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Energy-Saving Shut-Off and Regulating Device

I.R. Chinyaev, A.V. Fominykh, S.A. Sukhov*

OOO NPF «MKT-ASDM», Kurgan, 640000, Russian Federation

Abstract

A reliable and safe operation of piping systems depends on the precision of parameter regulation of the conducting medium with a minimum energy expenditure. The authors analyzed the use of gate and wedge shut-off valves by operating organizations in the mode of regulation of parameters of working media. The unintended use of pipe fittings causes its rapid failure. The authors have developed, manufactured and tested shut-off and regulating devices that have broad capabilities in the implementation of the throughput characteristics and requiring to control a drive of a smaller capacity. When the device opens or closes the opening in the gate, a closed controlled valve acts as a bypass, as in the flow of a working medium through an orifice the pressure is aligned in the inlet and outlet nozzles. After pressure equalization (reducing pressure drop), the gate is unloaded and its lifting and lowering require less power, while for the shut-off and regulating device with the electric drive, the latter step requires with lower power consumption. On the basis of the energy created by slide gate valves saving shut-off and regulating device with a wide implementation in the throughput characteristics, methods of its calculation and experimental research and rational parameters are defined.

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Keywords: shut-off and regulating device; capacity characteristic; torque moment; energy saving.

1. Introduction

The majority of scientific research devoted to the process of regulating the flow of the conducting medium, aimed at improving the accuracy of controlling the flow of the conducting medium, the increase of service life of pipe fittings and reduce consumption of energy. The main advantages of the currently used locking slide and wedge gate valves – small resistance when fully open passage.

* Corresponding author. Tel.: +7-3522-65-50-30.
E-mail address: ooodok@bk.ru

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2. The relevance

The use of shut-off valves to control flow of the working media, not on purpose, does not provide the required control accuracy and leads to the destruction of parts of shutter. The problems of establishing the regularities of interaction of the conducting medium with a gate node for the purpose of determination of rational values of design parameters of the regulating device for in-creasing the accuracy of regulation of the service environment, prevent damage to parts in the entire stroke range of the regulating element and reduction of drive power are relevant.

3. Statement of the problem

On the basis of slide valves to create an energy saving shut-off and regulating device, which has broad capabilities in the implementation of the bandwidth characteristics, to develop methods of its calculation and experimental studies to determine the rational parameters.

4. The theoretical part

In the process of solving the tasks performed by the authors analysis of studies of cavitation processes [1-7], methods for determining the cavitation characteristics of pipeline valves [8-12]. Developed samples of pipe fittings with improved characteristics [13-17]. Performed calculation and experimental studies [18-21]. Production tests showed increasing the service life significantly [22]. Developed the design documentation and manufactured a prototype regulation device DN 150 PN 160 in accordance with the requirements of [23-27]. In accordance with GOST R 55508-2013 [8] defined the hydraulic characteristics of shut-off and regulating device DN50 PN160 in the laboratory of OOO NPF «MKT-ASDM».

Based on the Bernoulli equation the proposed method of calculation of hydraulic characteristics, including throughput performance, slide gate valves [18-21], the results of calculations are confirmed by experiment. The developed method of calculation of force on a rod of the proposed regulating device.

4.1. The proposed shut-off and regulating device

Based on the review and preliminary calculations is proposed shut-off and regulating device [1]. The invention relates to mechanical engineering, namely to the valve engineering, and can be used both as shut-off and as in regulating de-vice in technological pipelines for various purposes. The technical problem solved by the present invention is to improve the reliability of the device and reducing a driving power of pipe fittings.

In Fig. 1 shows a section shut-off and regulating device in the closed position of the slide gate and the damper; Fig. 2 a section along A-A in figure 1. Locking and regulating device comprises housing 1 with inlet 2 and outlet channel 3, in which the seat of valve 4, cooperating with the slide gate 5 in the recess 6 with the valve 7 connected to a control spindle 8. The valve 7 has a through hole 9, which coincides with the opening of the shut-off and regulating device with a through hole 10 in the plate 11 and through hole 12 in the slide gate 5.

The gate 5 is on one side or two sides provided with channels 13 in which the clamps 14 are installed, which interact with the recesses 15 made in the valve 7 and with notches 16 made on the guide surfaces for the slide gate 5 in the housing 1. The valve 7 is connected with a control actuator (not shown) of the spindle 8.

4.2. Work shut-off and regulating device in regulating mode

When lifting valve 7 with the aid of a spindle 8, the upper edge of the passage opening 9 is aligned with the lower edge of the passage opening 10 of the plate 11 and the holes 12 of the gate 5. Upon further movement of the valve 7 between the edge of the through hole is formed and begins flowing conducting medium. The differential pressure between the inlet 2 and an outlet 3 decreases. Depending on the shape of the through holes 9, 10 and 12 can be obtained any flow characteristic of the flow control environment across the stroke range of the valve 7. After a complete matching through holes 9, 10 and 12 with a further rise of the rod together with the valve 7 begins to move the gate 5, the entrance opening of the channel of the housing 1, connecting the inlet 2 and the outlet 3, until the