



# MECHANICAL ENGINEERING AND MACHINE BUILDING

## ANALYSIS OF TRIBOTECHNICAL CHARACTERISTICS OF SELF-FLUXING COATING UNDER ROLLING AND SLIDING AT NON-STATIONARY LOADING

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This article discusses the possibility of self-fluxing nickel-based alloy for the friction pairs operating under rolling with sliding. The aim of research was to determine the kinetics of changes in the physical and mechanical, anti-wear and anti-friction properties of the sprayed coating of self-fluxing powder PG-AN9 among transmission oil. The method of assessment of tribotechnical properties of the coating is proposed in the start-up mode at step increase in load to the appearance of the first signs of the setting of the contact surfaces. It was established an increase of the normal operation period in sprayed coatings at 5,42 times for the coating thickness increases to 1,2 mm due to effective lubricating effect, low friction coefficient, reducing the specific friction work and reducing the degree of surface coating layers plasticizing by the lubricant components. The results can be used by specialists in the field of repairing and rebuilding worn parts of machines and mechanisms.

**Keywords:** self-fluxing coatings, wear, anti-friction properties, micro-hardness, non-stationary loading.

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## ANALYSIS OF THE ELECTRICALLY DRIVEN GAS PUMPING UNITS APPLICATION ADVANTAGES

page 9–12

This article discusses the impact of operational, environmental and economic factors on the drive choice to equip the gas pumping units. The main aim of this study is to analyze the factors influencing the choice of drive type, show the advantages of EDGPU, to determine the necessary conditions for their application. Comparison of frequency-controlled, hydrodynamic and mechatronic electric driven units with turbine driven is done based on the indicators of availability and the ability to implement different load regimes, efficiency, technological readiness and service life of equipment, ease of placement and need for production areas, requirements to energy supply and quality of gas quality, impact on the environment. Analysis on the basis of economic criteria includes consideration of the required investment costs, operating costs, including the costs of maintenance and repairs, the life cycle cost. Research results can be used for design of new and modernization of existing compressor stations of main gas pipelines, as well as the choice of technological compressors in various industries.

**Keywords:** gas turbine, electric motor, compressor, variable drive, operational, environmental and economic factors.

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## PRESSURE INCREASING DEGREE CALCULATION OF AIR-JET ENGINE'S AXIAL COMPRESSORS

page 13–18

It is well-known, that all the fundamental foundations of the modern theory of air-jet engines (AJE) are in full wrong, that generated wrong opinion that in zone H-B<sub>2</sub> turbine (engine) energy is not supplied to the gas flow and gas flow pressure up to maximum Π<sub>k</sub> in zone B<sub>2</sub>-K is provided only with diffuser (widen) canals between working wheel (WW) blades of low, middle and high pressure compressors (LPC, MPC, HPC) with providing turbine (engine) external work to LPC, MPC, HPC from the back. this in full wrong opinion, which exists during the last 86 years, is simply explained that in LPC, MPC, HPC diffuser (widen) canals are in full not exist because in these compressors only confusor (narrow) canal are existing. In zone H-B<sub>2</sub> turbine (engine) provides it's energy to the gas flow for widening (vacuum) and acceleration to receive calculated kinetic energy in the cross section B<sub>2</sub>-B<sub>2</sub>. In zone of the gas flow pressure B<sub>2</sub>-K the part of gas flow kinetic energy, which is stored in zone H-B<sub>2</sub>,

which is an external work, which turbine (engine) provides to compressors front the face, is generated into potential pressure energy by means gas flow axial speed decrease from step to step while gas flow braking is provided by pressure leaps, which are generated only on the backs of the blades of WW, and forehead resistant of the last. flow braking generates inertial force, which is directed by the flow and pressure the gas flow to maximum  $\Pi_k^*$ , while that static pressure of gas flow on the backs of the blowing profile blades is much more than the same on trough of the blades, which creates an additional revolve moment for rotor kinetic energy LPC, MPC, HPC keeping.

**Keywords:** kinetic and potential energy, inertial force, axial compressor.

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**MAIN ENGINE POWER CONTROL TAKING INTO ACCOUNT HYDROMETEOROLOGICAL CONDITIONS**

page 18–21

The problem of optimal control of the main engine load on the basis of the account of hydrometeorological navigation conditions is studied in order to minimize fuel and energy resources and the voyage providing for a scheduled time using the electric machine running on one propeller shaft with the main engine. The urgency of this problem is that when the weather conditions have any change there is load change on the engine. Researches show that the wind force affects the ship's power engine is already at 5 on the Beaufort scale. Therefore, the proposed concept of diesel-powership creates possibility to ensure the necessary operational control of the ship's power engine in storm situations. This concept provides the required reliability and safety for ships, which are often subject to changes in weather conditions.

**Keywords:** main engine, hydrometeorological conditions, propulsion unit, energy resources, electric machine.

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**ENERGY, ENERGY-SAVING TECHNOLOGIES AND EQUIPMENT**

**IMPLEMENTATION GROUNDING OF CONSUMER-REGULATOR TO CONTROL ELECTRIC LOADS IN THE POWER SUPPLY SYSTEMS**

page 22–26

This article discusses the use of combined heat power generation system by the automated electric heating units (customers, regulators) and the results of research. The main aim of this study is a feasibility study for the introduction of the automated control systems of electric load in electrical and heating systems of administrative buildings. The use of electrical accumulative heating systems, which are the consumers- regulators, enables alignment of the energy load curve in the power supply system for administrative buildings. In this article, we defined the technical and economic effect of the introduction of energy-efficient combined heat supply system with the accumulation of heat and three-band metering based on the auto-

mated transformer type unit for electric heating. Presented power supply system with built-in automated electric load control units can improve the energy efficiency of modes of distribution networks of power supply systems of administrative buildings. The evaluation of the overall effect of the alignment of the electric power system load curve gives an answer about the economic feasibility of the introduction of combined heating systems. The research results can be used in the design and development of electrical and heating systems of administrative buildings to control the selected load.

**Keywords:** consumer-regulator, electric load curve, energy efficiency, power supply system, cost of electricity, heating.

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## THE RESEARCH OF THE PROCESSES OF CAVITATION ENERGY USE FOR SOLVING HEAT ENGINEERING, ECOLOGICAL AND TECHNOLOGICAL PROBLEMS

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The results of the research of processes while using cavitation in heating systems, water purification and circuit-breaker oil reprocessing are discussed in the article. In the process of different original types of heat medium cavitation, i. e. water, mechanic glycerin, PDMS commixtures, characteristics of thermal effectiveness before and after cavitation are determined. The proposed methodology allows using the results of efficient cavitation while heating, water purification and oils reprocessing. Cavitation can be efficiently used not only in housing and utilities infrastructure, agriculture, energetics, food industry but also in lacquer, ready-mix paint, paper, biomass fuel manufacturing. In the article the authors propose to use the developed cavitation devices in the most fields of production, agriculture, housing infrastructure, whereas the need of energy saving, i. e. electric power, is sufficient. The results of author's research can be used by power engineers of industrial enterprises, glasshouse industry, farms, fish hatcheries, purification plants, water conditioning, oily water disposal systems.

**Keywords:** cavitation, pressure, whirlwind, rotation, purification, oil reprocessing, efficiency.

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# ELECTRICAL ENGINEERING AND INDUSTRIAL ELECTRONICS

## THE IMPACT OF SECTIONALIZATION OF DISTRIBUTION NETWORKS WITH THE VOLTAGE 6–10 kV BY AUTOMATIC DISCONNECTORS ON INTEGRAL INDEXES OF RELIABILITY

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The impact on integral indexes of reliability SAIDI, SAIFI and ENS of the method of sectionalization of distribution networks with the voltage 6–10 kV using an automatic disconnectors which pro-

posed in the works [2–4] has been researched in this work. The formulas for the definition forward-looking indexes of reliability were received based on assumptions which were adopted in this work. The indexes of reliability SAIDI, SAIFI and ENS for the standard models of transmission lines has been calculated using received formulas.

The impact of the use one or two automatic disconnectors in the distribution networks with the voltage 6–10 kV of any configuration without reserve, with manual and automatic reserve has been researched.



The results indicate reduction of indexes SAIDI, SAIFI and ENS, for the distribution networks with the voltage 6–10 kV:

- without reserve 10–30 %;
- with manual reserve 10–80 %;
- with automatic reserve 50–70 %.

Thus the automatic disconnectors can be used to improve integral indexes of reliability SAIDI, SAIFI and ENS of distribution networks with the voltage 6–10 kV.

**Keywords:** automatic disconnectors, sectionalization, indexes of reliability.

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**STUDY OF CIRCUIT NEGATRONS PROPERTIES, IMPLEMENTED ON OPERATIONAL AMPLIFIERS**

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The using of negative impedance circuits expands the set of basic electrical circuit components by three additional components: a negative resistor, a negative capacitor and a negative inductor, respectively, *R*-, *C*-, *L*-negatrons. The study of the properties and parameters of the circuit negatrons has been performed from the standpoint of theoretical foundations of classical Electrical Engineering: their definitions and component equations have been presented; also operation and reactions in alternating current circuits have been discussed.

The possibility of direct synthesis *R*-, *C*-, *L*-negatrons, which are based on operational amplifier with feedback circuits on both inputs, has been studied and the list of different negative impedance converters implementations has been presented with quantitative

evaluation of their parameters. Because of input signal's amplitude and frequency band effects on the negatron's working stability, the investigations of the permissible excitation signals deviations for negative impedance op-amp circuits were carried out and results were obtained in numerical expressions. The numerical values of the boundaries of the operating range of currents and voltages are determined by the value of electromotive force of op-amp supply, parameters of feedback elements and signal frequency excitation. Simulation results using MultiSim software have proved the validity of the considered limitations on the operating range of input signals and their frequency for different types of negative impedance circuits. Therefore obtained equations can be considered as compulsory initial relations for operational region analysis of specific op-amp negatrons and for creating recommendations about input signal values range.

**Keywords:** negative resistor, negative capacitor, negative inductor, negative impedance converter, negative impedance circuit.

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