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**SUMMARY and KEYWORDS**

## POWER AND CHEMICAL ENGINEERING

**I. P. Aistov, S. S. Busarov, I. S. Busarov, A. A. Kapelyukhovskaya, A. A. Galkova**
Analysis of influence of piston motion law on characteristics of working process of single-stage carbon dioxide compressor unit

The results presented in the work shows that the implementation of the carbon dioxide compression process in an oil-free low-speed stage of a reciprocating compressor with intensive external cooling can increase the refrigeration coefficient and improve the weight and size characteristics of the heat exchange and compressor equipment of vapor compression refrigeration machines. Therefore, the use of low-speed long-stroke compressor units in refrigeration units is a very promising direction of their development. In addition, the study of the issues of ensuring the required energy characteristics of single-stage compressor units with a linear hydraulic drive due to the synthesis of the linear hydraulic drive law, the piston of which is rigidly connected to the compressor stage piston using an example of such a refrigerant as CO2, will improve the parameters of the refrigeration machine and further reduce the overall dimensions of the compressor unit.

**Keywords:** refrigerants, the law of motion, linear hydraulic drive, low-speed long-stroke compressor unit, the working process of piston low-speed long-stroke stages, weight and size parameters.

**V. L. Yusha, S. S. Busarov**
Determination of polytropic indicators of schematized working processes of air piston slow-moving long-stroke compressor stages

Experimental studies of low-speed long-stroke compressor stages using the example of working fluid — air made it possible to determine such parameters of a schematized working process as polytropes of compression and reverse expansion. These parameters, firstly, can be used in engineering methods of calculation or first-level models, and secondly, they will make it possible to refine the existing methodology for calculating piston stages in terms of determining the volume factor. Based on the analysis, recommendations are given on determination of equivalent polytropes and polytropes of finite parameters. The values obtained are significantly different from those currently accepted for high-speed compressor circuits.

**Keywords:** low-speed long-stroke stage, polytropic indicator, experimental studies, schematization of the working process, indicator diagram.

**N. A. Raikovsky, V. L. Yusha, K. I. Kuznetsov, V. A. Korenev, V. S. Karpus**
Analysis of mechanical losses in the working chamber of rotary vane machines

The work is devoted to the analysis of reducing friction losses in rotary vane machines. It is established that the smallest friction loss is provided by lubricating the cylinder with water, while the values of the friction coefficient obtained by processing the results indicate the presence of the hydrodynamic lubrication regime. Unexpectedly large values of friction power losses are obtained when oil is used as a lubricant, which is primarily due to high hydromechanical losses, which, according to preliminary estimates, can reach 70 %. The analysis of the ratio «friction power/indicator power» in rotary vane compressor machines shows that the use of the water as a lubricant can significantly increase the speed of machines without a significant decrease in their energy characteristics. Increasing the speed of non-lubricated plate machines requires the search for new technical solutions and materials of friction units forming the working chamber.

**Keywords:** rotary vane compressor, mechanical friction, lubrication, non-lubricated working chamber, power.

**K. T. Ooi, P. Shakya**
A Simulation studies of a coupled vane compressor / trans. from Engl. M. A. Fedorova

In this paper, the mathematical models of the novel Coupled Vane compressor (CVC) is formulated to study its operational characteristics and to assess its performance. Coupled Vane compressor, as the name implied, has two vanes coupled together. The unique feature of the compressor is that a set of two vanes are coupled together and they cut through the rotor diametrically. Theoretically, any rotor size which can accommodate the vanes will work with this design. This design removes most of the geometrical constraints imposed on the size of the rotor, as what happened in most of the rotary compressors. The ability to accommodate a significantly small rotor in this new design, makes it substantially more compact which also indirectly reduces material wastage, cost of machining and fabrication. This new design is intended to be used in refrigeration, household cooling and heating applications.

**Keywords:** vane compressor, rotor, coupled vanes, geometric model, thermodynamic model, vane dynamics, operating process.
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**Y. S. Hu, H. J. Wei, J. Xu, P. Kwan, F. Wu, F. Y. Luo, L. P. Ren**
A Theoretical Study on the Novel Structure of Vane Compressor for High Efficiency / trans. from Engl. M. A. Fedorova

Aiming at the problem of excessive mechanical loss of the conventional vane compressor, this paper proposes a novel vane compressor structure. This compressor can significantly reduce the mechanical frictional loss through converting sliding friction between vane tip and cylinder into rolling friction by using a rolling bearing. The structure and operation principle are introduced in this paper, and mechanical friction loss calculation models of these two kinds of compressor are theoretically analyzed. The results show that mechanical loss of the novel vane compressor can be reduced by nearly 38 % under the same working conditions. At the same time, the actual tested results indicated that the total power consumption of compressor decreased 160,1 W (6,89 %), and the COP increased by 11,89 %.

**Keywords:** vane compressor, rotor, rolling bearing, mechanical loss, friction power calculation, experiment, results verification.
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## AVIATION AND ROCKET-SPACE ENGINEERING

**V. I. Trushlyakov, D. Ya. Davydovich**
Experimental research on the technology of manufacturing and burning of aircraft structures made of multicomponent materials

The analysis of the state of modern technologies for utilization of reinforced polymers is carried out. The task of the study was formulated. Based on thermodynamic analysis and consideration of various combinations of compositions for conducting experiments, six types of test multicomponent samples were selected for conducting experimental studies on their combustion. To determine the maximum combustion temperature, the ignition temperature of the samples, and the mass of combustion residues. The analysis of the results obtained was carried out, and the compositions of the components for further research were identified.

**Keywords:** combustion, plastics, energy materials, separated parts of aircraft and spacecraft.

**O. L. Prusova**
Methods of liquid evaporation on the basis of acoustic-vacuum and thermal influences (overview)

The basic effects and their combinations on evaporated liquid located on solid surface and in the form of a suspended droplet are analyzed. Methods of applying these effects for liquid evaporation under the

following boundary conditions of the liquid location: «drop», «film» are considered. The classification of one-, two-, and three-factor effects on the evaporated liquid is proposed. The direction of further research in the field of joint application of convective, conductive and vacuum influences on the dried object is formulated.

**Keywords:** liquid evaporation, drop, film, thermal and acoustic-vacuum effect, multi-factor influence, classification of effects on the evaporated liquid.

**V. I. Kuznetsov, V. V. Makarov, A. Yu. Shander, M. Yu. Agarin, I. A. Kuzmenko**
Energy exchange in vortex tube

The vortex tube operation is considered. The effect of separation of the peripheral and axial layers of gas at full temperature due to the exchange of work and heat between them is studied. The mechanism of kinetic energy transfer from the axis of the periphery is determined. The effect of viscosity forces and the gradient of angular velocities on the energy exchange in a vortex tube is verified. There is experimentally found dependence on the thermophysical properties of energy gas, a gas pressure value at the inlet of the vortex tube and exit valve and diaphragm geometric parameters of the main elements of the vortex tube. There is conducted research to identify the nature of the vortex effect — of the fibers of the gas temperature. The question of the development of the theory of real phenomena (Ranque effect) is considered. It is shown that the main work of the authors of this article can be regarded as the theory of the Ranque effect.

**Keywords:** energy domain, Rank effect, viscosity, gradient of angular velocities, mechanism of energy transfer from axis to periphery.