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Experimental research results of the slot seal constructed as hydrodiode for the hybrid power piston volumetric machine

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Abstract

The aim is to present the experimental studies results of the annular piston slot seal constructed in the hydrodiode form. This seal was considered in relation to the piston hybrid machine of volumetric operation. The paper describes the experimental test-bench, a node of load-registration and a hydrodiode node. The progress of the pilot studies has been described. Also some experimental results are presented in the paper. They allow to compare the numerical and field experiments findings and to conduct the slot seal initial geometry optimization, to make recommendations for the further design and construction of hybrid power piston volumetric machines

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Keywords: slot seal; hudrodiode; hybrid power piston volumetric machine; experimental studies

1. Introduction

The technology of modern chemical and petrochemical plants has implemented more and more processes that involve all kinds of gases and liquids compressed to significant pressure.

The extent of compressed gases and liquids usage at these plants is proved with the fact that their production consumes about 40% of capacity in the factory energy consumption overall balance.

Currently, the works associated with the development of hybrid power piston volumetric machines in our country are carried out quite intensively [1, 2]. The investigated machine is distinguished with the annular slot seal between the piston and the cylinder wall, made in the form of hydrodiode that improves cooling of the compressed

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gas and reduces works of friction forces. Annular gap seals largely affect on the working processes taking place in the working chambers of the hybrid machine piston.

2. Study subject

The study subject is an annular slot seal constructed as a hydrodiode having geometric parameters shown in Fig.1. As the geometric parameters of the work the following values were considered: h is height of the piston projections 3mm; δ_0 is the slot between the inner cylindrical surface and projections on the surface of the piston body 0.09 mm; α is an leading edge inclination angle of the projection 15°; β is the rear edge inclination angle of the projection 60°; L_1 is cylindrical surface length of the projection 4mm; L_2 is distance between the preceding projection and the beginning of a subsequent projection on the piston body 2mm; d_{pist} is piston diameter 89.85mm; L_{pist} is total length of the piston 129 mm.

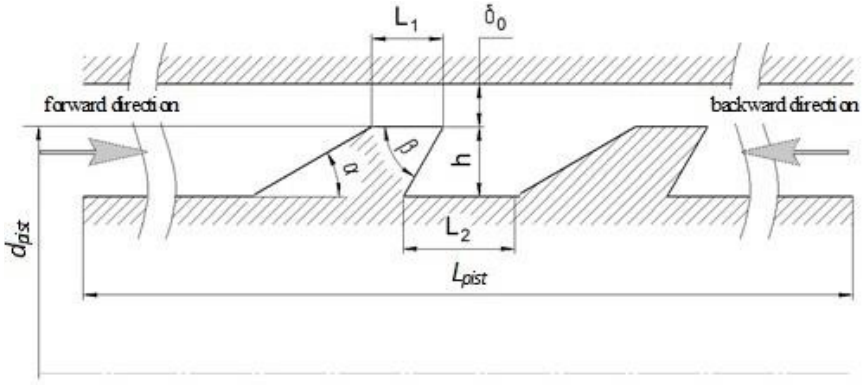

Fig. 1. Geometric parameters of the slot seal constructed as a hydrodiode.

The geometrical parameters of the piston annular slot seal of the piston hybrid power volumetric machine were obtained from preliminary calculations performed using the hydrodynamic package ANSYS CFX version 14.5.

For experimental studies a test bench has been designed and manufactured (Fig. 2) consisting of hydrodiode unit 1 and loading-registration node 2.