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# Summaries

UDC 621.396.6

**Kuznetsov G.V., Kats M.D.**  
**THE ANALYSIS OF ERRORS OF DETERMINING THERMAL CHARACTERISTICS OF STRUCTURAL MATERIALS BY PULSE METHODS**

The experiment errors have been theoretically analyzed by pulse methods on determining thermal characteristics of materials. The problem of nonstationary temperature field of material sample influenced by thermal pulse of short time dimension subject to cooling heated and "cold" surfaces was numerically solved. The influence of convective and radiative heat exchange on the results of determining thermal characteristics by pulse method was shown.

UDC 621.643.001:536.2

**Kuznetsov G.V., Polovnikov V.Yu.**  
**THE ANALYSIS OF HEAT LOSS OF HEAT-PIPELINES IN CONDITIONS OF INSULATION DAMPING SUBJECT TO THE PROCESS OF WATER LOSS**

Heat-and-mass transfer in saturated heat insulation of heat-pipeline has been numerically studied subject to water loss in porous structure of heat-insulating material. It was ascertained that taking into account evaporation process allows specifying significantly the value of heat-pipeline heat loss in conditions of heat network channel flood.

UDC 621.643.001:536.2

**Loginov V.S., Polovnikov V.Yu.**  
**NUMERICAL SIMULATION OF THERMAL CONDITIONS OF CHANNEL HEAT-PIPELINES IN CONDITIONS OF INTERACTION WITH DAMP AIR**

Heat-and-mass transfer in heat insulation of heat-pipeline laid in a channel way in conditions of interaction with damp air has been numerically studied. Heat-and-mass transfer laws and heat loss scales of channel heat-pipeline with damp air were determined.

UDC 621.039.534.54:621.364:634.3

**Kasyanov V.A., Loginov V.S., Yukhnov V.E.**  
**INTERMITTENT THERMAL DUTY OF WINDING BETATRON TRANSFORMER WITH ARBITRARY CYCLE INDICES "LOAD PAUSE"**

Dependences for calculating average nonstationary temperatures of winding betatrons with arbitrary number of heating and cooling cycles have been obtained. The example for practical implementation of the obtained expressions was examined. The results of numerical simulation of nonstationary temperature conditions of magnetizing winding of betatron electromagnet were given.

UDC 536.21

**Gorodov R.V., Kuzmin A.V.**  
**ESTIMATION OF CONVECTIVE CONSTITUENT AT BATCH HEATING IN A FURNACE AT GLASS FOAM PRODUCTION**

The solution of the problem of batch heating in the furnace of glass foam production subject to convective and radiative constituents of heat supply (the proposed model) has been compared with only convective heat supply (the existing model). The influence of the value of glass batch emissivity on heating process intensity was analyzed. It was concluded on the necessity of accounting radiative constituent of heat supply at calculation of temperature conditions of glass foam production process.

UDC 504.3.054:629

**Dolotov A.E., Kuznetsov G.V., Nemova T.N.**  
**SIMULATION OF EVAPORATION PROCESS OF ASYMMETRICAL DIMETHYLHYDRAZINE IN EARTH ATMOSPHERE**

Evaporation process of asymmetrical dimethylhydrazine under the influence of convection and radiation from the Sun at motion of its drops to the Earth surface after depressurization of fuel tanks of rocket carriers at altitudes to 40 km has been simulated. It was shown that only drops with typical size to 16 mm may reach the Earth.

UDC 536.468

**Zakharevich A.V., Kuznetsov G.V., Maksimov V.I., Panin V.F., Ravdin D.S.**  
**ESTIMATION OF FUEL OIL FIRE HAZARD IN CONDITIONS OF OVERLOAD, STORAGE AND TRANSPORT AT THERMAL ELECTRIC POWER STATIONS**

The possibility of fuel oil ignition by a single metal particle heated to high temperatures (1473 K) has been experimentally ascertained, dependences of ignition delay time on particle initial temperature have been determined. The influence of particle structure (single and porous) on laws of fuel oil ignition process was shown.

UDC 621.311.22.002.5

**Belyaev L.A., Romashova O.Yu., Shevelev S.A., Lebedev V.M.**  
**METHOD OF DYNAMIC PROGRAMMING FOR THERMAL LOAD PROPAGATION AMONG HEAT STATION TURBINES**

Mathematical model of optimal propagation of heating and production loads among heat station turbo-units using the method of dynamic programming has been developed. The results of bundled software implementation at operating heat station are given in the form of diagram of optimal load of heaters depending on open air temperature.

UDC 621.311.22.002.5

**Belyaev L.A., Romashova O.Yu., Lebedev V.M.**  
**MATHEMATICAL SIMULATION OF FEED WATER FLUX-DISTRIBUTION AT HEAT STATION WITH TRANSVERSE CONNECTION**

On the basis of hydraulic chain theory a mathematical model of feed water flux distribution over the system of high pressure heaters of heat stations with transverse connection has been developed. Algorithm of computing flux-distribution subject to pressure characteristic of twin feed pumps was developed. The proposed technique is available for being used in engineering calculations of turbo-unit energy characteristics as well as for selecting operating feed pump component.

UDC 621.311

**Ivanov N.S., Bepalov V.I., Lopatin N.S.**  
**MATHEMATICAL MODEL OF OPTIMIZATION OF SHORT-TERM MODE OF OPERATION OF HEAT STATION IN CONDITIONS OF COMPETITIVE MARKET**

The aim of optimal maintenance of modes of operation at thermal power stations has been considered. The description of mathematical model of optimization of modes of operation of thermal power station, data base formation and its interaction with optimization program are given. The description of algorithm and optimization criterion is given.

UDC 621.311

**Ivanov N.S., Bespalov V.I., Lopatin N.S.**  
**BUNDLED SOFTWARE FOR OPTIMIZATION OF MODES**  
**OF OPERATION OF THERMAL POWER PLANTS**  
**AND EFFICIENCY OF ITS APPLICATION**

The description and appearance of bundled software for optimization of modes of operation of thermal power plant have been given. The necessity of developing the instrument for detecting efficiency of bundled software operation is proved and the principle of its operation is examined. The possibility of applying optimization program for economic justification of selecting the way of power plant development is shown.

UDC 621.165

**Zalomikhin V.A., Kalugin B.F.**  
**HEATING BOILER AIR WITH RETURN DELIVERY WATER**  
**CONNECTED TO EXTRACTION TURBO-UNIT**

To increase the efficiency of production, tempering of thermal and electric energy to external consumers of thermal power plants the scheme of heating boiler air with return delivery water has been developed. Variants of operation of one of the existing now schemes are compared with that developed by the authors and analyzed. The developed scheme at extraction turbo-unit of the type T-115-8,8 LMZ allows decreasing specific fuel consumption by 3,5...13,85 % and saving 1,19...3,83 thousand tons of equivalent fuel per one heating season. Payback period of procedures on the developed scheme implementation for the examined station amounted to 4 months.

UDC 681.5.013

**Gribkov A.N., Artemova S.V.**  
**ALGORITHM OF RESOURCE-SAVING CONTROL**  
**OF DYNAMIC MODES OF MULTISECTIONAL DRYING UNITS**

Algorithm of resource-saving control of dynamic modes in multisectional drying units which may be used in information-management system for synthesizing optimal control actions in real time has been considered. Statement of problem of resource-saving control and the example of its solution for five-sectional drying unit are given.

UDC 621.928.93

**Aslamova V.S.**  
**COMPARISON OF THE RESULTS OF COMPUTING**  
**RESISTANCE COEFFICIENT AND PRESSURE LOSS**  
**OF DIRECT-FLOW CYCLONE WITH INTERMEDIATE**  
**SELECTION WITH THE EXPERIMENT**

Resistance coefficient values and pressure loss calculated by known dependences have been compared with the results of experimental investigation of direct-flow cyclone with intermediate selection with different initial diameters of exhaust manifold. The comparison of hydraulic resistance coefficient in self-similarity region by Reynolds number showed that relative error of determining cyclone resistance coefficient exceeds significantly 20 %. Relative error of pressure loss predictive values vary from 31,4...51,8 %.

UDC 621.928.93

**Aslamova V.S.**  
**CALCULATION OF HYDRAULIC RESISTANCE**  
**OF DIRECT-FLOW CYCLONE WITH INTERMEDIATE SELECTION**

Calculation technique of hydraulic resistance of direct-flow cyclone with intermediate selection has been given; there pressure loss in annular diffusion regions of steady chamber has been estimated on the basis of boundary layer characteristics and by the equivalent diver-

gent cone. Flux swirling was taken into account by additional coefficient introduction. An error of the proposed calculation technique of cyclone hydraulic resistance is not more than 9,3 %.

UDC 620.9:662.6

**Ilyina M.N., Ivanova I.A.**  
**INVESTIGATION OF ADSORPTIVE DEVICE FOR PREPARING**  
**ASSOCIATED PETROLEUM GAS FOR COMBUSTION**

The data on using adsorptive device in power stations as a pre-combustion preparation of associated petroleum gas at production place directly have been given. Comparative analysis of associated petroleum gas composition before and after adsorptive device was given. Usable resources of adsorbing filler-chabazite were analyzed for the specified conditions.

UDC 538.56:538.542.001.24

**Nosov G.V.**  
**EQUIVALENT PULSE PARAMETERS**  
**OF MASSIVE CONDUCTORS**

Formula for calculating equivalent pulse parameters of massive conductors subject to adiabatic heating and nonlinear magnetic properties of surface layer at diffusion of plane one-dimensional electromagnetic wave into conducting half-space have been obtained. Equivalent parameters (thickness and temperature of surface layer, magnetic field pressure and heat loss power, resistance and inductance) are accepted as averaged and constant ones at action of pulse voltage of magnetic field at conductor surface. This pulse form is approximately taken into account by its duration, mean square value and number of positive and negative half-waves. Nonlinear magnetic properties of ferromagnetic conductor are taken into account by power law for its magnetization curve. Reliability of the obtained formulas is confirmed by examining individual cases for nonferromagnetic conductors and computed dependences for magnetic permeability of structural steel.

UDC 621.317.313+621.317.318

**Baksh E.Kh., Burachenko A.G., Kostyrya I.D.,**  
**Lomaev M.I., Panarin V.A., Rybka D.V., Tarasenko V.F.**  
**SENSORS FOR CALCULATING NANO-**  
**AND SUBNANOSECOND CURRENT PULSES**

Construction of current sensors with shunts on the basis of strip lines and chip-resistors for measuring nano- and subnanosecond current pulses has been given. The advantage of these sensors in comparison with current sensors on the basis of resistors of TVO (TBO) mark was shown.

UDC 537.52:533.9

**Grigoriev A.N.**  
**ENERGY LOSS IN DISCHARGER AND ITS SWITCHING**  
**CHARACTERISTIC AT CONDUCTOR ELECTRIC EXPLOSION**

The method of determining the dependence of switch active resistance  $R_{sw}(t)$  on time by current oscillogram  $I(t)$  in a circuit has been proposed. Knowing the dependence  $R_{sw}(t)$  allows estimating energy lost in switch and carrying out optimization investigations in increasing efficiency of energy transfer from capacitive storage to load (burst conductor). Information on  $R_{sw}(t)$  (active resistance of the whole discharge circuit) allows also controlling circuit measurements.

Studying switching characteristic of air discharge operating on self-breakdown showed its evident influence on performance of energy transfer from capacitive storage to the load. In the case when switch inductance is  $L_{sw} \approx (0,05..0,1)L$  loss in switch amounts to the value  $\sim 11..22$  % from energy introduced into copper conductor (burst mode close to that matched by energy with infinite current pause).

UDC 535.374:621.375.8

**Chebotarev G.D., Latush E.L., Fesenko A.A.**  
**STUDY OF THE COMBINED DISCHARGE IN A TUBE**  
**WITH METAL SEGMENTS AS AN ACTIVE MEDIUM**  
**FOR GAS-DISCHARGE LASERS**

A combined discharge in a tube with metal segments as a method of active medium excitation combining the longitudinal and hollow-cathode discharge properties has been proposed and studied. At excitation in combined discharge a laser pulse at  $\lambda=585,3$  nm NeI, pulse three-wave generation at transitions KrII ( $\lambda=469,4$ , 458,3 and 431,8 nm), pulse and quasicontinuous three-wave generation at transitions CdII ( $\lambda=441,6$ , 533,7 and 537,8 nm), as well as continuous generation at  $\lambda=441,6$  nm CdII were obtained and studied. High gain coefficients exceeding significantly amplification in longitudinal discharge were achieved.

UDC 519.624.2

**Zimin V.P.**  
**INVESTIGATION OF FUNCTIONS FOR CONTROLLING**  
**PARAMETER OF BOUNDARY PROBLEM**  
**OF PLASMA DENSITY DIFFUSION**

Algorithm of searching for solutions of nonlinear boundary problem of plasma density diffusion in thermionic energy converter has been studied. Using representation of area of feasible solutions of the problem on phase plane (plasma density – ion current) it was shown that convergence region to physically adequate solution depends significantly on function structure for control parameter of boundary problem. Practical guidelines of selecting this function were given and algorithm of problem numerical solution was proposed. Numerical solutions of boundary problem for converter typical parameters were analyzed.

UDC 621.39: 621.311.6.0012

**Abramov S.S., Sazhnev A.M., Levin D.N.,**  
**Malinkin V.B., Rogulina L.G.**  
**SYSTEM DYNAMIC MODES AT EXTERNAL ACTION**

Simulation model of nonlinear system in medium Simulink subject to external actions on the third hand of load including asymmetrical linear and dynamic load has been developed. It allows estimating the degree of voltage distortion and calculating neutral wire section subject to compensating current as well as checking the system in operation from industrial network for compliance to dynamic characteristic norm.

UDC 621.3.078:620.9

**Demin Yu.V., Mikitinskii M.S., Mozilov A.I., Churakov A.A.**  
**METHOD AND DEVICE FOR ESTIMATING CORROSION**  
**OF TRANSMISSION TOWER ANCHORING**

Method of estimating corrosion of transmission tower anchoring and its hardware implementation have been described. Data on electric resistance of 35 mm anchor bolts on frequency 1,6 MHz are given.

UDC 616.831-073.756.8

**Fokin A.V., Brazovskii K.S.**  
**CURRENT SOURCE FOR ELECTROIMPEDANCE**  
**TOMOGRAPHY**

The diagram of alternating current source for electroimpedance tomography has been developed. Characteristics obtained at simulation in the medium MULTISIM 8.0 and investigations of laboratory mock-up are given. They show that application of such schematic solution allows increasing stability and quality of measurements in electroimpedance tomography.

UDC 615.47:681.2

**Zheludko S.P., Aldonin G.M.**  
**STRUCTURAL ANALYSIS ON THE BASIS**  
**OF POLYFUNCTIONAL MONITORING**  
**OF CARDIOVASCULAR SYSTEM STATE**

Polyfunctional analysis of cardio signals is of great interest for differential diagnosis of norm and pathology of cardiovascular system. Fractal analysis of cardiovascular system signals reflects its structural organization.

UDC 621.313.333

**Aristov A.V.**  
**ELECTRIC DRIVE OF OSCILLATION**  
**IN NONUNIFORM MOTION MODE**

The technique of forming nonuniform motion of induction motor shaft due to developing step electromagnetic field at oscillating conditions has been proposed. Functional diagram and mathematical model of intermittent motion electric drive is given. Influence of load parameters on output characteristics of electric drive and its accuracy is estimated.

UDC 621.313.3

**Gusev V.V.**  
**METHODOLOGICAL PREREQUISITES TO ESTIMATION**  
**OF ELECTRIC MACHINE MAINTAINABILITY**

Methodology allowing estimating electric machine maintainability from the point of view of system analysis has been given. Uncertainty of information data occurring at operation of electric machine was considered. Aim decomposition which is reflected in the form of "tree of objectives" was carried out for efficient maintenance and service of electric machine. The obtained results may be used as initial data for statement and solution of a number of tasks of controlling electric machine maintainability.

UDC 621.37/.39(091)

**Kuznetsova S.I.**  
**FIRST RADIO TECHNICIANS IN TOMSK**  
**TECHNICAL INSTITUTE**

History of radio engineering in TTI (TPI–TPU) has been recalled by archival materials and contemporary memories. Short biographies of first Tomsk radio technicians are given: V.V. Shirkov, B.A. Golubkov, A.A. Kholodkovskii.