

УДК 621.833

Определение напряжений в гибком колесе волновой зубчатой передачи / В. Н. Ткаченко // Вісник НТУ «ХПІ». Серія: Математичне моделювання в техніці та технологіях. – Харків: НТУ «ХПІ», 2015. – №18 (1127). – С. 159 – 163. Бібліогр.: 4 назви. – ISSN 2222-0631.

Для проверки гибкого колеса волновой зубчатой передачи на изгибную прочность и выносливость предложена методика определения напряжений от изгиба колеса генератором волны упругой деформации с применением теории упругих тонких оболочек. Вычисленные напряжения корректируются с учётом переменной изгибной жесткости в области зубчатого венца и наличия эффекта концентрации напряжений во впадинах между зубьями. Предлагается определить напряжения в двух опасных сечениях – во впадинах между зубьями венца и в области перехода от зубчатого венца к гибкому колесу. При этом для второго сечения расчёт напряжений проводится с учётом передаваемого вращающего момента. Из приведенного примера расчётов видна целесообразность предлагаемого подхода к оценке прочности и выносливости гибкого колеса волновой зубчатой передачи.

Ключевые слова: волновая передача, напряжения, гибкое колесо, теория оболочек.

УДК 621.646.45: 621.05: 621.454.2

Термодинамический расчёт пневмосистемы запуска ракетного двигателя / С. А. Шевченко, А. Л. Григорьев, М. С. Степанов // Вісник НТУ «ХПІ». Серія: Математичне моделювання в техніці та технологіях. – Харків: НТУ «ХПІ», 2015. – №18 (1127). – С. 163 – 195. Бібліогр.: 14 назв. – ISSN 2222-0631.

Выполнен анализ процессов нестационарного теплообмена газа со стенками полостей пневмосистемы запуска ракетного двигателя многократного включения. Получены формулы для расчёта коэффициентов теплоотдачи от газа к стенке с учётом формы полости. Для определения температуры внутренней поверхности стенки выведено интегро-дифференциальное уравнение и разработан новый метод его решения, использующий аппроксимацию регулярной части ядра сверточного интеграла в виде суммы нескольких экспонент. Показано, что при расчёте непроточных полостей пневмосистемы изменение температуры стенок можно не учитывать. Аналогичный метод использован для расчёта нагрева уплотнительных манжет пневмосистемы.

Ключевые слова: пневмосистема запуска ЖРД; нестационарный теплообмен; коэффициенты теплоотдачи газа; интегро-дифференциальное уравнение; экспоненциальная аппроксимация ядра.

УДК 539.3

Об особенностях термоупругих деформаций граничных поверхностей полого бесконечного цилиндра при воздействии на него цилиндрических температурных полей специального вида / В. И. Щеглов // Вісник НТУ «ХПІ». Серія: Математичне моделювання в техніці та технологіях. – Харків: НТУ «ХПІ», 2015. – №18 (1127). – С. 196 – 210. Бібліогр.: 4 назви. – ISSN 2222-0631.

Установлен эффект уменьшения внутреннего радиуса упругого полого бесконечного цилиндра B , являющегося телом вращения с круговыми цилиндрическими граничными поверхностями, при воздействии на него цилиндрического температурного поля, вызывающего равномерный нагрев бесконечного осесимметричного полого цилиндра \bar{B}_1 , соосного с цилиндром B , являющегося правильной его частью, при неизменности температуры полого цилиндра B во всех его точках, не принадлежащих поперечному сечению цилиндра \bar{B}_1 , причем дополнительно должны выполняться следующие условия: достаточная близость всех точек зоны нагрева полого цилиндра B к его внутренней граничной поверхности; положительность среднего значения коэффициента линейного расширения материала полого цилиндра B в пределах изменения его температуры в зоне нагрева; определенный характер зависимости от температуры модуля Юнга и коэффициента Пуассона материала тела B .

Ключевые слова: термоупругая деформация, граничная поверхность, полый бесконечный цилиндр, нагрев, температурное поле, модуль Юнга, коэффициент Пуассона, коэффициент линейного расширения.

ABSTRACTS

UDC 51(092)

Rare editions of Leonard Euler books stored in the library of Kharkov Polytechnic Institute / G. V. Pavlova // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in

engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 3 – 14. Bibliog.: 17 titles. – ISSN 2222-0631.

In the article the research activity and publications of the outstanding scientist Leonhard Euler are described. For the first time the collection of books and scientific publications by Leonard Euler stored in the library funds of the Kharkov Polytechnical Institute is presented and the history of its creation is traced.

Key words: history, mathematics, mechanics, hydrodynamics, astronomy, philosophy, collection, rarities, book memorial, scientific heritage.

UDC 539.3

Main achievements of scientists of NTU «KHPI» in the field of mathematical modeling in engineering / S. A. Nazarenko, S. I. Marusenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 14 – 19. Bibliog.: 2 titles. – ISSN 2222-0631.

The paper is concerned with the dynamic process of establishment and development of the research and pedagogic activity of the scientists and graduates of the National Technical University «Kharkiv Polytechnical Institute» (NTU «KhPI») in the field of mathematical modeling in engineering and technologies in the 19 – 21 centuries. The beginning of the Ukrainian technical science in the field of mathematical modeling in engineering and technologies is associated with the NTU «KhPI». The range of scientific designs created in the NTU «KhPI» varies from specific space products to a number of “common” products for the needs of machinery, power production, etc. The fundamental scientific trends of evolution of mathematical modeling in engineering and technological processes were discovered and explored here. The most important phases of formation and development of the research and design school of the NTU «KhPI» are shown. The world-famous scientists who worked at the NTU «KhPI» or graduated it are mentioned.

Key words: mechanics, mathematical model, engineering, technology, dynamics, design.

UDC 539

Numerical modeling of a plate impacted by a hemispherical indenter / L.V. Avtonomona, S.V. Bondar, A.V. Stepuk // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 19 – 24. Bibliog.: 9 titles. – ISSN 2222-0631.

The problems of numerical modeling of deformations of a circular plate and a package, which consists of two external steel plates and medium titanium one, are considered in three-dimensional setting. The plates are impacted by an indenter with hemispherically shaped working part. The transient coupled thermo- visco- plastic problem is solved in three-dimensional setting, taking into account the friction in the contact areas and the material yield strength, which depends on the strain rates and the temperature. The dynamic contact problems are numerically implemented by the finite element method using the ANSYS software package. The parameters of stress-strain states of the plate and the package are compared for two models of the defining relations: the Cooper-Simond and neural network models. It is demonstrated that the deviations of the obtained values of displacements and deformations intensities do not exceed 15%.

Key words: mathematical modeling, contact problem, impact, finite element, plate, thermo- viscoplastic deformation.

UDC 628.477: 519.876.5

A mathematical description of the process of cooling of generating gas in the installation for utilization of biowaste products / V. V. Vambol', V. E. Kostjuk, E. I. Kirilash // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 24 – 35. Bibliog.: 12 titles. – ISSN 2222-0631.

In the paper we consider a problem of accumulation of solid domestic and industrial wastes and ground its relevance. The method of solving the problem consists in utilizing the waste by means of mixed gasification. A significant drawback of the method is the secondary formation of highly toxic substances in the gaseous product of this process. To solve this problem a method of quenching the generating gas by injecting liquid by centrifugal dispersing nozzles into its flow is proposed. The article contains the mathematical description of the process of cooling of generating gas in the installation for utilization of biowaste products. On the basis of the classical theory of gas dynamics the mathematical relationships describing gas and dispersed phase and interphase interaction in the process of cooling are obtained.

Key words: utilization, biowaste products, ecological safety, dioxins, mathematical modeling, dispersion multiphase structure.

UDC 389.14+658.16(075.8)

Approximation of experimental data distribution law using beta distribution. Part 1 / S. O.Vambol', I. V. Mischenko, A. N. Kondratenko, O. A. Burmenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 36 – 44. Bibliog.: 34 titles. – ISSN 2222-0631.

The features of the beta distribution are investigated and the foundation for its application for approximation of the law of distribution of empirical data in comparison with other types of distribution laws in general is given. A practical application of such a distribution in the case of geometric characteristics of rolling bodies of bearings is studied. Specialized scientific technical and reference literature, the methods of mathematical statistics, probability theory, and numerical methods are analyzed. In this part of the study we apply typical distribution laws to the object of research and show that using the normal and other typical distributions for approximation is not always acceptable for finding the true distribution law or close one. For the first time the advantages of using the beta distribution for approximating the empirical distribution law of a wide range of possible measurement data on the example of geometric characteristics of rolling bodies of bearings are studied. The obtained methodology and mathematical apparatus for the application of the beta distribution can be used for solving the problems of approximation of the empirical data of any kind.

Key words: errors of measuring, empirical distribution, normal distribution, beta distribution, Pearson distributions, approximation.

UDC 519.67:621.762.4.04+621.762.53+537.52

Physical and mathematical model of compression in the process of consolidation of powders by spark-plasma sintering / Yu. G. Gutsalenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 44 – 53. Bibliog.: 16 titles. – ISSN 2222-0631.

The problem of physical and mathematical prediction of rational pressure during spark-plasma sintering of powder compositions is considered. The physical aspects of the problem are defined, and an approach to the calculation of the pressure in the compression cycle at the stage of pre-production and experimental development is presented. The calculation is based on Paschen's law applied to the considered model of spark plasma consolidation of powders under pressure. A calculation relational pressure database in the nanometer range of average grain sizes of the initial powders in production technologies by spark-plasma sintering is proposed. The calculation results are compared to the practical experience of energy-saving high-speed spark-plasma sintering of a dense ceramic composite of nanopowders Al_2O_3 -WC (50/50 wt.%). The directions for further research are suggested.

Key words: powder composition, spark-plasma sintering, electrical discharge, Paschen's law, compaction pressure, asymptotic dependence.

UDC 621.43.068.4

A mathematical model of the hydraulic resistance of the diesel particulate matter filter. Part 4: time coefficient / A. N. Kondratenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 53 – 61. Bibliog.: 11 titles. – ISSN 2222-0631.

The article deals with a mathematical model, which describes the hydraulic resistance of a DPF under the real operating conditions. The model is based on the flow characteristics of a single module of the filter element of DPF, obtained experimentally at a constant temperature of fluid, and the data of bench tests of an 2Ch10.5/12 tractor diesel, equipped with a full-sized DPF. The model allows to take into account a number of factors that characterize the operating conditions of a DPF in the exhaust system of this diesel. The factors are taken into account by introducing corresponding coefficients. The dependence of these coefficients on the operating and design parameters of the 2Ch10.5/12 diesel is experimentally obtained and described by the method of linear regression. In this part of the research we describe the physical meaning and evaluate the time coefficient of this mathematical model, which allows to take into account the dependence of the HR of DPF on the time of operation of the diesel in the stationary mode, that is the DPF clogging dynamics.

Key words: diesel, particulate matter filter, hydraulic resistance, mathematical model.

UDC 517.984.4

Double integration operator and its properties / G. V. Korobska // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 61 – 76. Bibliog.: 6 titles. – ISSN 2222-0631.

The article is devoted to the study of double integration operator in the space $L^2(D)$ where D is

a rectangle. The inclusion of this operator in the node is accomplished. It is shown that the calculation of the node characteristic function is associated with the solution of a Darboux-Goursat problem with data on characteristics. The restriction of the operator on the subspace of functions $f(x; y) \in L^2(D)$ of the form $f(x; y) = f(xy)$ is considered. The restriction operator is included in the node; characteristic function of the given node is calculated. It appears to be an integral operator which acts in the same space of functions ($f(x; y) = f(xy)$).

Key words: double integration operator, node, Hilbert space, orthoprojector, characteristic function.

UDC 621.43

Features of emissions of nitrogen oxides of a diesel operating on biodiesel fuel and possible methods to reduce them / A. M. Levterov, L. I. Levterova, V. D. Savitsky // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 76 – 86. Bibliog.: 29 titles. – ISSN 2222-0631.

In the article an analysis of the features of formation of nitrogen oxides during operation of an engine with ignition from compression on methyl and ethyl esters of fatty acids (biodiesel) and attempts to explanation them in scientific publications are presented. The methods for decreasing the NO_x content in the engine exhaust gases are also indicated. The research of biodiesel combustion is complicated by the variety of the fuels which is caused by the changing composition of the esters, and the absence of data on thermodynamical and thermochemical properties in the publicly available literature. In the article the results of numerical and motor experiments concerning the influence of the advance angle of the fuel supply and the coefficient of the air excess on the magnitude of the emission of the nitrogen oxides in the exhaust gases of the diesel for biodiesel and diesel fuels are proposed.

Key words: diesel, biofuels, emissions of nitrogen monoxide, exhaust emissions, modeling, motor experiment.

UDC 629.429.3:621.313

Rational speeds of movement of suburban electric trains with asynchronous traction motors / B. H. Lubarsky // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 86 – 92. Bibliog.: 8 titles. – ISSN 2222-0631.

Nowadays the developing and operating of new types of electric trains lead to the problem of determining their rational speeds. We consider a methodology of determining the most rational speed for electric trains based on complex criteria. It is noted that for a suburban electric train with the traction electric drive based on an induction traction motor considered in the paper increasing the maximum speed results not only in increasing the average speed of the train, but also in reducing the energy consumption by 3.75%, which is due to the drive operating in the modes with a high efficiency value.

Key words: train, asynchronous electric traction, maximum speed, optimal modes of traction drive, integrated performance criterion.

UDC 519.254

Covariant analysis in the processing of three-dimensional images / R. P. Mygushchenko, M. M. Volobuev, O. M. Rebrova // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 92 – 98. Bibliog.: 8 titles. – ISSN 2222-0631.

The questions of automatic formation of Fisher statistics sets that uniquely characterize the state of the control or identification object by using methods of statistical analysis are considered. The effectiveness of the statistical approach to the analysis of the three-dimensional model of the information signal conversion is proved. This analysis allows to reduce the dimension of images, thus highlighting four informative criterion F – statistics dispersion relations that have significant functional differences by type of object state control or management. The set of F -statistics is formed by the covariance analysis of the three-dimensional image of the object using a series of sections along the argument axes. The result of the process is a set with coordinates F_0, F_1, F_2, F_3 . The obtained F -statistics being random variables with known distribution law, to assess the likelihood of error diagnosis on the basis of standard parametric models discriminant analysis. It is shown that the analysis of the covariance transformation plan allows to measure the localized spectral-time non-stationary signals. The research can be used to develop algorithmic and software defect detection complex industrial equipment. The developed software can be used for simulation.

Key words: F – statistics, analysis of covariance, regression, a two-dimensional model, transformation, data archive.

UDC 517.955.8

On synchronization of oscillations of two coupled Berger plates with nonlinear interior and boundary damping. Part 1 / O. A. Naboka // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 98 – 108. Bibliog.: 20 titles. – ISSN 2222-0631.

A system of Berger PDE's describing nonlinear oscillations of two identical elastically coupled plates with partially clamped and partially free boundary and nonlinear dissipation acting inside plate domain as well as on the free part of the boundary is considered. We are interested in the dependence of the structure of the system global attractor on the value of the parameter γ describing the intensity of plate coupling. We prove that the upper limit of the attractor for $\gamma \rightarrow \infty$ belongs to the diagonal of the system phase space, which means that the coupled plates tend to synchronize (i.e. oscillate identically) as time and the coupling intensity tend to the infinity.

Key words: coupled Berger plates, asymptotic synchronization, nonlinear dissipation, free boundary.

UDC 519.64, 539.3

Modelling the interaction of plane harmonic waves with cylindrical inclusions / O. M. Nazarenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 108 – 115. Bibliog.: 9 titles. – ISSN 2222-0631.

A plane problem of diffraction of harmonic waves on hard and elastic inclusions of arbitrary cross-section is considered. The integral representations for the displacement amplitudes of the reflected wave field are constructed. The boundary problems are reduced to a system of singular integral equations that are numerically implemented. The additional conditions required for the unique solvability of the singular integral equations of the first kind are explained. The numerical implementation of these algorithms is carried out by mechanical quadrature method.

Key words: diffraction, rigid or elastic inclusion, singular integral equations, additional terms, numerical implementation.

UDC 629.423.3

Simulation of operation of an inertial electromechanical energy storage in the system of a traction drive during train braking / L. V. Overyanova, O. V. Omelyanenko, I. V. Novofastovskiy // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 115 – 119. Bibliog.: 3 titles. – ISSN 2222-0631.

Operation of an electric traction drive with an onboard inertial electromechanical energy storage is investigated. Applying a reversible increasing/decreasing DC-DC converter is proposed to extend the range of operating voltages of the traction motor and the electromechanical energy conversion system of the storage. The scheme of inclusion of the storage in the traction electric drive with a DC-DC converter and a mathematical model of the energy exchange are provided. The schematic solution proposed allows to improve the efficiency of utilization of the braking energy of the electric rolling stock, which can be used during the subsequent acceleration of the train.

Key words: electric traction, electromechanical inertial energy storage, DC-DC converter, electromotive force, energy exchange.

UDC 629.7.05

Reference model of rotation of a solid body on the basis of representation of the quaternion of orientation as the functions of Krylov's angles changing in time / Yu. A. Plakhsy // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 120 – 130. Bibliog.: 7 titles. – ISSN 2222-0631.

A new continuous rigid body rotation model based on the representation of the quaternion of orientation of the model as functions of Krylov's angles simultaneously changing in time is proposed. The analytical dependences for the quasicordinates on a step of calculations of the parameters of orientation and the components of the quaternion corresponding to such rotations are constructed. The realizations of the model for several sets of parameters are obtained. The results are presented in the form of dependences of the quasicordinates on time and the trajectories in the configuration space for orientation parameters. It is shown that the new model describes the rotation of a rigid body other than the case

of regular precession. The model can be used as a reference model for estimating the errors of orientation algorithms in strapdown inertial navigation systems.

Key words: quaternion, orientation, reference model, quasicordinates, trajectories in configuration space.

UDC 621.224

The influence of the complex circular offset of the runner blades in Kaplan turbine PL20 upon the flow pattern and the hydrodynamic characteristics of the flow part / A. V. Rusanov, O. N. Khoryev, A. V. Lynnyk, P. N. Sukhorebryi // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 130 – 141. Bibliog.: 8 titles. – ISSN 2222-0631.

The results of numerical investigation and the analysis of influence of the complex circular offset of the runner blades in Kaplan turbine PL20 Kremenchugskaya HPP upon the flow pattern and the hydrodynamic characteristics of the flow part are set out in the article. The flow pattern is given. The dependences of the energy losses in the runner and the values of efficiency in the flow part at optimum operating conditions on the offset value are described. The application of the complex circular offset for investigated hydroturbine is shown to have allowed increasing the value of maximum efficiency throughout the range of discharge at optimum installation angle of the runner blades. The investigations were carried out using the software system *IPMFlow*.

Key words: hydro turbine, flow part, spatial profiling, circular offset, runner, hydrodynamic improvement.

UDC 621.923

Ensuring the processing accuracy of grinding operations / I. A. Riabenkov // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 142 – 147. Bibliog.: 5 titles. – ISSN 2222-0631.

The paper presents a theoretical analysis of the technological capabilities for improving the accuracy and efficiency of processing by grinding circuit with initial interference in the process system, i.e. the schemes used in the nursing practice. For this purpose an analytical solution of the problem of determining the magnitude of the elastic displacement when grinding with an initial predetermined interference in the process system is obtained. It is shown that the value of the elastic displacement decreases exponentially in time, taking the values corresponding to the conditions of high-precision machining. The time of processing required to achieve the desired (target) accuracy is determined. This allows to determine scientifically by calculation the optimum processing parameters based on the requirements on the accuracy of the machined surface.

Key words: grinding, cutting force, machining precision, elastic movement, the initial tightness, technological system, the performance of processing, the processing time.

UDC 532.5, 614.844, 621.227

Water jet cannon for solving environmental problems / A. N. Semko, Yu. V. Sherstiuk // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 147 – 159. Bibliog.: 26 titles. – ISSN 2222-0631.

The article describes the main areas of application of impulse fluid jets of high speed in technological processes, their advantages and disadvantages and further prospects of development. The schemes of water jet devices are given. The difference in the physics of the processes occurring during the ingression and expiration of water from the nozzle of a water jet cannon and a water pulse jet are described. The equations to calculate the internal ballistics and the finite-difference approximation of the equations of motion by the Rodionova method, adapted to calculate the hydro pulse units, which satisfies the requirements of monotony, uniformity, conservatism, and has a second-order approximation in time and coordinate, are given.

Key words: impulse water jet, high-speed jet, water pulse jet, water jet cannon.

UDC 621.833

Determining stresses in the flexible wheel of a wave gear / V. N. Tkachenko // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 159 – 163. Bibliog.: 4 titles. – ISSN 2222-0631.

To check the flexural strength and endurance of the flexible wheel of a wave gear a method of determining stresses by bending the wheel by a generator of elastic deformations using the theory of thin elastic shells is proposed. The calculated stresses are adjusted taking into account the variable flex-

ural stiffness in the ring gear, and the effect of stress concentration in the valleys between the teeth. It is proposed to determine the stresses in the two dangerous sections - in the valleys between the teeth of the crown and in the area of transition from the ring gear to the flexible wheel. For the second section the calculation of stresses is carried out taking into account the transmission of torque. The example of calculations given in the paper confirms the feasibility of the approach proposed for evaluating the strength and endurance of the flexible wheel of a wave gear.

Key words: wave gearing, stress, flexible wheel, shell theory.

UDC 621.646.45: 621.05: 621.454.2

Thermodynamic calculation of rocket engine pneumatic starting system / S. A. Shevchenko, A. L. Grigoriev, M. S. Stepanov // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 163 – 195. Bibliog.: 14 titles. – ISSN 2222-0631.

The analysis of processes of unsteady-state heat exchange between a gas and multiple ignition rocket engine's pneumatic starting system's wall cavities has been done. The formulas for calculating the coefficients of heat exchange from a gas to a wall have been obtained considering the shape of a cavity. The integro-differential equation for determining a temperature of the inner surface of a wall has been obtained. The new method for its solution has been developed. It uses approximation of a convolution integral's regular part kernel as a sum of several exponents. It has been shown that a wall temperature changing while calculating non flowing cavities of a pneumatic system can be ignored. A similar method for calculation heating of sealing cups for a pneumatic system has been used.

Key words: LRE pneumatic starting system; unsteady-state heat exchange; gas heat-transfer coefficients; integro-differential equation; exponential approximation of kernel.

UDC 539.3

On the features of termoelastic deformations of boundary surfaces of a hollow endless cylinder affected by cylindrical temperature fields of a special kind / V. I. Shcheglov // Bulletin of National Technical University «KhPI» Series: Mathematical modeling in engineering and technologies. – Kharkiv: NTU «KhPI», 2015. – №18 (1127). – pp. 196 – 210. Bibliog.: 4 titles. – ISSN 2222-0631.

The effect of diminishing the internal radius is discovered for an elastic hollow endless cylinder B , which is a body of revolution with circular cylindrical boundary surfaces, at affecting it by a cylindrical temperature field, inducing the even heating of an endless axisymmetrical hollow cylinder \bar{B}_1 , having a general axis with the cylinder B , being its correct part, while the temperature of the hollow cylinder B at the points, not belonging to the hollow cylinder \bar{B}_1 , remains constant. Besides the following conditions must hold: sufficient closeness of all points of the zone of heating of the hollow cylinder B to its internal boundary surface; positiveness of the mean value of the coefficient of linear expansion of the material of the hollow cylinder B on the range of the temperature changes in the zone of heating; certain character of dependence on the temperature of the Yung's modulus and the Poisson ration of the material of the body B .

Key words: termoelastic deformation, boundary surface, hollow endless cylinder, heating, temperature field, Yung's modulus, Poisson ration, coefficient of linear expansion.