

#### ENGINEERING GEOMETRY and COMPUTER GRAPHICS

**A. A. Lyashkov**

Geometric and computer modeling of the main objects for shaping of technical products

There is considered geometrical and computer modeling of the main objects for forming products: envelope, enveloping and removable layers based on the joint methodology. There is carried out a study of discriminants of two-dimensional surfaces and three-dimensional hypersurfaces. The obtained results determine the envelope and enveloping families of lines and surfaces from a single viewpoint of analytical and numerical methods, respectively. This methodology is developed for performing 3D modeling by means of CAD, both enveloping and removing layers. There are developed surface models of families of lines after their display in the space. These models are used to analyze the effect on the shape of the envelope of the shape parameters of the forming line, as well as the setting of the product relative to the tool.

**Keywords:** geometric and computer modeling, objects of shaping, envelope, enveloping, cut-off layers.

#### MECHANICS

**P. D. Balakin, V. E. Konovalov**

Auto-tensioning in frictional contact of adaptive drives of machines

On the basis of the principle of designing of mechanical systems investment of systems with property of adaptation to actual parameters and the mode of operation, energetically modern mechanical system constructed on the basis of friction gear with an autosteered tightness that allows to keep value of mechanical efficiency adequate to the transformed power stream in the conditions of multimode operation is offered.

It is reached due to the drive of a chain of steering which is built in the main link which functions on the basis of laws of mechanics due to energy of the main power stream, adequately autochanging the kinematic size of a link and, therefore, tightness size in frictional contact piece.

The given ratios of forces and deformations in a chain of steering are necessary at a stage of outline design for determination of the design sizes of elements of a mechanical drive gear with new properties.

**Keywords:** mechanical drive gear, adaptation, steering chain, additional movement, autochangeable tightness.

**P. D. Balakin, V. E. Konovalov, A. V. Krivtsov**

Compensatory couplings of heavy machine aggregates

Units of real mechanical systems have linear and angular errors of mutual arrangement. The harmful effect of these errors is weakened by the use of compensating couplings. Analysis of the construction and properties of couplings for switching heavy units of high-energy machines revealed the advantages of gear clutches. An engineering analysis of the work of the gear couplings is performed.

**Keywords:** linear and angular misalignments, compensatory coupling, engineering analysis.

**Yu. A. Burian, A. V. Zubarev, D. V. Sitnikov**

Emitted vibrational power in an oscillating system with an electrodynamic compensator

The problems of measuring the emitted vibration in the active dynamic vibration damper are considered in the paper. The principle of action of the active dynamic vibration damper (electrodynamic compensator of vibration forces) is that with the reciprocating motion of the mass, the inertial force is created to compensate the vibration force at the given frequency. Principal schemes, equations of motion, transfer functions and estimates of radiated power are given.

**Keywords:** vibration isolation, electrodynamic compensator, control system, vibration power.

#### AVIATION AND ROCKET-SPACE ENGINEERING

**V. I. Trushlyakov, V. Yu. Kudentsov, A. K. Buryak, D. D. Matyushin**

Influence of surfactants on formation of droplets of liquid from the surface of film during kerosene vaporization in tank launcher

The method of increasing the efficiency of evaporation of kerosene based on convective heat transfer in closed volumes and the introduction of a surfactant is developed. The method is relevant for many technological processes including: production of the launch vehicle (LV) with liquid rocket engines (LRE) in the shops of the manufacturer (drying fuel tanks after a technological operations associated with filling their technological fluids for washing, calibration, hydraulic testing, etc.); operation of the LV after shutting off of the LRE to ensure explosion safety of fuel tanks, extraction of unused energy resources in liquid fuel residues in LV tanks.

The results of an experimental study of the effect of surfactants on the thermophysical parameters of liquid kerosene on the determination of the coefficient of surface tension, viscosity with allowance for the introduced surfactants for various degrees of concentration are presented. It is recommended for surfactants based on polydimethylsiloxane for its possible use as an additive in kerosene.

There are obtained experimental data on the effect of a surfactant based on polydimethylsiloxane on the surface tension of kerosene with various mass concentrations of surfactants.

The application of surfactants to cryogenic fuels (for example, to liquid oxygen) is difficult, in view of the absence of surfactants active at such low temperatures.

Theoretical estimates of the effect of surfactants on the intensity of droplet entrainment from a free surface are considered. It has been established that the introduction of a surfactant with a mass content of 0,2 % reduces the critical droplet breakdown rate by 18–22 %.

**Keywords:** evaporation, liquid residues of kerosene, fuel tank of the launch vehicle, surfactants.

#### MATERIALS SCIENCE

**E. N. Eremin, A. S. Losev, S. A. Borodikhin, Yu. O. Philippov, I. A. Ponomarev, A. E. Matalasova**

The effect of heat treatment on the structure and characteristics of coatings based on martensitic chromium steel obtained by surfacing with flux cored wire

This study explores the effect of heat treatment regimes on the structure and characteristics of a metal deposited by a high-chromium martensitic flux-cored wire type 20Kh15. It has shown that tempering at 800 °C ensures the metal hardness to acceptable values for machining. This happens

due to the structural components breakdown and the low values of the matrix and the strengthening phases microhardness. It is established that hardening with a temperature of 1020 °C is functional to increase the hardness of the metal after tempering with subsequent machining. The hardness of such a metal practically coincides with the hardness of the metal after surfacing. It has shown that this is due to the formation of a martensitic-ferritic structure strengthened by precipitates of  $\delta$ -ferrite,  $\sigma$ -phase and chromium carbides. The proposed heat treatment modes can be used in the wear resistant surfacing technology of parts of chemical and oil-and-gas machine building.

**Keywords:** surfacing, flux-cored wire, chromium steel, heat treatment, martensite, hardness, structure.

**D. A. Negrov, O. Yu. Burgonova, K. N. Pantyukhova, V. Yu. Putintsev**

Influence of impurities on structure and reliability of gear-type pump operation

The paper concerns the definition of the various defects in the gears of the pump, which lead to increase of gaps in the pump increasing the internal losses of the working fluid, reducing performance. The text gives a detailed account of spectral analysis of the chemical composition and toughness. It investigates the microstructure, the measured hardness and micro hardness of samples. In conclusion the authors made conclusions on the results obtained, and the chemical composition of the studied samples.

**Keywords:** gear pump, structure steel, heat treatment, effect of impurities, cementation.

**D. A. Negrov, E. N. Eremin, P. M. Korusenko, S. N. Nesov**

Effect of ultrasonic activation on the structure formation of polytetrafluoroethylene modified with boron nitride

Work is devoted to detection of patterns of influence of ultrasonic power impact on structural features of synthesizable polymeric composition material on the basis of the modified polytetrafluoroethylene modified by boron nitride and its operational properties.

It is established that joint influence of ultrasonic influence and particles of filler leads to increase in degree of crystallinity and the size of blocks in structure of a crystal phase. Researches of element structure and chemical condition of atoms indicate improvement of structure of the fluoroplast created with participation of nitride boron, which, suppresses education – C–H<sub>x</sub> of communications and defective conditions of carbon (C-C) that causes increase in mobility of molecular chains of a polymeric matrix in a thin surface layer and leads to reduction in the rate of wear by 17 %, and a friction coefficient by 13,7 % .

**Keywords:** boron nitride, ultrasonic vibrations, politetraftoretillen, polymeric composition material, structure.