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Analysis of ratio influence of discharge and suction pressure on operating processes on hybrid power piston volumetric machines

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Abstract

The paper considers the prospective design of hybrid power piston volumetric machines through the use of gas pressure oscillations in the discharge line. Using the developed mathematical model, a numerical experiment of the effect of the ratio of discharge pressure and the suction pressure on the operating processes, power and loss characteristics of the hybrid power piston volumetric machines

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Keywords:compressor; operating processes; cooling; hybrid machine.

1. Introduction

Considered impact on the performance and efficiency of the compressor operation, as well as the conditions for its safe operation is due to cooling the compressed gas and the elements of the working chamber of the compressor. When gas is compressed in compressors of volumetric action temperature and pressure of compressed gas are substantially increased. Increasing the gas pressure increases the load acting on the working bodies of the compressor and distribution systems (valves). An increase in temperature leads to a deterioration in economic performance of the compressor.

Currently, to improve the efficiency of the piston compressors they combine their work and piston pumps work [1, 2]. This unit is named a hybrid piston power machine. These machines increased gas compression efficiency with improving the cooling of compressed gas, reducing leaks and reducing the work of friction forces. In addition the machine can be used in the petrochemical industry.

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2. Study subject

The authors of the papers [3] have proposed the design of the perspective piston power hybrid volumetric machine through the use of pressure fluctuations in the gas discharge line; its schematic diagram is shown in Fig. 1.

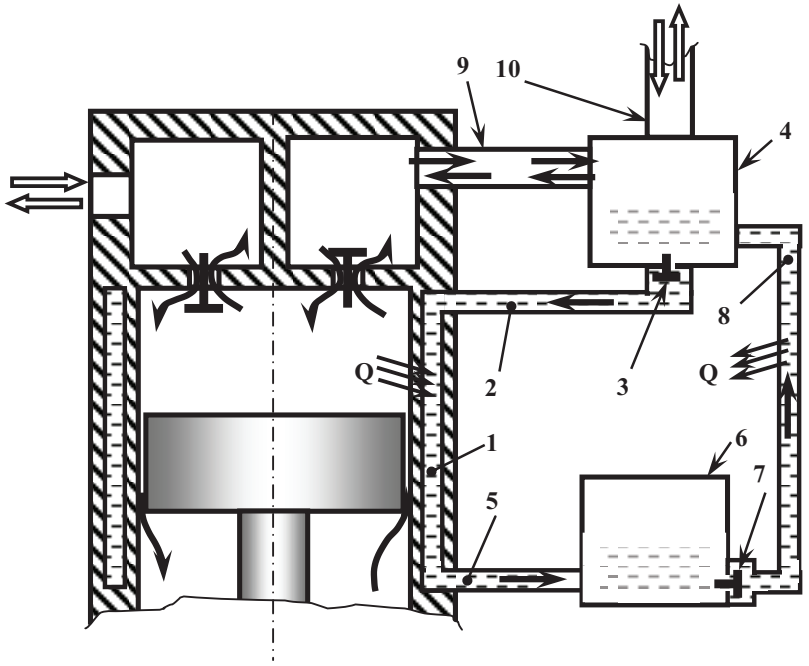

Fig. 1. Schematic diagram of a hybrid power piston machines using gas pressure fluctuations in the discharge line.

The operating principle of the illustrated construction is that compressed gas from the working chamber comes into discharge cavity through the discharge valve. From the discharge cavity the gas enters receiver 4 through pipeline 1. The lower part of receiver 4 is filled with liquid and the upper part is filled with gas. Pipeline 2 connects the lower part of receiver 4 through a check valve with jacket space 3 of the compressor cylinder. The lower part of the jacket space is connected to the pipeline and the lower part of receiver 6, which is also filled with liquid as well as the lower part of receiver 4. The upper part of receiver 6 is filled with gas. The lower part of receiver 6 is also connected through check valve and pipeline 8 with the lower part of receiver 4. From the upper part of receiver 4 the gas is supplied to the consumer through the regulating valve.

3. Methods

To solve effectively the problems in the development and study of the proposed design of the piston hybrid power machine on the basis of modern methods of mathematical stimulating of pump compressors operating processes [4,5] there was developed a mathematical model of piston hybrid power machine operating processes. The mathematical model of operating processes includes the calculation of thermodynamic parameters in the chambers of constant and variable volume, the calculation of non-stationary one-dimensional motion of gas in connecting pipeline 1, unsteady motion of fluid in the connecting pipelines. The mathematical model of operating processes is based on fundamental laws of conservation of mass, movement and energy, but also the ideal gas equation is used.