ABSTRACT AND REFERENCES

APPLIED MECHANICS

MATHEMATICAL MODELING OF GAS DYNAMIS OF POWDER STREAM IN IMPLEMENTATION OF RAPID PROTOTYPING TECHNOLOGY (p. 4-11)

Pavlo Kondrashev

In the modern world of rapid development of scientific and innovative technologies it is impossible to imagine any industry without using laser technology. Such a universal tool as laser can be used by many modern technologies, one of which is Rapid Prototyping technology, widely used in highly developed countries all over the world for immediate production (e.g. production of dies, press-molds, etc.). Despite the smashing success of laser technique and technology, developers face the issues of increasing the productivity and quality of forming the products from powder materials.

The author's method, aimed at improving the quality parameters of products obtained due to the implementation of Rapid Prototyping technology, is presented in the paper. The method is based on numerical simulation of gas-dynamic processes taking place in a gas-powder stream. This approach is implemented using the Ansys CFX software package, which is an indispensable tool in modern engineering and allows solving a great variety of issues in the field of fluid dynamics. The method allows developing the means of powder composition delivery to the laser radiation area with optimal aerodynamic parameters.

Thus, the research results, given in the paper, are of scientific and practical interest. The author showed the opportunity of using the method of numerical simulation of the gas-powder stream behavior for designing the coaxial nozzles that allows increasing the quality parameters of products obtained due to the Rapid Prototyping technology.

Keywords: powder composition, gas-powder stream, laser processing, dispersion.

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3D PARAMETRIC MODELING PROTOTYPE INTERNAL COMBUSTION ENGINE MEANS DELCAM OF POWERSHAPE (p. 11-14)

Pavel Nosov

The features of using computer-aided design systems and modern technologies in the automobile industry are considered in the paper. Methods of using modern information technologies and systems for modeling the structure of internal combustion engines are proposed. The advantages of combining CAD and CAM systems in particular software products are emphasized. Approaches to using Delcam plc products are justified, the sequence of design for ensuring an optimum design solution is specified.

The requirements and risk analysis for designing internal combustion engines are given. Special attention was paid to the problem of geometric calculations of the crank mechanism parts when modeling cranks and pistons. An algorithm for constructing the 3D- model of internal combustion engine prototype with increased capacity, without changing the body size, is considered. Design algorithm consists of four stages, each of them determines the final shape of all construction parts.

Keywords: CAD/CAM systems, automobile engines, geometric calculations, reliability, Delcam plc systems.

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INFLUENCE OF EXTERNAL FACTORS ON THE LAWS OF INITIAL WORK ANTIFRICTION (p. 15-19)

Miroslav Kindrachuk, Julia Khlevna

The paper presents the results of studying external force effect on the formation of tribological structures at the stage of "BrAZhMts10-3-1, 5 - AMG-10 - 30KhGSA" system burn-in. Based on analytical model of friction and wear processes, burn-in characteristics, namely time and wear, were defined. Experimental data, processed by methods of mathematical statistics, allowed establishing maximum permissible loads for the burn-in stage, coefficient of friction force variation 10% corresponded to the burn-in finish and beginning of a stationary mode of system operation. It is shown that stepwise increase of load, frictional heat emission regulation and constant sliding speed activate the burn-in process, expand the area of maximum permissible loads, thus reducing time and wear, as well as the probability of jamming, grip and denial of burn-in. It was found that as a result of burn-in, carbon-saturated tribological structures are formed,due to mechanical destruction of oils and surface-to-surface transfer of positively charged elements.

Keywords: friction, burn-in, tribological system, wear, friction coefficient, transfer, stepwise load.

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ENSURING ASSEMBLING ACCURACY WITH THERMAL INFLUENCE OF MULTI-ELEMENT CONNECTION (p. 19-23)

Olga Cherkashyna

The quality of production depends on supporting the regulatory framework of the product output at all stages of production life cycle. The paper is devoted to ensuring the accuracy of assembling with thermal influence of multi-element connections due to the calculation of dimensional accuracy at the stage of technological preparation of production with regard to expansion gaps formed by heating and assembling the elements of products. The analysis of processes, that take place under the thermal influence at the point of contact of mounting surface of multi-element connection components, was performed, mathematical simulation of the product thermal state was carried out and the regularity of expansion gap change was determined using the existing systems of computer-aided engineering analysis. Based on the analysis an improved formula for calculating the dimensional accuracy of assembling was obtained and a classification of the bush-type parts with models of determining expansion gaps, included in the calculation, was proposed.

Keywords: regulatory support, assembling quality, dimensional accuracy, thermal influence, expansion gap.

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UNIFIED THEORY OF MOVERS ON CONTINUOUS FLOWS. BRIEF THEORY OF SINGLE ROW AIR SCREWS (p. 23-30)

Borys Mamedov

The main mistake that Professor Nikolay Yegorovich Joukowski has committed in formulating the Kutta–Joukowski theorem, formula (1), is the introduction of such an incorrect notion as circulation, $\Gamma=t\cdot\Delta W_u$.

The Kutta–Joukowski theorem, derived by Professor Nikolay Yegorovich Joukowski, does not stand up to any criticism, as it absolutely does not agree with experimental data of the modern theory of jet engines, where it, formula (1), is incorporated as fundamental. This is due to the fact that under such a concept as circulation, $\Gamma=t\cdot\Delta W_u$, the maximum pressure of blowing flow on the blade of blowing profile is where circulation is maximum, that is on the outlet edge of blowing profile, and zero pressure of blowing flow on the blade of blowing profile is on the inlet edge, as on the inlet edge $\Delta W_u=0$. Such a diagram of pressures of blowing flow on the blade of blowing profile, generating a gradient of static pressures, directed against the flow, is in direct contradiction with the experimental data of modern theory of jet engines, which declare that the maximum pressure of blowing flow on the blade of blowing profile is within the inlet edge and this pressure is gradually reduced as blowing flow is displaced to the outlet edge of blowing profile, thus forming the pressure gradient directed along the flow, [1]. Therefore, the Kutta–Joukowski theorem, derived by Professor Nikolay Yegorovich Joukowski in 1912, is incorrect and can not be fundamental for any theory, this theorem should be formulated in the other way, which is described in the paper.

Keywords: kinematic analysis, thrust of blowing profile, lift force

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SIMULATION OF THE FORCED VIBRATIONS OF THE LIQUID FREE SURFACE IN THE SPACECRAFT TANKS (p. 30-34)

Krystyna Gorielova

Studying the free surface behavior in various flight conditions of spacecraft (SC) is one of the most important tasks of innertank hydrodynamics and the dynamics of this surface allows determining the nature of fuel reorientation.

Fluid motion in rectangular-shaped SC tank under constant horizontal disturbing force is considered in the paper. In case of translational acceleration of tank there are no studies on the motion nature of free surface of fluid. In the paper such tasks are proposed to solve by dividing the potential of fluid speed by the relative component of speed potential relative to tank and its walls. This provision is the basis for analytical researches. The paper also gives the adaption of the proposed model to existing conditions and results of numerical calculations.

This paper gives an algorithm for calculating the profile of free surface of liquid for flat tanks depending on the values of relative loading under a uniformly accelerated motion of tank with acceleration at various points of time. It was found that for approximate estimation, the value of tank bottom baring can be determined by constructing the points of intersection of free surface profile with a profile of the tank bottom.

Keywords: spacecraft, fuel tank, free surface of liquid, speed potential.

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DETERMINATION OF TRAJECTORIES OF POLYDISPERSE HETEROGENEOUS FLOW COMPONENTS (p. 34-37)

Ludmila Knaub

The paper presents a mathematical model which describes stationary processes of the interaction between polydisperse heterogeneous and incident flows, taking place in vortex units for mixing and separation. For determining the changes of gas-dynamic functions and geometrical sizes of separators, refrigerators and evaporators-mixers it is necessary to have differential constraints of changes in energy levels of heterogeneous flows in interaction with a single-component incident flow with specified amplitude-frequency characteristics. Therefore, the kinematic parameters of components, controlled at the input by reactor, which forms a free vortex and the magnitude of boundary layer, were proposed to introduce into the mathematical model, describing the vortex processes. The model allows determining the velocity and position of components of polydisperse heterogeneous mixture that allows calculating the path length and defining the trajectory of a single particle, as well as the parameters of the pulsator of additional perturbations for creating amplitude-frequency oscillations in order to improve the process of mixture separation into the desired number of fractions.

Keywords: polydisperse heterogeneous flow, thermogas dynamic process, vortex unit, components.

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THREE-PASS TURBOJET ENGINE (p. 38-41)

Yuriy Tereshchenko, Ekaterina Doroshenko, Ivan Lastivka

The main tendency of constructing promising engines and their units is using non-conventional schematic and constructive solutions, creating new materials, developing and implementing effective calculation software packages, improving the integration of power

plant with aircraft, creating advanced measurement, informational and control systems and equipment.

The paper gives a scheme of a three-flow turbojet engine with turbofan attachment. The calculation of efficiency factor of pure, double-flow and three-flow turbojet engines is given. Based on the calculation, the economy analysis of these types of engines was made. Specific fuel consumption of three-flow engine at subsonic flight speeds (up to 300 m/s) is less than specific fuel consumption of turbojet engine and double-flow turbojet engine due to higher values of overall propulsive efficiency.

Keywords: three-flow engine, overall efficiency, specific fuel consumption

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PRESSURE LOSS AT UNSTEADY MOTION OF INCOMPRESSIBLE FLUID IN THE PIPELINE (p. 41-44)

Oleg Jahno, Roman Gnativ

The analysis of available literature data on unsteady motion of fluid was made. It was shown that the velocity distribution at unsteady motion does not correspond to the velocity distribution peculiar to steady motion. According to the literature data, the change of velocity distribution in pressure pipelines during unsteady motion is little studied experimentally. The irregularity of velocity distribution on the effective cross-section is not taken into account during the determination of inertial pressure in the used calculation methods. When analyzing the experimental data it was revealed that at the present level of practical hydrodynamics necessary information about the flow structure can be obtained by the flow visualization with simultaneous measurement of velocity fields and turbulence characteristics. Based on the experimental and theoretical studies an improved method was suggested for determining the pressure loss at unsteady motion of incompressible fluid in pipelines.

Keywords: unsteady, non-stationary, fluid motion, velocity distribution, flow structure, pressure loss, inertial pressure.

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GYRO ERRORS CONDITIONED BY DEVELOPING PITCHING MOTION OF FUSELAGE DURING FLIGHT OPERATIONS (p. 45-47)

Volodimir Karachun, Viktorij Mel'nick, Vladislav Shibetskii

Numerical analysis of the error of a single-degree-of-freedom gyro sensor of angular velocity of the DUSU2 type with liquid-static suspension in conditions of asynchronous structure of the angular movement of fuselage in acoustic flying fields was made. It aims at studying the influence of developing aircraft pitching motion on the error of single-degree-of-freedom differentiating gyro.

The study of this phenomenon is based on the change of absolutely firm float suspension surface to the impedance one, arising during flight operations, that inevitably causes the elastic stress state and Euler inertia forces, forming the error structure.

For the most typical frequency values of kinematic perturbations, systematic components of the instrument errors and their resonance values, were identified, bearing the greatest practical interest and caused by the selectivity effect of kinematic perturbations of the corresponding forms of acoustic vibration from the suspension surface.

The results can be applied during recording flight-navigation equipment of various aircrafts and ground based aids.

There is a need of solving the problems of creating acoustic comfort of airborne equipment using passive methods or circuit designs.

Keywords: floated gyro, asynchronous pitching motion, systematic error, three-component pitching motion.

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HYDROIMPULSIVE LIQUID JET: THEORY AND DATA FLOW IS DISPERSED (p. 48-54)

Volodymyr Babenko, Andriy Kremena

The results of the research of a hydraulic stream, dispersion of which is carried out by the generation of pulsations of pressure in a stream outflowing from the sprinkler (hydroimpulsive liquid jet) are presented. On the basis of phenomenological analysis of the data of high-speed photography of the liquid jet, we pick out the elementary constituents of the process of dispersion including:

- forming the sequence of identical portions of liquid, consisting of high-speed and low-speed liquid jets;

- their non-elastic collision, attended with transformation of the portion in a structure consisting of a drop and remaining area of low-speed stream, which are crushed in the gas stream flowing them around, forming a total torch.

The mathematical model of dispersion taking into account the features of physical picture of the process has been developed, the formulae linking dispersion characteristics, form of torch and jet range with frequency and amplitude of the pressure pulsations generated in a stream have been obtained. The conducted experiments have shown good coincidence of their results with the design data. The results obtained can find wide application for creation of thermal screens, suppression and disinfection of harmful blowouts, fire extinguishing and so on.

Keywords: hydroimpulsive liquid jet, model of dispersion, form of torch, range.

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ENGINEERING METHOD OF CALCULATION OF KINEMATIC PARAMETERS OF PNEUMATIC IMPACT UNIT WITH BUILT-IN TANK (p. 54-58)

Yurij Atamanov, Gennadyj Krytikov, Maryana Strizhak

The method of engineering calculation of impact parameters (maximum speed and coordinates of its realization) of high-speed pneumatic unit with built-in tank is set forth in the paper. The method is based on the method of nonlinear mathematical model rationing with minimum number of dynamic similarity criteria. A number of assumptions allowed obtaining the solutions of differential equations in a dimensionless form as an analytical dependence of maximum value of impact velocity of the piston coordinate, in which the velocity is realized, on dynamic similarity criteria of pneumatic unit. Based on this, the diagrams of velocity and coordinate dependence on the similarity criteria were developed, which cover the whole domain of existence of pneumatic impact units with built-in tank and allow calculations without using a PC. An example of calculation is given.

Keywords: method of engineering calculation, kinematic parameters, pneumatic impact unit with built-in tank.

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INCREASE OF RELIABILITY OF V-BELT TRANSMISSIONS OF MECHANICAL PRESSES (p. 59-62)

Alexander Yavtushenko, Anna Yavtushenko

The problem of increasing the durability of V-belt transmissions of mechanical presses is considered in the paper. The issue of determining the factors that influence durability and ways of its improvement is set. Based on fatigue strength provisions it was found that transmission durability is determined primarily by the largest stress

value in transmission sides and the number of belt runs. The major way of increasing the durability is ensuring the minimum initial tension, sufficient for design load transmission, and its systematic control. Durability of belts is improved by increasing transmission ratio, reducing the number of runs, increasing spacing on centers. Durability of drive as a whole is determined by reliability of separate belts, their quantity and condition of drive failure as a system. Increasing the number of transmission belts improves durability of transmission as a whole only with the use of hot standby. The research results can be used in designing belt transmissions of other technological and transport machines for increasing their performance standards.

Keywords: press, transmission, belts, reliability, failure, stress, pull factor, number of cycles, reservation, completeness.

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