pressure is an actual problem. The article suggests construction and studies operation modes of DC-arc plasmatron, which eliminates the need for powder coating material of a specific particle size, allows using as source material of introduction aqueous solutions of salts and increases the effective utilization of the implementation material at surface treatment of the glass. In view of the construction features of the developed plasmatron and its working conditions, as well as the weak dependence of the voltage of the electric arc on the Knudsen criterion (complex pd) a simplified equation of the current-voltage characteristics is proposed. The calculation of the current-voltage characteristics of the proposed dependence is in satisfactory agreement with the experimental data. The coefficient of efficiency of the developed plasmatron is 63 ... 80 %.

Keywords: plasmatron, glass, implementation material, modification of the surface, coating.

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INFLUENCE OF MATERIAL PARAMETERS ON RELIABILITY INDICATORS OF TWO-STAGE THERMOELECTRIC DEVICES

page 34–40

It was taken a comparative analysis of the main parameters and reliability indicators of two-stage thermoelectric devices while using various combinations of the source materials, which differ by of thermoelectric power and electrical conductivity coefficients, for temperature changes from 60 K to 90 K and modes of operation from the maximum cooling capacity to the lowest failure rate.

The possibility of reducing the total failure rate and increase the probability of failure of two-stage thermal power devices using of source materials with high electrical conductivity is presented. It was received a number of patterns which allows to determine the main parameters and reliability indices for different combinations of source materials compared with traditional modes of operation and temperature changes.

Variants of combinations of averaged parameters of raw materials for the construction of two-stage thermoelectric devices including traditionally used in the production are represented. There were developed models for determination of relative distribution of thermocouples number in thermoelectric device stages, the relative failure rate model, the model of relative power consumption in stages, the model of relative cooling coefficient.

The comparative analysis of the basic parameters and reliability operation indicators from the maximum cooling capacity to the lowest failure rate was taken, which has showed that compared with traditional version we get a win on the failure rate by 10–20 % with a corresponding increase in the probability of thermoelectric coolers failure-free operation. These researches can be applied in the manufacture of thermoelectric cooling devices of high reliability while maintaining the value of the product.

Keywords: reliability, thermoelectric devices, materials, temperature, failure rate.

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CORRECTION OF CHARACTERISTICS OF HIGH-VOLTAGE TEST TRANSFORMER

page 41–46

Dependence of performances of serial high-voltage testing transformer ИОМ-100/25 with a measuring winding from character of a loading is explored. Substantial growth of a high voltage measuring error by means of measuring winding ИОМ-100/25 is fixed at a capacitive load.

The cause of a capacitive load effect on a measuring error of a high voltage for the given type of transformers and its analogues is defined — proportions of a leakage inductance of a measuring winding and all high-voltage winding do not coincide with the nominal division ratio for these windings, owing to design features of the given type of transformers.

The procedure of the high voltage measuring error correction defined by means of measuring winding ИОМ-100/25 (or analogous transformers), by means of compensation of the inductive voltage drop on measuring winding by the additional capacitor which is switched on in succession with a measuring winding is offered.

The results of the research can be used to upgrade the high voltage electrical testing laboratories.

Keywords: test transformer, leakage inductance, capacitance current, inductive voltage drop.

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MECHANICAL ENGINEERING AND MACHINE BUILDING

INVESTIGATION OF STRESS-STRAINED STATE OF COMPLEX PARTS AFTER PLASMA SURFACE HARDENING

page 47–50

The structure and properties of 35CML steel after plasma hardening was investigated, the mechanisms of influence upon formation of phase composition and residual stresses after surface treatment were revealed. It was found out that that residual microstresses at surface treatment of steel represented an algebraic sum of strain of two kinds — thermal strain, caused by uneven distribution of temperature along the part's cross-section and structural strains, due to changes in volume resulting from phase transitions.

Residual stresses in the surface layer were determined experimentally. Distribution of deformations in the specified part was simulated by applying of a source of highly concentrated energy. Recommendations were offered for the choice of the modes of plasma treatment.

A part, made of the specified steel was hardened with application of designated modes and its geometric shape was controlled. Plasma surface treatment proved to be a promising method of increasing durability of engineering parts.

Keywords: plasma treatment, stress, strain, structure, phase composition, simulation, element, properties, exploitation.

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DEVELOPING OF INTEGRAL CONTROL SYSTEM OF TOPOLOGICAL ELEMENTS OF OPTICAL SCALES AND GRIDS

page 51–55

An integrated approach to creating TV measurement system of geometrical dimensions of topological elements of scales and grids is considered in the article. The main aim is to create and increase the accuracy of measuring television system based on a microscope Biolam to control the geometric dimensions of the topological elements of optical scales and grids. The study was conducted by optical methods and atomic force microscopy. It is developed a technical approach to create an integrated measuring system for technical audit and control of geometric dimensions of topological elements of optical scales and grids. The factors that affect the value of the desired signal are analyzed and the advantages of LED-display as the illuminator in front of the halogen lamp in the developed measuring system are experimentally demonstrated. The experiments on the integrated measuring system using a microscope Biolam and television camera Novus-130 BH allow determining the optimum conditions and reduce the measurement error of topological elements of optical scales and grids by 4,5 % and measure the size of the elements 6–10 microns with an accuracy of ±0,5 microns. Results of the study can be applied to the optoelectronic enterprises to improve an accuracy of control scales and grids.

Keywords: optical system, geometric dimension, microscope, measure, scales and grids LED-display.

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RHEOLOGICAL PROPERTIES AND HYDRODYNAMICS OF THE UNSTABILIZED FLOW OF THE NON-NEWTONIAN FLUIDS IN THE WORKING CHANNELS OF MOULDING EQUIPMENT

page 56–60

The questions related to the rheological behavior of non-Newtonian fluids in channels of forming equipment. Parameters of rheological equation and their dependence on hydro and thermal modes of processing media are obtained as a result of data processing of rheometric research. Selecting the values of shear rate in the flow processing material and the temperature of its heating effect on the modal performance of the molding equipment and reduce energy consumption for its processing. An experimental research of the processes of unregulated movement of non-Newtonian fluids in channels with sharply varying geometry is conducted. It is shown that the length of the hydrodynamic flow stabilization depends on the rheological properties of the medium and the conditions of entry of the forming equipment into the working channels. Information about the characteristics of the flow medium is manifested in the presence of anomalies of viscosity of inertial forces in the flow required for the analysis and calculation of process parameters of high-speed spinning of viscose fibers.

Keywords: rheological properties, unregulated flow, channels with variable geometry.

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DEVELOPMENT OF THE CONSTRUCTION OF THE CUT-OFF BLADE FROM CIRCULAR SAWS

page 60–64

The aim of this article is to develop the design of the cut-off blade from circular saw, as a way of reducing consumption of cutting tool during cutting operations. The work is carried out in order to increase the reliability and service life of the cut-off blade of disk type, material of cutting parts are made of high speed steel P6M5. It is proposed the design of fixing of proposed cutter in the lathe tool carriers. The influence of the degree of sharpening the cutting edge on the firmness of cutting-off blade is offered. It is proposed to determine the severity of the blades by scanning on background of millimeter divisions by scanner with high resolution, allowing controlled rounded cutting edge with radius of 0,2 mm by diamond bar. Edge rounding allowed receiving increase sustainability of the tool to 1,8 times in a determined range of thickness of cut.

Keywords: cutting pieces, cut-off blade, disk cutter, circular saw.

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ANALYSIS OF PROMISING METHODS FOR PROTECTION OF FRUIT TREES GENERATIVE ORGANS FROM SPRING FROSTS

page 64–69

Analysis of the known methods and means of mechanization of frost protection was carried out. Schemes of the direction of flow of cold and warm air using various methods and means of mechanization were composed. It was proposed a classification of methods and means of mechanization of fruit trees protection from frost, which allows selecting a promising direction to enhance the process of protection of the generative organs of fruit trees from spring frosts.

It was found that a promising direction is the development of the complex system which consists of temperature condition monitoring, protection technological process and mechanization means.

Frost protection can be performed in several ways, by combining known methods. In such case, it is necessary to examine the type of frost.

Addressing these problems helps to choose a promising direction of development of this sector of mechanization, as well as to expand the set of methods and means for the protection of the generative organs of fruit trees from spring frosts.

Keywords: fruit trees, generative organs, crop yield, frost protection, mechanization.

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EXPLORATION OF DESCRIBING THE VECTOR-PARAMETRIC BI-SPLINE, DEFINED BY THE CUBIC SPLINE WITH CONTROL POINTS INCIDENT WITH SURFACE OF APPROPRIATE SMOOTHNESS

page 69–72

Explorations carried on within the framework of geometrical simulations are aimed to develop already existing techniques describing spline surface, since under certain circumstances it appears to be hard to construct even outlines applying available methodologies. The proposed technique is based on the principle that control points belong to the curve under consideration.

Basing on the preceding researches the article proposes a technique of bispline configuration as a vectorial-parametrical surface with control points incidental to the relevant curve applying the third degree splines meeting the evenness criteria within the first and the second degrees. To achieve this purpose the vectorial-parametrical spline $r = r(u)$ is extended (or, so to say, pulled out) in the direction identified with v, i. e. in a direction, other than u thus enabling to develop the appropriate surface «portions». Further, to obtain bispline with appropriate evenness adherence of appropriate surface portions is required preserving the appropriate evenness along the adhering line, obtaining thus the equity of appropriate derivatives (both the first and the second). However, to maintain total evenness of the second degree, i. e. to preserve the continuity of the second quadric form within the entire form it is yet necessary to meet the compound derivatives equity criterion. The test examples of the bicubic splines are included into the work.

The benefit of this research is to develop new, more convenient method that gives the developer more flexible and convenience in its operation that was described above.

Keywords: vectorial-parametrical bispline, bispline, spline with control points incidental with the appropriate curve, evenness.

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ANALYSIS OF TECHNOLOGIES OF FORMING DETAILS FROM SHEET THERMALLY STRENGTHENED ALUMINUM ALLOYS

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This article is devoted to study ways of forming thermally-hardened alloys, including aluminum and titanium. The authors analyze the advantages and disadvantages of traditional methods of forming such as bending to free press, rolling on three and four roll bending machines, blast forming, bending with stretching on special robots or pulling presses and combined processing methods. These methods require special technological equipment and highly skilled performers; require performance processing for a large number of transactions and conversions and is labor-intensive; after the formation it is necessary to carry out additional processing to reduce surface roughness. These processes are not quickly adjustable that in a single and small batch production of double curvature surfaces resulting in increased cost of the final product. The authors proposed to use for the manufacture of parts, from the above materials, laser forming process that is flexible, quickly adjustable and has enough performance. In addition, the authors suggest using forced cooling of the sample during processing that will increase the productivity of the process and additionally prevent thermal softening of the material.

The use of laser forming for forming thermally-hardened aircraft materials will simplify and reduce the cost of the process of manufacturing parts of double curvature without loss of performance.

Keywords: laser forming, sheet materials, bending, aluminum alloys, pellet-impact forming.

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