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# Summaries

UDC 620.179.1

**Vavilov V.P., Ivanov A.I., Nesteruk D.A., Shiryayev V.V.**  
**THE TECHNIQUE AND EXPERIMENTAL IMPLEMENTATION**  
**OF PULSE THERMAL TESTING OF PLASMA COATINGS**

The technique of testing and processing of experimental data including: simulation of delaminating type defects and changing coating thickness by the methods of thermal conductivity theory for experimental procedures optimization and development of defect parameters identification algorithms; implementation of «optimized» experiment and analysis of noises; increase of the ratio signal/noise by computer processing of image sequence; generation of binary defect maps and estimation of defect parameters, has been proposed on the basis of analysis of studying in the field of infrared thermographic testing of plasma coatings and personal experience of the authors. The experimental data on testing standard and real samples, which confirm the possibility of applying pulse thermal testing for estimating parameters of two main types of defects typical for thermal protection coatings: delaminating and changing the thickness, are introduced.

UDC 536.2.083

**Kuznetsov G.V., Kats M.D.**  
**TRUNCATION ERRORS OF DEFINING THERMOPHYSICAL**  
**CHARACTERISTICS OF STRUCTURAL MATERIALS BY PULSE**  
**METHOD AT LASER BEAM SPATIAL INHOMOGENEITY**

The problem of space nonsteady temperature field of the material sample has been numerically solved at local nonuniform affecting of a heat pulse of a small temporary expansion on its surface. The scales of errors of defining material thermophysical characteristics by a pulse method connected with supposition about one-dimensionality of heat transfer process in the sample, and laser pulse space homogeneity were estimated.

UDC 536.24

**Kuznetsov G.V., Al-Ani M.A., Sheremet M.A.**  
**NUMERICAL ANALYSIS OF TEMPERATURE DROP INFLUENCE**  
**ON ENERGY TRANSFER MODES IN A CLOSED TWO-PHASE**  
**CYLINDRICAL THERMO-SIPHON**

Mathematical simulation of thermal conditions of the closed two-phase thermo-siphon has been carried out at change of temperature drops at the device outer borders. The boundary problem of mathematical physics was stated on the basis of mass, momentum and energy conservation laws in non-dimensional variables «flow function – rate vorticity vector – temperature» in cylindrical coordinates. Streamline, velocity field and temperature distributions reflecting the scales of rayleigh number influence on thermo-hydrodynamic modes were obtained.

UDC 621.039.53:539.261:539.374

**Lyubimova L.L., Makeev A.A., Zavorin A.S., Tashlykov A.A.**  
**STRESS FLUCTUATIONS IN ZIRCONIUM ALLOY PIPE WALLS**  
**FOR TECHNOLOGY CHANNELS OF NUCLEAR POWER UNITS**  
**AT REPEATED DEFORMATION**

The curve connecting deformation cyclicity with structural defect density and intragranular stress of the second order, determining

grain brittle fracture and allowing diagnosing the stage of occurring the catastrophic alloy corrosion by elementary cell parameter, has been obtained by the method of roentgen dilatometry. The most important strength characteristic – damping capacity was determined by the curve of inner stress redistribution at deformation.

UDC 621.039.5;004.942

**Shamanin I.V., Bedenko S.V., Pavlyuk A.O., Lyzko V.A.**  
**USING THE PROGRAM ORIGEN-ARP WHEN COMPUTING**  
**ISOTOPIC COMPOSITION OF SPENT FUEL OF THE REACTOR**  
**VVER -1000**

The computed studyings of errors occurring at modeling slow nuclide kinetic and isotope composition of fuel for reactors using the package of applied programs ORIGEN-ARP have been carried out. It was shown that the error in determining concentration of the main long-life actinoids of irradiated fuel does not exceed 22 %; it means that neutron component of radiative characteristics is underrated by 20...30 %. The contribution of a-n-neutrons for perspective ceramic uranium fuels used in reactors at fast neutrons was determined.

UDC 621.039.517.5

**Chertkov Yu.B., Naimushin A.G.**  
**USING THE PROGRAM TRACE FOR DEVELOPING**  
**THERMOHYDRAULIC SIMULATOR OF REACTOR IRT-T**

The main features of developing stationary single-loop thermo-hydraulic simulator of the reactor IRT-T have been introduced. The results of model computing in the program TRACE and the variants of its improving for analyzing emergency at the reactor connected with coolant loss are given.

UDC 621.643.001:536.2

**Polovnikov V.Yu.**  
**THE ANALYSIS OF THERMAL MODES OF SINGLE-TUBE**  
**HEAT PIPELINES WITH REGARD TO AIR CONVECTIVE**  
**MOTION IN CHANNEL CAVITY**

Numerical analysis of heat pipeline thermal modes on the basis of solving conjugate problems of heat transfer in the system «underground channel single-tube heat pipeline – environment» has been carried out. It was shown that accounting air convective motion in channel cavity allows analyzing in details thermal modes of heat transfer systems.

UDC 531.7.53.082.2;550.34.038.8

**Babushkin I.A., Demin V.A., Pepelyayev D.V.**  
**THE PRINCIPLES OF INERTIAL SIGNAL REGISTRATION BY**  
**CONVECTIVE SENSORS**

The effect of external inertial influence on convective currents in Hele-Shaw cell heated below has been theoretically studied. Temperature fields and flow patterns at inertial signal action oriented randomly in flat surface of extended boundaries were calculated. The results of calculations are planned to be used at designing the device capable of recording and identifying inertial actions by amplitude and frequency. Power fluid was selected and optimal values of geometrics of the developed sensor convective camera were found on the basis of numerical simulation.

UDC 536.21

**Sheremet M.A., Syrodo S.V.**  
**THE ANALYSIS OF FREE-CONVECTIVE HEAT TRANSFER**  
**MODES IN ENGINEERING SYSTEMS OF CYLINDRICAL FORM**

Numerical investigation of heat-gravitational convection modes in a closed vertical cylinder with heat-conducting walls of the finite thickness with local heat source in the area bottom in conditions of convective heat exchange with the environment has been carried out. The mathematical model was stated in non-dimensional variables «flow function – velocity vorticity vector – temperature» in cylindrical coordinate system. The influence of Rayleigh number, instability factor, relative coefficient of heat conductivity and thickness of cylinder lateral surface on the modes of convective heat transfer was analyzed.

UDC 621.1.0161.7

**Feoktistov D.V., Loginov V.S.**  
**EXPERIMENTAL RESEARCHES**  
**OF VAPOR PHASE TEMPERATURE CHANGE**  
**AT SIMPLE SUBSTANCE DISTILLATION**

Thermal balance of the plant distiller apparatus ARNP-2 with the experimental magnitude determination being a part of correlations for determining virtually used heats has been made. The empirically obtained thermograms of one-component and binary aqueous liquids at heating and cooling were analyzed; the boundaries of temperature change intervals depending on the distilled substance composition were determined in the process. The correlations of vapor phase temperature change at warming-up (I interval) and cooling (V interval) at simple substance distillation were found.

UDC 662.6;519.6

**Zholbov V.V., Ivanova I.A.**  
**NUMERICAL INVESTIGATION OF GRANULATED**  
**FUEL LAYER IGNITION**

Mathematical model for describing heterogeneous environment mechanics of axially symmetric motion of combustion products mixture of igniter and granulated fuel layer in double-speed, double-fraction and double-temperature approximation has been proposed. The process simulating cap chamber interaction with black powder batch and granulated fuel layer was calculated as the model application.

UDC 662.7

**Vizgavlyust N.V.**  
**SIMULATING NITROGEN OXIDE FORMATION**  
**IN PULVERIZED-COAL FURNACES**  
**AT ORGANIC FUEL COMBUSTION**

Various kinetic schemes of forming nitrogen oxide used at numerical simulation of furnace medium in respect to coal dust combustion on the basis of one-dimensional and three-dimensional mathematical models of aerodynamics, combustion and heat exchange have been tested.

UDC 621.315.211;616.7;536.6.001.24

**Fleming I.V., Kim V.S.**  
**APPLICATION OF METHOD OF CALCULATING**  
**COMPOSITE MATERIAL THERMOPHYSICAL PROPERTIES**  
**TO CABLE RUBBER**

Mathematical model of predicting composite material thermophysical characteristics of G.N. Dulnev has been applied for calculating heat capacity and heat conductivity of cable rubbers. It was shown that for the engineering rubber grades the disagreements of theoretical values considering raw rubber and filler content with the data obtained experimentally does not exceed 10 %. The accuracy may be increased if more ingredients of rubber mixture were taken into account at calculation. This technique is proposed to be used when calculating cable product construction and studying the process of rubber thermal aging.

UDC 620.179.15:621.391:621.396.96:535.317.25

**Solodushkin V.I., Klimenov V.A., Udod V.A., Temnik A.K.**  
**APERTURE DISTORTIONS OF SHADOW**  
**RADIATION IMAGES IN RADIOMETRIC CONTROL SYSTEMS.**  
**P I. ONE-DIMENSION CORRECTION**

Algorithm of one-dimension correction of aperture distortions of shadow radiation images in radiometric control systems has been proposed. Its advantage in comparison with the algorithm based on application of a known inversion formula of aperture distortions is noted; the examples indicating the efficiency of its use are introduced.

UDC 620.179.15:621.391:621.396.96:535.317.25

**Solodushkin V.I., Klimenov V.A., Udod V.A., Temnik A.K.**  
**APERTURE DISTORTIONS OF SHADOW**  
**RADIATION IMAGES IN RADIOMETRIC CONTROL SYSTEMS.**  
**P II. TWO-DIMENSION CORRECTION**

Rather simple and technically easily realizable algorithm of two-dimension correction of aperture distortions of shadow radiation images based on distortion inversion in spatial domain has been proposed. Concrete examples of shadow radiation image recovery according to the given algorithm are introduced.

UDC 621.384.647.001.5

**Sivkov A.A., Isaev Yu.N., Vasilieva O.V., Kuptsov A.M.**  
**MATHEMATICAL MODELING OF COAXIAL**  
**MAGNETO PLASMA ACCELERATOR**

Mathematical model of coaxial magneto plasma accelerator has been constructed and studied. Field of vector potential, inductance of inductor having complex configuration, running inductance of coaxial system cord-electrode were calculated by the example of the model by computational experiment methods. The solution of the equation system of stress and current balance in the circuit and its connection with mechanical processes in the system was obtained; energy balance without erosion was graphically introduced.

UDC 537.52

**Lavrinovich V.A., Khoang Tuan An**  
**STUDYING ARC PROPERTIES**  
**IN VACUUM ARC-QUENCHING CHAMBER**  
**AT SHORT DISTANCES BETWEEN CONTACTS**

Properties of vacuum arc obtained at breakdown of inter-contact gap 0,25...1,00 mm have been studied. It was shown that such arc properties are identical to the properties of vacuum arc occurring at load switching out by vacuum interrupting unit. Characteristics of chopping current and residual current of vacuum arc were studied.

UDC 621.313.12

**Nosov G.V., Pustynnikov S.V.**  
**INDUCED GENERATOR OF PULSE CURRENT**  
**FOR FREQUENCY SUPPLY MODE OF RAILGUN**

Application of pulse current induced generator for frequency supply mode of railgun has been considered. The induced generator consists of special synchronous electric machine generator operating in short-time impact mode; its phase winding with alternating electromotive force and two groups of thyristors is used for energy storage in magnetic field of primary winding of air transformer. The secondary winding of this current increasing transformer is connected to the railgun. Each phase of three-phase synchronous generator is capable of supplying its transformer and railgun. The equations and results of computation are introduced in the form of time dependences and tables. These generators are capable of being used with high efficiency at independent objects and may compete with other sources of electromagnetic energy.

UDC 621.311.016.361

**Gotman V.I., Glazachev A.V.**  
**OPTIMIZATION OF REACTIVE POWER MODE**  
**OF LONG-DISTANCE POWER LINES**  
**WITH INTERMEDIATE SYSTEMS**

Laws of voltage and reactive power regulation of extra-high voltage long-distance power lines with intermediate systems by the data of providing minimum losses have been considered. Load range within which the coordinated voltage control mode providing maximum transmission efficiency is possible, is noted. Loss influence at corona effect on coordinated voltage control regions is studied.

UDC 621.316.13; 621.314

**Ivanov A.Yu., Mikhailchenko G.Ya.,**  
**Mikhailchenko S.G., Rusanov V.V., Fedotov A.V.**  
**ENERGY SAVING TECHNOLOGIES OF REACTIVE POWER**  
**AND DISTORTION POWER COMPENSATION**

The items of developing new technologies of compensation of reactive power in electric energy distributive networks but also distortion power emitted to the network by nonlinear loadings have been discussed. The main focus is on issues of solving the problem of compensation by modern means of power electronics and modeling of electromagnetic processes.

UDC 621.311

**Masterova O.A., Tyulkin M.V.**  
**STUDYING THE EFFICIENCY OF IMPLEMENTING**  
**PILOT PROJECT ON SET OF STATIC VAR COMPENSATOR**  
**AT SUBSTATION NOVO-ANZHERSKAYA 500 kV**

The efficiency of implementing «FSK EES» pilot project on changing synchronous condensers to static VAR compensator at substation Novo-Anzherkaya 500 kV has been analyzed. This device influence on modes of Kuzbas energy system was examined from the point of view of voltage regulation, improvement of stability and limits of power transmitted through the power lines, decrease of equipment wear rates.

UDC 621.396

**Pavlov V.I., Aksenov V.V., Belova T.V.**  
**OPTIMIZATION OF MEASUREMENT SYSTEM OPERATION**

The issues of measurement system adaptation to changing conditions of operation by simultaneous meter structure and measuring control have been considered.

UDC 621.3.024:621.317.79

**Shestakova V.V., Isaev I.S.**  
**DETERMINING THE ELEMENT WITH REDUCED**  
**INSULATION RESISTANCE IN BRANCHED ELECTRIC**  
**NETWORK OF CONSTANT CONTROL CURRENT**

The method of determining the element with reduced insulation resistance in branched network of constant control current of power plants and substations, based on current phase change in failed connection due to occurrence of conductance active component at leakage current appearance, has been proposed. The simultaneous network superimposition of harmonic control current and high frequency current pulses, synchronized with zero transition point of sine signal stress at network poles, is proposed to be applied.

UDC 620.179.1.082.7.05

**Redko V.V., Burtseva L.B., Redko L.A.**  
**CABLE PRODUCT ISOLATION AS THE OBJECT**  
**OF ELECTRO-SPARK PROCESS CONTROL**

The connection of cable product isolation parameters, its control modes and processing features with the requirements to testing facilities energy characteristics has been analyzed. The obtained results allow analyzing the influence of isolation parameters and processing on the required electric capacity of testing facilities.

UDC 621.31

**Nechaev M.A.**  
**THE DEVELOPMENT OF CONTROL SYSTEM**  
**OF MAGNETRON SPUTTERING DEVICE SCANNING MOTION**

The construction of control system of magnetron sputtering device scanning motion with regard to kinematic scheme features has been shown. The requirements to electric drive of these devices were stated on the basis of mathematical model of film thickness growth and analysis of processing features.

UDC 621.3.07

**Langraf S.V., Glazyrin A.S., Glazyrina T.A.,**  
**Afanasiev K.S., Timoshkin V.V., Kozlova L.E.**  
**STUDYING PARAMETRIC ROBUSTNESS**  
**OF SENSORLESS VECTOR INDUCTION MOTOR DRIVE**  
**WITH KALMAN IDENTIFIER**

The results of studying parametric robustness of sensorless vector induction motor drive with Kalman identifier at change of such inner parameters of electric motor as rotor active resistance, magnetization chain inductance, inertia moment have been introduced. Stability boundaries of electric drive operation at increase of each mentioned parameter were determined.

UDC 004.942;621.316.1.05

**Kazantsev Yu.M., Kostarev I.S., Lekarev A.F.**  
**PROJECT ANALYSIS OF ELECTROMAGNETIC COMPATIBILITY**  
**OF POWER SUPPLY ISOLATED SYSTEM CONTROLLER**

The technique of analyzing electromagnetic compatibility of spacecraft power electronic systems has been introduced. The results of computing frequency spectrum of electromagnetic disturbances by electric and magnetic field intensity are given and they are compared with the experimental data.

UDC 621.317.727.1

**Zarevich A.I., Muraviev S.V.**  
**MATHEMATICAL MODEL OF INDUCTIVE VOLTAGE**  
**DIVIDER WITH ELECTRONIC COMPENSATION**

The results of mathematical modeling of decade inductive voltage divider with electronic compensation of current in primary winding have been introduced. It is shown that the use of compensation technique reduces transient duration in inductive voltage divider, steps down current in primary winding that decreases errors in lower frequencies.

UDC 621.373.13

**Rybin Yu.K.**  
**THE ANALYSIS AND SYNTHESIS OF OSCILLATION**  
**SYSTEMS OF ELECTRIC SIGNAL GENERATORS**

The method of analyzing oscillation systems of electric sine signal generators has been proposed. The restrictions to transfer functions of linear frequency-dependent chains and active elements at which sinusoidal oscillations are possible in oscillation system were obtained. The technique allows simplifying the oscillation system synthesis.

UDC 621.373.4/5:681.8

**Khmelev V.N., Genne D.V., Barsukov R.V., Tsyganok S.N.,**  
**Shalunov A.V., Abramenko D.S.**  
**MATCHING ELECTRONIC GENERATORS**  
**WITH PIEZOELECTRIC OSCILLATION SYSTEMS**  
**FOR INCREASING ULTRASONIC DEVICE EFFICIENCY**

The article is devoted to solving the problem of matching piezo-electric oscillation system with electronic generator for maintaining optimal energy transmitting mode from electronic generator to piezo-electric oscillation system. The results confirming the efficiency of the proposed matching technique are introduced.

UDC 534.143

**Torgaev S.N., Trigub M.V., Soldatov A.I.**  
**ULTRASOUND MILK FLOWING TYPE DISINFECTANT**

Structural diagram of ultrasound milk flowing type disinfectant and the analysis of its operation have been introduced. The possibility of implementing the automatic frequency control mode, when using as a feedback signal of radiator current, is shown.

UDC 534.6.08

**Dichev N.V., Soldatov A.I., Makarov V.S., Sorokin P.V., Fiks I.I.**  
**THE METHOD OF DETERMINING TEMPORARY POSITION OF SLOWLY RISING ECHO-PULSE**

The method of determining temporary position of slowly rising echo-pulse by envelope segregation has been considered. The main calculation expressions for its usage were proposed. The real echo-signal with envelopes constructed by this method was used as the example. This method was compared with the traditionally used ones, the conclusion was drawn.

UDC 535:621.373.826:539:541.124.2:541.126

**Tsipelev V.P., Morozova E.Yu., Skripin A.S.**  
**LASER INITIATION OF PENTHRITE POWDERS IN VOLUME COMPRESSION CONDITIONS**

Energy thresholds of initiation have been determined and kinetics of explosive decay process of pentaerythritol tetranitrate powders compressed volumetrically to pressure  $5 \cdot 10^8 \text{ N/m}^2$  at laser radiation pulse action at wave lengths 1064 nm (transmission region) and 266 nm (self-absorption region) has been studied. The conditions of low-threshold initiation for pure penthrate powders of the first, second and forth radiation harmonics of neodymium laser were implemented.

UDC 629.1.015.3;535.21.5

**Malov A.N., Orishich A.M., Fomin V.M., Vnuchkov D.A., Nalivaichenko D.G., Chirkashenko V.F.**  
**STUDYING THE STRUCTURE OF SUPERSONIC AIR STREAMS WITH ENERGY SUPPLY FROM QUASI-STATIONARY OPTICAL DISCHARGE**

The processes of energy control of supersonic air stream parameters in conditions of real gas-dynamic flow of aerodynamic model have been studied. The researches were carried out using the quasi-

stationary optical discharge created for the first time in conditions of scaled aerodynamic device. It was shown that at interaction of thermal trace from optical discharge zone with a head shock wave generated by the model the considerable change of the structure of flow behind the falling shock wave from the model in the region of its interaction with thermal trace created by optical breakdown was observed.

UDC 535-3:53.083

**Avdeev S.M., Sosnin E.A., Smirnov A.A., Tarasenko V.F.**  
**OPTICAL CHARACTERISTICS OF MULTI-BAND EXCIMER LAMP PLASMA OF BARRIER DISCHARGE ON  $\text{KrCl}^*$ ,  $\text{Cl}_2^*$ ,  $\text{Br}_2^*$  MOLECULES**

Energy and spectral characteristics of barrier discharge excimer lamps on triple mixtures of Ar-Kr- $\text{Cl}_2$ , Ar-Kr- $\text{Br}_2$  have been measured for the first time. Radiation spectra represent B $\rightarrow$ X band of  $\text{RX}^*$  molecule and D' $\rightarrow$ A' band of  $\text{X}_2^*$  molecule where R is the rare gas atom, and X is the halogen atom. In conditions when the intensity of these bands is comparable the power of 1,8 W and radiation efficiency of ~1,7 % are achieved. Low radiation efficiency is connected with specific character of forming the given molecules.

UDC 621.373.8

**Trigub M.V., Torgaev S.N., Fedorov V.F.**  
**SEMICONDUCTOR PUMPING SOURCES OF CuBr-LASER**

The results of studying semiconductor pumping sources for CuBr-lasers of various geometry have been introduced. The possibility of developing solid-state high-frequency (higher than 100 kHz) pumping sources was shown. Pumping diagrams at active load operation were investigated experimentally and by modeling in the package of applied programs PSpice.