

---

# Summaries

UDC 536.468

**Kuznetsov G.V., Strizhak P.A.**  
**IGNITION OF LIQUID HYDROCARBONIC FUELS**  
**BY AN INCANDESCENT SINGLE PARTICLE**

Numerical modeling of the liquid ignition process by an incandescent single particle within the limits of the gas-phase model of ignition, taking into account in the processes of heat conductivity bidimensional arrangement, evaporation, diffusion and convection of fuel vapors in the oxidizer environment, the process of steam vap formation between the particle and the liquid, partial heating source immersing into the liquid has been carried out. The relationship between the accuracy of calculation at problem solution and grid parameters has been established.

UDC 621.396.6

**Kuznetsov G.V., Kats M.D.**  
**ON CONDITIONS OF PULSE METHOD APPLICATION**  
**FOR DEFINITION OF THERMOPHYSICAL CHARACTERISTICS**  
**OF CONSTRUCTIONAL MATERIALS**

The analysis of the conditions of experiments for definition of thermophysical characteristics of materials with application of pulse methods has been carried out. The problem of non-stationary temperature field of the sample is numerically solved at influence of a thermal impulse of small time extent onto its surface. Boundaries of ranges of possible change of the pulse thermal flux to the surface of the material, impulse duration of and thickness of experimental samples (depending on the type of material), providing reliability of the obtained results are established.

UDC 536.46; 536.3

**Bushlanov V.P., Bushlanov I.V.**  
**THE METHOD OF HEAT TRANSFER CALCULATION**  
**BY RADIATION IN FURNACE OF THE AXIS-SYMMETRICAL**  
**CONFIGURATION ON THE BASIS OF EQUATIONS**  
**FOR COMPONENTS OF THE SUM VECTOR OF THE RADIANT**  
**ENERGY FLUX. THE SYSTEM OF EQUATIONS**

The equations of preservation for the current of the burning mix of gases in furnace of a small-sized boiler with capacity of 1 MW with a porous ceramic torch where the burning zone is concentrated in the field of the size 1 cm around the surface of the torch and in its surface porous layer with the width of 1...3 mm are written. In the equation of gas energy conservation the flux of radiant energy is considered traditionally, it is equal to volumetric density of spontaneous radiation from gas. The nontraditional assumption is that the monochromatic radiation absorbed by gas is at once isotropically radiated by gas owing to significant chemical disequilibrium in a narrow zone of burning. The equations for calculation of heat exchange by radiation are written not for the intensity of radiation, which is the function of coordinates and two corners of direction of radiation distribution, and for the sum vector of the radiant energy flux (SVREF) which components depend only on coordinates. Such reduction of independent variables on 2 is essential for numerical calculations. Components of SVREF inside the furnace and on the surface of the torch are presented obviously in the form of integrals from the known functions and boundary radial components of SVREF on the cylindrical surface of the furnace – functions of only one longitudinal coordinate. For the specified boundary radial component of SVREF the integrated equation of Fredholm of the 2<sup>nd</sup> kind is obtained.

UDC 536.46; 536.3

**Bushlanov V.P., Bushlanov I.V.**  
**THE METHOD OF HEAT TRANSFER CALCULATION**  
**BY RADIATION IN FURNACE OF THE AXIS-SYMMETRICAL**  
**CONFIGURATION ON THE BASIS OF EQUATIONS**  
**FOR COMPONENTS OF THE SUM VECTOR OF THE RADIANT**  
**ENERGY FLUX. THE ENGINEERING TECHNIQUE**

Differential equations of the quasi-one-dimensional calculation method of heat transfer by radiation in furnace of the axis-symmetrical configuration are obtained on the basis of the system of equations presented in the first part of the article. Equations and differential formulas of the method of engineering calculation of heat exchange by radiation at presence of a screen grid near the torch surface are written. The technique is suitable for application at engineering calculation at definition of the optimum furnace configuration and definition of the optimum distance of the screen grid from the torch surface.

UDC 536.46+533.6

**Subbotin A.N.**  
**RESEARCH OF BURNING MODES AT RECYCLING**  
**IN CYLINDRICAL REACTOR OF COKING**  
**INDUSTRIAL WASTES**

The two-dimensional axis-symmetrical non-stationary mathematical model of interaction of high-enthalpy flux of a gaseous oxidizer with porous firm coking fuel is examined. The influence of the parameters of the blown gas-oxidizer, moisture and porosity of fuel on formation of the modes of physical and chemical transformations and distribution in the form of the burning wave is investigated. It is found that by means of the offered model it is possible to model high-, low-temperature modes of burning and the mode of decay.

UDC 536.24

**Knyazeva A.G., Chumakov Yu.A.**  
**DISTRIBUTION OF TEMPERATURE AND THERMAL STRESSES**  
**IN POROUS BODY OF A CYLINDRICAL RADIATING TORCH,**  
**OPERATING IN THE STATIONARY MODE**

The model of filtration burning of incompressible gas in porous body of a cylindrical torch, operating in the stationary mode under condition of ideal internal heat transfer and in view of the interaction with heat exchanger is offered and numerically analyzed. The analytical solution suitable for evaluation of temperature and thermal stresses in the burning device is obtained. Distributions of temperature, mechanical stress, typical for stationary operating conditions of the burning device, and dependences of gas burning velocity, radiating thermal flux on technological parameters are constructed.

UDC 519.87:532.525.3

**Senchurova Yu.A., Murko V.I., Fedyaev V.I.,**  
**Dzyuba D.A., Puzyrev E.M.**  
**THE RESEARCH RESULTS OF WATER-COAL FUEL**  
**DISPERSION BY PNEUMOMECHANICAL ATOMIZERS**

The research results of water-coal fuel dispersion by pneumomechanical atomizers are presented. It is shown that two qualitatively various systems of drops are formed at fuel dispersion. The first system with "drops" more than 80...100 mkm in diameter is presented by coal particles; the rest is presented by water-coal drops.

UDC 621.43

**Zeer V.A., Martynov A.A.**  
**MODELING OF THE CRANK-ROD MECHANISM OF INTERNAL COMBUSTION ENGINE WITH VARIABLE CYLINDERS**

The calculation technique of power parameters of crank-rod mechanisms of the engine with variable cylinders is offered. The results of mathematical and imitating modeling of the crank-rod mechanism on the example of a straight four-cylinder engine are presented.

UDC 656.135

**Zeer V.A., Martynov A.A.**  
**THE TECHNIQUE OF NORMALIZATION OF FUEL CONSUMPTION IN CARS WITH VARIABLE ENGINE CYLINDERS**

The technique of calculation and normalizations of fuel consumption in taxi-cabs with variable engine cylinders at idling is offered. The calculation results of fuel-economic parameters of the vehicle GAZ-3110 are presented.

UDC 621.311

**Galashov N.N.**  
**EFFICIENCY OF GAS TURBINE APPLICATION ON THERMAL POWER PLANT FOR AUXILIARY DRIVE**

Conditions of efficiency of electric drive replacement of auxiliary mechanisms by gas turbines are shown. The influence on economic benefit of thermal and cost indexes of gas turbines and cost of electric power and fuel is defined. The equations allowing to define economic feasibility of electric drive replacement of a number of mechanisms of own needs by gas turbines at designing thermal power plant are cited.

UDC 621.311.15.017

**Manusov V.Z., Zaigraeva Yu.B.**  
**THE FORECASTING MODEL OF CAPACITY LOSSES IN POWER GRIDS OF AN ENERGY SYSTEM**

The questions of calculation, forecasting, normalization of capacity losses in power grids of an energy system with application of artificial neural networks are examined. The algorithm of optimum architecture of artificial neural networks, functions of activation, algorithm of training on the example of the main electric systems of the Center is realized.

UDC 621.311:537.871.3

**Belitsyn I.V., Makarov A.V.**  
**THE INFLUENCE OF THE OVERHEAD LINE SLACK ON ELECTROMAGNETIC FIELD PARAMETERS**

The influence of the overhead line slack on the value of the electric field intensity is shown, the technique of intensity calculation is cited, recommendations on definition quantity of the flights, necessary for maintenance of sufficient accuracy of calculations, are given.

UDC 621.311:537.811

**Belitsyn I.V., Kotyrla T.V., Makarov A.V.**  
**ELLIPTIC ELECTRIC AND MAGNETIC FIELDS OF ELECTRIC INSTALLATIONS. THE METHOD OF CALCULATION AND NORMALIZATION**

The approach to creation of the criteria of normalization of electromagnetic field influence on human is shown. The analytical expressions for calculation of elliptic fields are obtained on the basis of the analysis of the fields created by electric installations of industrial frequency. It is proved and offered to use the operating value of intensity of electromagnetic fields as new criterion. The comparison of criteria for evaluation of electromagnetic field intensity for a specific object of electric power industry is cited – overhead line electromagnetic field is 500 kW.

UDC 621.316.99:614.825

**Alaev E.G., Dyomin Yu.V., Mozilov A.I., Sadovskaya L.V., Safroshkina L.D., Kislitsyn E.Yu., Ivanov G.V.**  
**DEVELOPMENT OF THE CALCULATION TECHNIQUE AND THE ANALYSIS OF ELECTROMAGNETIC INTERFERENCE INFLUENCE ON PARAMETERS OF ELECTRIC SAFETY OF GROUND GRIDS**

The technique of definition of electric safety parameters of ground grids with a number of elements of more than 1000 is offered. The influence of factors distorting the accuracy of definition of potentials on metal, on touch voltage and on electromagnetic condition is investigated.

UDC 621.372.4:537.52

**Isaev Yu.N., Kuleshova E.O., Vasilyeva O.V., Rusol D.A.**  
**THE CALCULATION METHOD OF DISTRIBUTION OF CHARGES OF CONTINUOUS PLATES AND PLATES WITH AN APERTURE IN THE FORM OF A CIRCLE AND THE FORM OF SPHERICAL SEGMENTS AT PRESENCE OF THE EXTERNAL ELECTROSTATIC FIELD**

The problem of definition of charge distribution of on the surface of flat and spherical plates with an aperture and without it through potential of the plate at absence and presence of the external field is solved. The equation describing the connection between charge distribution and potential of the plate is an integral. The polynoms allowing reducing a complex integrated equation to the algebraic equations are obtained. Examples of calculation of charge distribution on the surface of a continuous disk and a disk with an aperture, plates in the form of a continuous spherical segment, are cited.

UDC 621.372.4:537.52

**Kuleshova E.O., Isaev Yu.N., Vasilyeva O.V., Rusol D.A.**  
**CALCULATION OF PLATE CHARGE DISTRIBUTION AT PRESENCE OF THE EXTERNAL ASYMMETRICAL FIELD**

The algorithm of calculation of charge distribution on the surface of the conductor of the uncanonical form at presence of any external field is offered. The algorithm allows finding the solution of the integrated equation of Fredholm of the first sort in the form of decomposition on characteristic functions of the integrated operator of Fredholm, which is essentially simplifies the solution of a complex incorrect problem. The algorithm includes synthesis of the auxiliary basis of the physical system in view that this system can only be in conditions formed by a linear combination of its auxiliary functions. In this case the equations describing the condition of the system become simpler and it is possible to transfer to the system of algebraic equations from the integrated equations.

UDC 621.311.001

**Shilovskiy S.V.**  
**FORMATION LAWS OF SPECTRUM AND STRUCTURES OF AUXILIARY ELECTROMECHANICAL OSCILLATIONS**

The solution of a system of differential equations of electromechanical movements in the form of harmonious function is offered. The questions of definition of formation laws of spectrum and structures of auxiliary electromechanical oscillations are examined. Estimations of harmonious structure of electromechanical oscillations are investigated. Application of frequencies of characteristic oscillations as parameters for estimation of remoteness of the mode from the limiting on stability is proved.

UDC 621.311.002

**Shilovskiy S.V.**  
**POWER PARAMETERS DESCRIBING THE POSSIBILITY OF STABILITY LOSS**

The vibrational energy is considered as a parameter for evaluation of stability. The informativity and a possibility of use of the vibrational energy for solution of the problem of definition of dangerous in sta-

bility sections of the scheme are substantiated. The numerical estimations are offered allowing obtaining the general concept about the system, to define how much a specific stationary mode is removed from the limit on stability, on what sites of the network the infringement of stability is possible. The technique of definition of dangerous in stability sections of the incorporated electric power system is described.

UDC 681.5:519.281.1

**Shmoylov A.V.**  
**SELECTIVITY AND TECHNICAL EFFICIENCY**  
**OF RELAY PROTECTION AND AUTOMATICS**

The classification of devices and systems of relay protection and automatics, other monitoring systems is presented, the analysis of their selectivity is made, the probabilistic theory of technical effect in view of properties of operating the controlled object is developed. It allows purposefully making the choice, designing and development of the named relay and monitoring systems.

UDC 621.3.078

**Wainstein R.A., Tentiev R.B., Yudin S.M.**  
**INCREASE OF RELIABILITY OF GENERATOR PROTECTION**  
**FROM GROUND SHORT CIRCUITS, BASED ON IMPOSING**  
**OF AN AUXILIARY CURRENT WITH FREQUENCY OF 25 Hz**

The possibility of increase the control current, obtained from a special source, applied for protection against ground short circuits and executed on the basis of an electromagnetic divider of frequency, without increase in the consumption of active materials and dimensions of the source, is offered and substantiated.

UDC 621.311.016.001.24

**Slyusarenko S.G., Kostyuk L.Yu.**  
**CALCULATION OF SHORT CIRCUIT MODES AND REDUCTION**  
**OF ELECTRIC SCHEMES CONTAINING BRANCHES WITH EMF**

The universal algorithm of calculation of currents of three-phase short circuit on the basis of iterative transformation of electric schemes without reduction of parameters to basic conditions and with preservation of power balance for initial and equivalent models is offered.

UDC 621.3.01 (075)

**Makenova N.A., Kanev F.Yu., Nosov G.V.**  
**CONSTRUCTION OF COMPUTER MODELS UNDER THE**  
**COURSE OF THEORETICAL FUNDAMENTALS OF ELECTRICAL**  
**ENGINEERING IN VARIOUS PROGRAMMING SYSTEMS**

The comparison of a series of virtual laboratory works written in the programming language C++ and the works constructed in the editor Electronics Workbench 5.12. is carried out. Advantages and disadvantages of the methods of creation of computer applications intended to be used in the educational process are marked. A number of models used in the course of electrical engineering are examined as examples.

UDC 621.316.06

**Loginov S.V.**  
**ENERGETICS OF PULSE GENERATORS WITH AN INDUCTIVE**  
**STORAGE AND A CURRENT INTERRUPTER**

Electrotechnical analysis of current interrupter connection circuits in a contour with inductive energy storage is given. Interrupter connection circuits without load, and also with inductive, or resistive loads are considered. Analysis of two-stage pulse sharpening scheme and also the scheme with the load upstream from the interrupter is fulfilled. In the case of linearly rising interrupter resistance, the analytical

formulas for the load pulse parameters determining are obtained. It is given comparison with experimental results.

UDC 620.179.1.082.7.05; 679.7.05

**Redko V.V., Yakimov E.V.**  
**DYNAMIC TESTS OF CABLE ISOLATION BY**  
**A HIGH CONSTANT VOLTAGE**

The condition of the question regarding dynamic tests of cable products isolation by a high direct voltage in Russia and abroad is analyzed. The results of the experiments confirming legitimacy of the given kind of tests are cited. The purpose of the article is to promote dynamic tests of isolation by a direct voltage in Russia.

UDC 661.879+621.365+621.314

**Dementiev Yu.N., Knyazkov A.F., Knyazkov S.A.**  
**GEOMETRICAL ADAPTATION SYSTEM OF SPECIALIZED**  
**WELDING ROBOT**

The geometrical adaptation system for the operating prototype of a specialized robot-technological complex is introduced in the paper. The functional scheme of control system of the inclination angle depending on the weldpool position according to the required law for any pipe diameter and welding speed is presented.

UDC 621.313.333

**Orlov Yu.A., Dementiev Yu.N., Odnokopylov G.I.,**  
**Orlov D.Yu., Odnokopylov I.G., Stolyarov D.P.**  
**PROTECTION SYSTEM OF THE BRIDGE CRANE ON THE BASIS**  
**OF MONITORING OF THE ELECTRIC DRIVE PARAMETERS OF**  
**THE LIFTING MECHANISM**

On the basis of researches with application of mathematical model of the lifting mechanism of the electric crane, the adequacy of which is confirmed by experiments on the real sample of the bridge crane, the expediency of monitoring of electric parameters of a drive engine for provision of protection functions against dangerous operational influences is shown. The indirect method of weight measurement of a lifted cargo on the basis of monitoring of electric parameters of the electric drive of the lifting mechanism is examined, which provides survivability of the protection system of a climbing crane is considered and increases the safety of operation.

UDC 621.318.3

**Leonov S.V., Fedyanin A.L., Muravlev O.P.**  
**STATIC MODEL OF HERMETIC SYNCHRONOUS ENGINE**  
**OF THE DISK TYPE WITH MAGNETICALLY BOUND POLES**

The questions concerning modeling of the synchronous engine of the disk type with magnetically bound poles are examined. The algorithmic model is executed on the basis of the combined scheme using advantages of the field method of integrated equations and the electromagnetic method of calculation with a three-dimensional concentrated displacement circuit of stator magnet system.

UDC 621.313

**Lukutin B.V., Shandarova E.B., Muravlev A.I.**  
**POWER EFFICIENT CONTROLLED GENERATORS**  
**FOR WIND-DRIVEN POWER PLANT**

The research of conformity of power characteristics of the wind turbine and the generator at variable frequency of the power unit rotation is carried out. Recommendations on the choice of synchronous generators of the wind power installation are formulated. The account of the given recommendations will allow reducing mass/volume parameters of synchronous generators and their cost by 10...15 %.

UDC 621.311.6

**Kremzukov Y.A.**  
**THE STUDY OF DYNAMIC CHARACTERISTICS**  
**OF THE SOLAR BATTERY SIMULATOR IBS-300/25**

The variant construction of the solar battery simulator is examined. The structured scheme and the voltage-current feature of the simulator are shown. The comparison of accounting and experimental dependency of the total output resistance (the module of complex resistance) from frequency is carried out.

UDC 621.396.6+621.792

**Kuznetsov G.V., Mamontov G.Ya., Titov A.V.**  
**ESTIMATION OF RELIABILITY OF A SEMI-CONDUCTOR**  
**DEVICE IN CONDITIONS OF THERMAL OXIDATION**  
**OF CURRENT-CARRYING ELEMENTS**

Numerical modeling of a non-stationary bidimensional temperature field of a current-carrying path of a semi-conductor device has been carried out for two cases of work of a typical power transistor: in conditions of the conductor oxidation by oxygen, and without the process of metal oxidation. The rates of the transistor failures are compared for these two cases. It is shown that the change of the failure rate in conditions of oxidation makes not less than 50 %. It is estab-

lished that at estimation of parameters of reliability of devices it is necessary to carry out the analysis in view of the process of metal oxidation.

UDC 338.45:621.31

**Surzhikova O.A.**  
**CONDITION OF RUSSIAN ELECTRIC POWER INDUSTRY**

The statistical material and the analysis of electric power, one of the main secondary power resources, are cited. The condition of generating capacities, demand, production, offer and deliveries of electric energy around the country are analyzed. Prospects of Russian electropower sector for the nearest years and its interrelation with primary fuel power resources are examined.

UDC 553 (09)

**Plotnikov O.N.**  
**THE FOURTEENTH RECTOR OF TPU (TPI) I.I. KALYATSKIY**  
**(1927–2005)**

The life of Ivan Ivanovich Kalyatskiy is portrayed at all stages of his work in Tomsk Polytechnic Institute, and then University: from the head of department to the rector.