MECHANICAL ENGINEERING AND MACHINE BUILDING

RETROSPECTIVE ANALYSIS OF ARRAY OF THE PUBLISHED PATENTS, CHARACTERIZING DEVELOPMENT OF THE CAST-ROLLING MODULES AT 2000–2013 IN UKRAINE AND RUSSIA

page 4–7

It is performed a retrospective research of an array of published patents, characterizing the development of the casting-rolling units for the period 2000–2013 in Ukraine and Russia. These researches identify the relevance of the work to improve the casting-rolling units, the dynamics of the rolling production in general and the production of steel in the casting-rolling unit, which allowed to determine the direction of future research.

The research showed that during this period there is a continuous development and improvement of the combined processes of casting-rolling both in Ukraine and in Russia. In Ukraine in 2004 the intensity of the development of this area has increased, reached a peak in 2010, in 2013 decreased slightly, but it was no less than 2004. These researches have allowed to identify disadvantages in the development of casting-rolling units, which are as high temperature of metal casting. It is therefore necessary to make decisions that will reduce the ability to quickly become overheated during casting and create the additional crystallization centers inside the metal.

Keywords: rolling production, casting and rolling unit, number of patents, retrospective analysis, technological process.

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DETERMINATION OF EFFECTIVE FIELD OF APPLICATION OF ACTIVE METHODS OF VIBRATIONS AND NOISE SUPPRESSION IN HYDRAULIC AND PNEUMATIC DRIVES

page 8–11

It is analyzed the causes of noise and vibration in the hydraulic and pneumatic drives. It is determined that the main sources of noise and vibrations in such systems are pneumatic or hydraulic sources of energy, the connecting lines. The motor can be identified as a source of mechanical vibration motor. Frequency spectra arising in hydro pneumatic systems are determined. It is shown that in a large number of cases, the fundamental components of noise and vibrations are low frequency. The known passive methods to reduce vibration and noise are considered. It is established that their use for suppressing of low-frequency spectrum is ineffective. A review of active methods of abatement of vibration and noise, performed well when working at low frequencies. Particular attention is paid to compensate for the active devices built on the principles of feedback systems and systems in the perturbation. It is considered the existing developments of active suppress devices of low-frequency noise and vibration in the hydraulic and pneumatic drives, which proved to be effective. It is shown the promising circuit design of such devices and possible areas of its application.

Keywords: vibration, noise, hydraulic drive, pneumatic drive, active systems, vibration damping, noise reduction.

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RESOURCE TESTS OF FACE PACKING SEALS WITH REVERSIBLE GROOVES

page 11–15

The analysis of existing designs of face mechanical, stuffing box packing and hydrodynamic seals, as well as methods for experimental determination of physical and mechanical properties of packings and hermetic sealing of the seal unit, that allowed to do the conclusion about the relevance of investigation and development of new face packing seal designs was conducted. The face packing seal design with reversible grooves, allowing due to hydrodynamic unloading of friction pair and return pumping of flow in sealed medium, to reduce the leakage value, friction and wear, as well as significantly expand the operating parameters (sealed pressure and sliding velocity) of friction pair was created. The investigations have shown that the seal can be guaranteed used at sealed liquid pressures to 2 MPa, providing minimal leakages and allowed thermal state of the seal unit. Resource tests have confirmed the working capacity, hermetic sealing and durability of the new seal design that can be used for pumps of general industrial purpose, pumping chemical and neutral fluids.

Keywords: face packing seal, friction pair, reversible grooves, flexible bottom, hydrodynamic pressure.

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INFLUENCE OF TECHNOLOGICAL HEREDITY ON RELIABILITY PARAMETERS OF PRODUCTS

page 15–21

It is grounded an expediency of systematic approach to solution the problem of product reliability with implementation of comprehensive system of product (machine) lifecycle management (Product Lifecycle Management — PLM), designing the functionally-oriented technologies of engineering production by parallel engineering means — CAPE (Concurrent Art-to-Product Environment). The role of technological inheritance in the technological chain of manufacturing products is determined. It is shown the importance of blanking operations in study of impact of technological inheritance on quality parameters of the final product due to the close relationship of structural and technological inheritance. It is developed the mathematical relationship, which determines the reliability of technological process $P(t)$ implementation given the current state of science and technology. It is shown the priority of finishing and strengthening operations based on surface plastic deformation over the finish machining operations to ensure the desired performance and reliability. In particular, treatment by vibration-centered strengthening of drilling pump cylinder sleeves helped reduce the high-level and step parameters of the surface layer (R_a, R_z, R_p, R_{max}) in 1,5–5,8 times and increase the mean time between failures to 1,79 times compared with the original polished and treated bushings. The ways for further research towards optimizing the structure of processes are marked taking into account technological inheritance; practical recommendations on the use of energy-saving technologies, including the use of vibration to improve the performance of machine parts.

Keywords: product reliability, technology, process, surface engineering, finishing and strengthening operation.

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ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

ANALYSIS OF THE ADEQUACY OF THE FINITE ELEMENT MODEL OF SINTERING PROCESS OF THE IRON ORE CHARGE

page 22–25

The analysis of the current state of the problem of modeling the sintering process is conducted and weaknesses in existing numerical models are identified. The simulation results of the sintering process burden on the author's developed finite element thermal model of the sintering process, taking into account segregation processes in the layer of feed material, namely the distribution of fuel and chemical compounds by height of layer.

The results of simulation and field experiment conducted in the experimental device of sinter plant IC «Zaporizhstal» (Ukraine) are analyzed for the sintering conditions on the existing sinter machine № 1, confirmed the adequacy of the presented model.

Simulation error is 2,61 % that indicates the possibility of using this model to conduct numerical experiments to manage segregation of charge materials and fuel in order to optimize the thermal regime of the sintering process.

Keywords: segregation, simulation model, model adequacy, thermal regime, layer horizon, charge.

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OPTIMIZATION OF FLAT SOLAR COLLECTORS AREA FOR HOT WATER SYSTEMS

page 25–30

In materials for planning of solar hot water heating systems (SHWHS) at determination of solar collector's area the mode of operations and losses of warmth at transmission to coolant are not taken into account. Optimization of solar collector's area on the criterion of a minimum of the annual resulted expenses in the divalent setting for a hot water-supply taking into account these factors is taking place. The annual expenses were determined taking into account an ecological constituent that included the payment for harmful extras according to the Tax code of Ukraine and Kyoto protocol. It is got as a result of researches, that area of collectors for SHWHS working during the warm half of year, it is necessary to determine on specific insolation in June. The angle of collectors tilt must be equal to 25°. For SHWHS working the whole year round, the angle of collectors tilt is equal to 40°, and the area of collectors must be determined on specific insolation in May. The got results promote efficiency of the SHWHS use for a hot water-supply in the south of Ukraine conditions.

Keywords: area of solar collectors, the annual resulted expenses, ecological constituent of expenses, duration of work.

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ABOUT THE OPTIMAL DISPLACEMENT POWER FACTOR OF ELECTRIC POWER SUPPLY SYSTEMS

page 30–34

Based on the physics of electric power transmission in electric power systems, it is proposed during the calculations of modes not use the peak value of reactive power, which it is usually operated in this case and its current value. This is possible because mathematically and practically reactive electric power as part of the internal electric power of electric power system varies sinusoidally and increases active losses and reduces the carrying capacity of electric power networks of specific electric power consumers and electric power supply networks of organizations.

It is proposed the algorithms of damage determination from reactive load of electric power transmission based on consideration of its displacement power factor that must meet the current value of its reactive power.

It is argued that the practice of billing calculation for reactive load of electric power consumers that exists in our time because at the state level, there are regulations that require such payment that neither theoretically nor practically impossible. It is obvious that such practice contradicts the moral and legal norms and must be stopped.

Keywords: electric power, electric power supply, reactive load, displacement power factor.

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ANALYSIS OF MODERN POSSIBILITY OF INCREASING THE QUALITY OF TRAINING FOR ELECTRIC POWER INDUSTRY UKRAINE

page 34–41

This paper analyzes the main problems existing in professional education Ukraine, which resulted in a low level of training that does not meet the needs of employers in the electricity sector. The analysis showed that the main problems are: the isolation of the educational system of real production; imperfect system of formation of state order for training; old practice of financing and management of education; level of logistics universities; high academic load of teachers; decline in the prestige of engineering specialties. Past research excellence of modern methods of education have shown that to solve the existing problems, the following measures: the development and introduction of professional standards that help to hold the relationship between the demands of employers and university curricula; establishing close cooperation between educational institutions and manufacturing enterprises, namely improving career guidance, strengthen employers on stage as a professional choice and student learning, and to ensure his employment; comply with the current level of production of material and technical base of vocational education; reduce workload for teachers that will thoroughly prepare for lectures and continually improve their level in line with modern trends of science and technology; improving the monitoring of and evaluation system by implementing and testing simulators specially adapted.

Keywords: electricity, higher education, employer, quality of education, professional standards, scientific and technical activities.

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DEVELOPMENT OF SUPPORT METHOD THE OPERATION OF THE BIOGAS UNIT IN COGENERATION SYSTEM

page 41–46

The method of biogas unit functioning support at the level of decision-making is developed in this article based on the proposed cogeneration system. Prediction of changes in attenuation temperature allows the use of fermented wort in a low-grade energy source for the heat pump to determine the heating temperature of the coolant at the inlet to the heat exchanger embedded in the digester with temperature measuring of coolant at the outlet of the heat exchanger. The developed method of support the biogas unit operation at the level of decision-making allows, for example, reduce the cost of electricity and heat in the range of 20–30 % in the production of 352,5 m^3/day of biogas saving of 25400 m^3/year with increasing marketability of a biogas unit at 13,94 %. Annual energy savings in terms of fuel equivalent is 19500 f. e. and cash equivalent of additional produced energy is about 100000 UAH/year.

Keywords: cogeneration system, biogas unit, heat pump.

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DEVELOPMENT OF COMBINED HEATING SYSTEM OF HOUSES AND PUBLIC FACILITIES IN RURAL AREAS

page 46–51

In the article it is considered the problem of creating a combined heat system of houses and public facilities in rural areas, alternative heating system using natural gas.

During analysis of the possible options have been substantiated sources of energy for the combined heating system: such as electrical systems, gas, solid fuel boilers individual, alternative energy sources — wind and solar.

It was found that the power of the wind flow is directly proportional to the area through which it passes, and the cube of the wind speed. For many regions of Ukraine has great potential for the use of wind energy, especially for the southern and mountainous regions, which can significantly (up to 20 %) to cover the energy needs for heating.

It is proposed the method of electricity use for heating at night, when the failures of the load in the energy system up to 40–50 %, and the outdoor air temperature during this period is the lowest.

It is shown that the ambient temperature during the day varies sinusoidally that should be considered when determining the required capacity of the coolant.

It is proposed a method for determining the required capacity of coolant within the time of day (once per hour) as a function of ambient temperature and a predetermined temperature in heated area.

It is offered a minimum value of the total amount of energy obtained from different sources as a condition of optimal operation of the combined heat systems of houses and public facilities.

Keywords: heating, combined system, energy sources, automation, algorithm.

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ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

ALGORITHM DEVELOPMENT OF PROTECTION MEANS CHOICE OF THE INDUCTION MOTORS WORKING IN THE CONDITIONS OF THE LOW-QUALITY ELECTRIC POWER

page 52–56

The article is devoted to the decision-making problems on the choice of devices to protect of induction motors operating in conditions of low-quality electric power. It is considered a complex model of the induction motor, which allows to evaluate the energy performance and thermal state based on probabilistic characteristics of power quality to substantiate the economic feasibility of the proposed activities.

The designed in article algorithm for selecting of cost-effective means of energy efficiency improving of IE when operating in conditions of low-quality electric power allow make an economically justified decision about choosing the means of compensating the negative impact of low-quality electric power on technical and economic parameters of IE, which was adopted on the basis of damage comparison, the cost of the electric motor and the proposed technical means of protection. The research results are undertaken to use by OJSC «Ukrspecservis», they are expanding toolkit of energy management of industrial enterprises and can be used for training of specialists in the field of energy efficiency of enterprises.

Keywords: electrical networks of power industry, low-quality electric power, induction motor, quality indicators of electric power.

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ANALYSIS OF HIGH-VOLTAGE CASCEDE GENERATOR PULSATIONS OF A DIRECT CURRENT

page 56–61

In the article the issue of modes calculation for the high-voltage cascade generator with nonlinear loading by means of an analytical method is resolved. For a cascade high-voltage source of a direct current the analytical solution for its pressure and a nonlinear pulsation is found. Research of pulsations amplitude versus oscillator circuit parameters is conducted.

The offered analytical method of research for high-voltage installations of a direct current allows perfroming analytical, high precise parameters calculations of cascade voltage generators that is used for the first time. The conducted researches showed that the voltage ripple factor significantly depends on the installation mode of a high direct current voltage and its loading.

The obtained results show that the offered analytical method allows perfroming the precise calculations of voltage modes for high-voltage cascade generators with nonlinear loading defining its qualitative characteristics as power supplies of high-voltage technological installations.

Carrying out further investigations parameters of a high voltage installations of a direct current with nonlinear loading is relevant and will allow defining its characteristics that influence on quality of the technological processes constructed with use of such units.

Keywords: cascade high-voltage source, an analytical method, amplitude of voltage pulsation, nonlinear loading.

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