



ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

NON-OZONE GERMICIDAL LAMPS FOR UNITS OF PHOTOCHEMICAL AND PHOTOBIOLOGICAL ACTION

page 4–7

The use of ultraviolet radiation is now becoming more and more important as the method of ultraviolet disinfection successfully destroys bacteria, fungi and viruses.

The widespread use of UV radiation has become possible due to the expansion of the production of nomenclature of artificial light sources and increasing their efficiency. To this end, we have proposed the design of non-windowing germicidal lamp for UV irradiation of drinking water, air, surface and other liquids.

As the basis of manufacturing technology it is proposed a construction of germicidal lamp, based on the following technical approach – invention, namely the transition from double capped fluorescent lamps to compact single-ended lamps.

Design features of germicidal lamp, which limits the output of ozone in the environment, the following: the space between the discharge tube and the outer bulb is a gas filter, the spectral transmittance ratio adjusting pipe diameters and the partial pressure of oxygen and nitrogen. This radiation with a wavelength of 254 nm substantially not delayed by a gas filter, but the amount of ozone is reduced by 3–4 times, without exceeding the allowable limits.

UV lamp is equipped with the necessary start-up equipment, which makes it possible to use in the domestic environment for the disinfection of drinking water and surfaces.

Keywords: UV-efficiency ultraviolet lamps, germicidal disinfection, non-windowing lamp, UV flow.

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PRACTICE OF DEFINING LEVELS OF PROGRESSIVE ELECTRICITY CONSUMPTION BY MINING COMPANIES WITH UNDERGROUND KINDS OF IRON ORE MINING

page 7–14

The paper presents a number of differences of iron ore mines from other industries, analysis of the factors that affect the electricity and energy effectiveness of mining enterprises and, consequently, on the levels and modes of electricity consumption. During the investigations it is developed the modern methodology of actual programs to improve energy efficiency of extraction of iron ore, which makes it possible to identify cost-effective measures aimed at the implementation of the existing energy potential in the enterprise. The authors presented a technique for assessing the state of power consumption modes of mining companies and their modeling and forecasting technique for determining the levels of power consumption and algorithm of its interval prediction.

The article provides an analysis of intra-annual dynamics, which is essential for forecasting and the development of operational activities for qualified energy management industry.

Keywords: electricity and energy effectiveness, levels of power consumption, seasonality, forecast electricity consumption, factor model, mining enterprise.

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ANALYSIS OF MODE OF SURGE ARRESTER IN THE PRESENCE OF NONSINUSOIDAL VOLTAGE

page 15–19

In the article it is considered the work of nonlinear surge arrester in quasi-stationary modes and found that similar work almost impossible. Many power engineering specialists believe that NSA works so as the valve gap. This claim is false because NSA is connected directly to the network through a gap the spark gap. Therefore NSA is constantly under the influence of the working voltage, which causes additional requirements for its parameters when a quasi-stationary over the network. The calculations of the energy dissipation of NSA under the action as part of which there are higher harmonics allow to conclude that in accordance voltage requirements of GOST on energy quality. NSA is working properly supporting thermal balance. However, NSA violation of thermal balance can occur when working in networks with a high content of harmonic oscillations, leading to its failure. Calculations are made on the basis of current-voltage characteristics of NSA, which allows determining the value of currents in the presence of voltage in the network containing harmonic oscillations.

Keywords: nonlinear surge arrester, current-voltage characteristics, thermal condition, harmonic oscillations.

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ULTRASONIC METHOD DEVELOPMENT OF FLUID FLOW VELOCITY MEASUREMENT

page 19–24

In this article short analysis was done on main ultrasonic methods and means of fluid and gaseous flow control. New mathematical model of ultrasound wave distribution in fluid was proposed and ultrasonic method of fluid flow measurement on its basis. After research of various scientific works regarding near size of ultrasonic transducers a mathematical equation was derived that shows ultrasound frequency dependency on fluid flow velocity. Consequently, stated mathematical model was simulated in Matlab environment showing some efficient results. Research on physics process of forming a sound wave in piezoelectric elements helped to discover frequency dependency on flow speed, which in turn made it possible, due to the new approach, to develop a mean of flow rate measurement and furthermore to propose perspective fluid and gas flow meters.

Keywords: meter, flow control, ultrasound, sound speed, frequency, near zone, measurement accuracy.

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INCREASE OF SAFETY OF ELECTRIC ENERGY USAGE IN COAL MINES

page 24–28

The work is devoted to the creation of ultrafast device for protecting electrical networks in hazardous industries, such as coal mines, from the emergency operation of short circuit. For response time to ensure the unit up to 100 microseconds, as the drive of the contact group was used electro effects – electric emulsion. Switching devices such working one-sticks, until recently was not in the world practice.

The results will help to reduce the probability of occurrence in coal mines dangerous on gas and dust of man-made accidents (explosions and fires), with heavy technical and social consequences.

In addition, a similar device can be effectively used in the chemical, petrochemical and other industries in which the possible presence of an explosive or the environment.

Keywords: electricity, power supply, mine, explosion, cutoff, center of the fire, short circuit, magnetic station.

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ANALYSIS OF PULSE TRANSFORMER VOLTAGE RIPPLE OF INVERT TYPE OF MODULAR STRUCTURE

page 29–35

The mathematical models of voltage ripple in input and output circuits of pulse converters of DC modular structure with power channels of the inverting type are obtained and analyzed. The mathematical model is focused on the power of channels in the boundary mode operation that can reduce energy loss in the transformation. The mathematical model is generalized to the single-phase and multiphase transformation principles, auto-transformer and transformer connection of storage chokes of power channels.

The methods and algorithms for calculating the voltage and current ripple in the input and output circuits of these converters are presented.

The simulation results of the electrical processes in input and output converters with autotransformer turning of the choke are presented. It was established that the principle of multi-phase transformation reduces the magnitude of both fluctuations in the input and output circuits. This allows developing the converters with improved mass-dimensional and cost indicators.

Keywords: multi-phase pulse converter, modular structure, power channel, pulse, mathematical model.

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THE USE OF SOLENOIDAL WINDING MODELS FOR THE CALCULATION OF THE LEAKAGE INDUCTANCE OF POWER TRANSFORMERS

page 36–40

The necessity of modification of the known method of average distances for calculating leakage inductance of power transformer windings. The calculated expressions for the leakage inductance of power transformers obtained from the use of solenoidal winding models are given. Theoretical materials of the article tested on the results of the experiment. A calculation expression of leakage inductance with the relative sizes of the windings is proposed.

The relevance of this article due to the absence, to date, the recommendations for engineering calculations the leakage inductance of power transformer windings, based on the use pattern of the magnetic field of windings with the saturation of steel of magnetic core.

As a result it is shown that multiple attempts to develop a method of average geometric distances with rectangular cross-sections of the windings can be successfully replaced the use of solenoidal models.

For the first time it is obtained an experimental confirmation of the proposed modification of the method of average geometric distances.

On the basis of article materials can be constructed rapid calculation methodology of leakage inductance of power transformer windings for their design, as well as testing.

Keywords: leakage inductance, power transformer winding, experiment, magnetic core, solenoid.

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ELECTRIC FIELD CALCULATION OF HIGH-VOLTAGE DIRECT CURRENT TRANSMISSION LINES

page 40–45

It is adapted charges equivalent method for calculating the electrostatic field intensity under single-stranded and double-stranded bipolar DC transmission lines in the absence of corona wires on line in dry climates.

Simple and noniterative calculation method required in order to engineer could assess whether not to exceed maximum permissible levels of the electrostatic field strength in DC power lines.

As a result of research first obtained expressions that simplify engineering calculations of electrostatic field, taking into account the symmetry of the poles as the central axis supports of bipolar lines, and do not use iterative methods of payment.

Development of methods for calculating electric field of direct current transmission lines is an important task, because in the near future is expected to increase the number of data transfers in the world, not only by building new, and as a result of the conversion of existing lines AC line DC.

Keywords: DC power line, bipolar line, electric field, method of equivalent charges.

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ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT

SIMULATION OF THE RESISTANCE MOMENT OF SINGLE-PISTON COMPRESSOR OF SHIP REFRIGERATION UNIT

page 46–51

The article discusses the problem of mathematical modeling of the mechanical single-piston compressor of ship refrigeration unit. The dynamics of the crank mechanism is analyzed. Basic equations of the forces acting in the compressor are obtained on the basis of schematized indicator diagram and sequence of calculation of torque resistance is proposed. Simulation model is developed in the simulation environment Matlab/Simulink that enables the analysis of changes of resistance moment in the function of the rotation angle of the shaft of the drive motor, compressor design features and conditions of its operation.

The verification of the model is conducted on example of the compressor XKB-6 of small refrigeration unit. Characteristic curve of resistance moment of resistance moment in the function of the rotation angle of the shaft of the drive motor during working the compressor RAC-6 in nominal mode on freon gas R-600a and air. With the described method of calculating and modeling it is revealed that the average value of the resistance moment of test compressor in both modes of operation corresponds to the marking and experimental data.

Keywords: single-piston compressor, mathematical model, resistance moment, refrigeration unit.

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PHYSICAL BASE DEVELOPMENT FOR MATHEMATICAL SIMULATION OF TRANSMISSION PROCESS

page 51–55

Based on the physics of normal operation of power systems, in the article it is proposed new scientific and methodical approach to determining reactive power transmission systems to the power industry and customers equated to them, which is based on understanding the mains voltage as a potential form of electricity. That is why the generation and consumption of electricity in the same time and give it the properties of mobility and versatility. It is proposed realistic modeling of power, in which the mathematical calculations of the regime based on the physics of the process of power transmission technology.

It is emphasized that electric networks at a voltage of 110 kV should be considered counter energy market and to establish a base (wholesale) price of electricity for each of its customers on the basis of the concept of its power from the 110 kV network system with the normative coefficient of reactive power transmission ($tg\varphi_d$).

Keywords: electricity, power simulation, electric power, active power, reactive power, full power.

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EVALUATION OF THE HYDRAULIC CLUTCHES INTRODUCTION FOR CENTRIFUGAL PUMPS PRODUCTIVITY CONTROL

page 55–60

The problems of the effectiveness of controlled hydrodynamic drives for performance control of centrifugal pumps are considered in the article. The advantages of this technology are shown. They are consists in saving investment cost, high reliability, durability and technical readiness, ease of maintenance and service equipment. Examples of calculations of energy savings for the pumps of various capacities are given. The factors which have the most significant impact on the payback period in the implementation of this technology are analyzed. As the initial information about the required investment and the savings of resources is used data on the implementation of the drives in the thermal energy sector of the CIS countries, including Zaporozhye, Kurakhovo, Starobeshevo TPP, TPP-5 and TPP-6, as well as the power plants of «Kyivenergo». Results of the analysis allow determining priority types of centrifugal pumps. It is advisable to equip the hydrodynamic drive. These include nutritional, network, oil, sludge and other heavy-duty centrifugal pumps, also having high speed and running most of the time at part load.

Keywords: hydrodynamic variable drive, hydraulic clutch, centrifugal pump, energy efficiency, throttle control, power consumption.

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THE DEVELOPMENT AND STUDY OF IMMERSED BURNING APPARATUS WITH MULTIPLE PHASES INVERSION

page 60–64

The results of researches the phenomenon of multiple phase inversion for ascending gas – liquid flow in immersed burning apparatus (IBA) is given in the article. For the first time it is

shown that the organization of multiple inversions of gas – liquid contacting phases in the direct-flow gas – liquid by heightwise installation of separation grids or valve plates intensifies heat and mass transfer and favorably distinguishes them from bubbling devices of similar purpose. This ensures high efficiency of contact phases; stable operation over a wide load range gas and liquid; high transporting property of liquids by gas, which simplifies heating technology; high intensity of processes in the gas – liquid system; reducing fuel consumption for heating the coolant (or technological product).

Keywords: heat transfer, immersed burning apparatus, bubbling, phase inversion, energy efficiency, contact-modular system, separation zone.

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MECHANICAL ENGINEERING AND MACHINE BUILDING

THE PROCESSABILITY EVALUATION OF COMPOSITE OF SHIPS AND FLOATING STRUCTURES BASED ON SYSTEM-TECHNICAL APPROACH

page 65–68

The article discusses the indicators of design manufacturability of biological protection of ships and floating structures for the transportation and storage of radioactive cargo of low and medium activity. The new metal-glass electric-arc coatings and aluminum-matrix hot-pressed tiles are proposed for protective layers of structure production, cladding being is carried out with epoxy adhesive.

In order to select the variant of the design which corresponds to the technological and economic indicators of efficiency, the systematic and technical approach based on the detailed complex technological indicators has been used. The coefficients of material capacity, design complexity, manufacturability of materials have been selected as the proper criteria. The detailed characteristics of technical and economic indicators of manufacturing structures of biological protection have been considered and the nomogram for determining complex coefficient of manufacturability with different types of composite protective layers was built. The influence of material and coating composition on the factor of material capacity has also been detected. The determination of the complex coefficient of design manufacturability for different design and layout solutions will allow to develop organizational and technical activities and predict the dynamics of the formation of the factors of economic efficiency. The results can be used at the stages of design studies, technological preparation of manufacture, construction and operation of ships and floating structures.

Keywords: floating structures, designs of biological protection, systematic technical approach, manufacturability.

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DEVELOPMENT OF THE MATHEMATICAL MODEL FOR THE CHOICE OF THE OPTIMAL CUTTING CONDITION WITH COMBINED AXIAL TOOL

page 69–72

Analysis of the literature showed that the issue of determining the optimum cutting conditions when processing a combined axial tool is not considered carefully enough. In this regard, in order to increase productivity and ensure the required quality of processing holes in hydraulic and pneumatic valves by combined axial tool were developed and solved the three one-criterion problem with the corresponding evaluation function: the standard deviation of the average speed of cutting; the standard deviation of the feed per revolution; processing time. The simulation results in the system MathCAD shown that the most productive cutting conditions is obtained by the function of maximum performance. The results for the one-criterion tasks suggest that there is potentially solution that satisfies all three evaluation functions, so that it was proposed to solve the problem of rational choice of cutting conditions for combined tools as minimax problem with restrictions, including three previously proposed estimators.

Keywords: combined axial tool, minute feeding, rate speed, cutting speed, performance.

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QUALITY MANAGEMENT OF REPAIR PRODUCTION FOR DISASSEMBLY OF PRESSURE COUPLING

page 73–77

The problems of quality management of disassembly of pressure coupling for effective functioning of repair production are considered because the effective use of machinery and equipment is the high level of maintenance and repair, which affects product

quality and production costs. A condition for quality disassembly is to preserve parts of the repaired product. Particularly complex disassembly of pressure coupling is complex if they large or design does not allow using simple mechanical pullers as well as compounds which, as a result of heavy operation, is one-piece steel. Quality and productivity disassembly of such compounds occurs only using induction heating. However, normative-technical provision of such technologies is virtually absent, which makes their use is not effective in energy costs. Therefore, the aim of the work was to determine and justify the principle of laying the foundations of normative and technical provisions of quality, energy-efficient and productive technology of repair production for example, disassembling connections with interference when using induction heating. The structural-parametric principle for creating a normative-technical provision, system of construction classifications of disassembled pressure coupling with heating parts in their inbox, unified operations based on the account settings, limiting quality of products and a mathematical model of the process of repair of thermal technologies on the example of disassembling connections with interference which can be used for quality control in the production of repair schemes for any pressure coupling.

Keywords: quality parameters, unification, classification, repair technologies, limiting parameters, disassembly.

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OPTIMIZATION OF SUPPORTING PROCESSES OF MACHINING TAKING INTO ACCOUNT ORGANIZATIONAL AND TECHNOLOGICAL COSTS

page 77–83

It was developed the model to optimize the organizational and technological structures by synchronizing processing of parts implemented in multi-machine complex. Its structure

includes a microstructure formation technique of technological method, transition, method of accounting indicators of change of employer's work capacity during of shift, optimization model of organizational and technological costs.

The feasibility of using this model can be dictated by the need to maximize the profitability of the production process, in which you need to seek the optimal combination of performance and its cost. In the conditions of multiproduct manufacturing start schedule compression must be substantiated by sufficiently precise figures of projected time-consuming. The complexity and value, in these circumstances, is the definition of time-consuming preparation of strokes carried out by worker.

As a result, it has established the degree of influence on the cost of such factors as: lot resistance, limiting the type of instruments and mutual accommodation of multi-machine complex for different types of parts. With this information, it can be managed calendar production plans, the parameters of lots of details in the treatment process, to form a group of technology and organizing subject-enclosed areas. All this will contribute to the development of route in a low-volume production.

Keywords: machining, auxiliary time, machine and handmade work, multi-machine industrial complex.

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INTRODUCTION OF THE CIRCULAR TUBE IN THE CARRYING SYSTEM OF GONDOLA CARS TO ENSURE THE RATIONAL STRENGTH INDEX

page 83–89

Features and results of the study on the introduction of round pipes in the carrying systems of gondola cars based on the proposed method by the author are presented in the article. The use of such method allows minimal consumption of materials of introduced elements under the conditions of strength and operational reliability by ensuring rational indicators of strength.

Results of complex theoretical and computational testing, computer modeling, durability and operational reliability of improved design of gondola cars pointed to its performance and efficiency of the implemented technical solutions. So as a result of its test of strength in all cases calculated according to calculation mode it is found that the resulting equivalent load does not exceed the allowable normalized their values of fatigue strength (at the base of test in 10^7 cycles) is provided, project service life is more than 32 years. In addition, the results of additional analysis to ensure strength in welded joints have also confirmed their performance.

Keywords: gondola car, improvement of carrying structure, implementation of round pipes, rational indicators of strength.

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