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SUMMARY and KEYWORDS

MECHANICAL AND THEORETICAL ENGINEERING

E. V. Artamonov, V. V. Voronin, T. E. Pomigalova
Research of vibrations of vertical component of cutting force during turning

A method for localizing bands of vertical component of the cutting force in time spectrum during metal turning has been established. The method for determining the source of spectral components is based on the windowed Fourier transform. The powers of the spectral components of vibration signals at different cutting speeds in especially sensitive frequency ranges are compared.

Keywords: vibration, metal cutting, turning, Fourier transform, cutting force.

V. A. Ilyinykh
The effect of lubricants with mineral additives on friction in supports of spindle assemblies

Currently, the task of increasing the reliability and wear resistance of mechanisms and machines is being solved on the basis of the use of new composite materials. The most effective method of obtaining composite materials is the use of geological activators, which are introduced into the friction zone of the components of mechanisms and machines through a lubrication system, which allows increasing the micro-moisture of the friction surfaces up to 2,3 times, as well as reducing friction in sliding and rolling bearings. According to the research results, it is found that the use of repair and restoration technologies in friction pairs leads to energy savings of 10–20 %, an increase in wear resistance by 2,5 times, an increase in the resource of lubricants by 2,5–5 times, a significant reduction in vibration noise, as well as an increase in the inter-repair resource by at least 2 times and a reduction in operating costs. However, for the widespread introduction of these technologies, additional studies are needed, which are given in this paper.

Keywords: spindle assembly, rolling supports, sliding supports, repair and restoration composition (RVS), friction coefficients, rolling coefficients.

I. Yu. Lesnyak, Z. N. Sokolovskiy, S. V. Gavrilenko
The analysis of structural fatigue under cyclic temperature loads

A problem has been identified related to deformations of aircraft structures operating in the extreme north and orbital objects in near-earth orbits under conditions of cyclic alternating temperature loads. The formulation of the problem of studying the deformations of materials of structures operating under conditions of cyclic alternating temperature loads using the theories of cyclic strength, low-cycle fatigue and crack resistance is presented. It is assumed that at 16 revolutions of an orbital object around the Earth (the number of temperature loading cycles $n \geq 1{,}2 \cdot 10^5$), cracking occurs or the size of existing cracks increases to a critical size from low-cycle fatigue. Linear deformations of the body material of the International Space Station are determined, taking into account heating from solar radiation and cooling, while in the shadow of the Earth. A hypothesis has been put forward that, under conditions of cyclic temperature loads, the maximum effect on the material endurance is exerted by the calculated ones: the amplitude of the stress cycle, the maximum stress of the cycle and the range of stress fluctuations in the cycle, both separately and jointly. Comparative analysis of the results of calculating the stresses under cyclic temperature loading according to 3 hypotheses showed that the values of the calculated stresses are the closest to the maximum cycle stress or to the cycle stress amplitude.

Keywords: endurance, temperature cycle, deformations, cracks, low-cycle fatigue.

D. A. Blokhin, Yu. A. Blokhina, M. M. Lakman
Mapping positional accuracy for milling machine table

The article presents a technique for compiling a map of the positional accuracy of the table of a vertical milling machine when a vibration load of various frequencies is applied. A laboratory setup for creating forced oscillations of a cross table has been developed and manufactured. The reasons for the emergence of the highest deviations in specific areas of the working area of the machine tool are analyzed.

Keywords: machining centers, processing accuracy, rigidity of the machine tool system, vibration resistance.

ELECTRICAL ENGINEERING

D. A. Polyakov, N. A. Tereshchenko, K. I. Nikitin
Research of partial discharge characteristics features in bushings

The paper is devoted to partial discharge measurement and analysis in switchgear bushings. PD bushing structure analysis is described to assess possible defect sources in bushings. An experimental 10 kV bushing sample with the natural defect is obtained from the bushings' manufacturer. It is tested using the PD measurement technique. Test results showed significant PD intensity at voltages from 12 kV and higher. We have an assumption that a part of registered discharges occurred in the air close to the high voltage electrode sharp edges. To check this assumption we grind them off and repeated the test. The second test does not show considerable PD characteristics change. Therefore, we assume that the bushing sample has an inner defect because the bushing's surface is not contaminated to generate surficial discharges. The bushing is researched by a destroying method for defect localization. However, inside the bushing, possible defect locations are not found. It might be connected with the fact that the defect could not be found visually at the test time or the defect is located in the gasket between the high voltage electrode and insulator's body. Besides, there are determined features of phase-resolved partial discharge patterns in switchgear bushings.

Keywords: partial discharges, bushing, switchgear bushing, diagnostics, condition monitoring.

I. V. Komarov, D. A. Polyakov, K. I. Nikitin
Partial discharges characteristics study in XLPE cable insulation with multiple defects

The paper simulates the electric field intensity picture in the cable with one and several defects. Modeling has shown that the presence of several closely spaced defects does not lead to an increase in the electric field intensity in comparison with one defect. On the basis of experimental studies, an analysis of defects' number influence on various parameters of partial discharges (PD) is performed. Artificial defects are created in the area of the XLPE-insulated cable termination. The following parameters of PD are measured: the magnitude of the apparent charge, the power (intensity) of partial discharges, the phase-resolved partial discharge (PRPD) patterns, the shape of PD signals. The analysis shows an increase in the number of defects does not affect the characteristics of partial discharges, despitethe fact the defects are located in different sections of the cable with distributed parameters. Thus, it can be difficult to quantify defects during cable partial discharge measurements.

Keywords: insulation breakdown, insulation defect, partial discharge, multiplies defects, insulation diagnostic.

I. Yu. Kholodilin, A. V. Korzhov, M. A. Grigoriev, Yu. I. Khokhlov, N. V. Savosteenko
Highly efficient electric drive with vision system for traction applications in heavy tracked vehicles

A new type of electric motor as a traction drive DET-400 based on a field regulated reluctance machine (FRRM) provides high energy efficiency and high specific torque. A comparison is made between FRRM and various types of traction electric drives. The issues of designing the FRRM are considered, the geometric parameters of the electric machine are optimized to achieve the maximum specific indicators. To expand the functionality and ensure operational safety, it is proposed to

introduce computer vision into the electronic control system. As a result, the FRRM is designed for traction applications based on the real requirements of a Russian-made crawler tractor.

Keywords: traction electric drive field regulated reluctance machine, electromechanical transmission, intelligent electric drive, computer vision.

INSTRUMENT ENGINEERING, METROLOGY AND INFORMATION MEASURING EQUIPMENT AND SYSTEMS

D. A. Ivanov, T. G. Galieva, A. V. Golenishchev-Kutuzov, M. F. Sadykov, R. I. Kalimullin, A. V. Semennikov

Detection acoustic signals of partial discharges on defects in high voltage insulation

The article is devoted to the method of acoustic registration of partial discharges in high-voltage insulators. Physical processes of generation of various types of partial discharges in high-voltage insulators are considered. The instrumental implementation and method of processing diagnostic information from sensitive elements — acoustic receivers of the ultrasonic range are described. The ability to detect sources of partial discharges with reference to the place of origin is important for localizing a faulty element and its further diagnosis.

Keywords: high-voltage insulators, partial discharges, defects, acoustic sensors, monitoring diagnostics, technical condition.

E. V. Leun, V. K. Sysoev, A. E. Shakhanov, Yu. N. Mishin

Features of modern circuitry of strain-resistive pressure sensors: fiber-optic pyrometric thermal compensation, optical radiation supply

The article discusses the issues of improving strain- resistive pressure sensors (PS) for their joint use with modern achievements of fiber optics (FO). The possibilities of implementation and features of FO pyrometric compensation of the temperature error of semiconductor and resistive strain-resistor, optical and/or electrical heating of the strain gage for self- calibration of the pyrometer, power supply by optical radiation transmitted through a light guide with galvanic isolation of the PS circuit, increased noise reduction and fire and explosion safety are considered. Noise properties of semiconductor and resistive strain- resistor are also considered.

Keywords: strain-resistor, samarium sulfide, pyrometer, chalcogenide light guide, optical radiation supply, fire and explosion safety, phase-digital conversion.