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STUDY OF AN ISOTHERMAL PRESSURE GOVERNOR OF GAS ON THE BASIS OF A VORTEX TUBE

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Decrease of reserves of propellant natural resources, constant rise in price of propellant resources in modern conditions the creations of know-hows, conserving energy, require not only at consumption, but also transfer of power resources. Most ecologically secure and widely used propellant is the gas distillate, heliport able on pipeline gas mainlines with stress up to 9,8 MPa at stress, demanded for the consumer, of gas distillate less than 1,2 MPa. It requires presence of devices of pressure control of gas on posts of allocation of gas, where throttle governors now are applied, basically.

Use of throttle governors carries on to drop of temperature of heliportable gas, originating of irreversible power losss, formation of a condensate, drop of temperature of equipment components in posts of allocation of gas, to formation of ice plugs (at presence of a moisture in gas) [1]. For prevention of formation of ice plugs and crystallohydrates it is necessary, that the relative humidity of gas was lower than 60 % at lowest of calculated temperatures of gas. Other solution of the given problem can be served by use of isothermal pressure control of gas for prevention of drop of temperature of gas at drop of stress.

Use in logistics systems by gas distillate for drop of stress of turbine controlling devices (turbines, pressure reducer valves) results in sharp decrease of temperature of gas during gas amplification, to complicating the schemas of regulation, to magnification of expenditures at servicing of machinery, to presence of rotating members. Advantage of such systems is the capability of padding development of electric energy at drop of stress of gas distillate [2,3].

The throttle and turbine governors require prewarming of gas (before drop of stress), that carries on to incineration from 0,08 up to 0,2 % of gas from throughput capacity of station of regulation [2,3].

In a fig. 1. the isothermal pressure governor of gas is introduced on the basis of a vortex tube, designed and investigated by the authors. The isothermal pressure governor of gas represents the thermostatic body with the vortex tube, contracted inside him, so, that the inlet elbow of a vortex tube communicates with a mainline of high pressure gas, and the "warmer" and "cold" yields of a vortex tube communicate with room of the thermostatic body [3]. The schema of the experimental installation on study of an isothermal pressure governor of gas is rotined in a fig. 2.

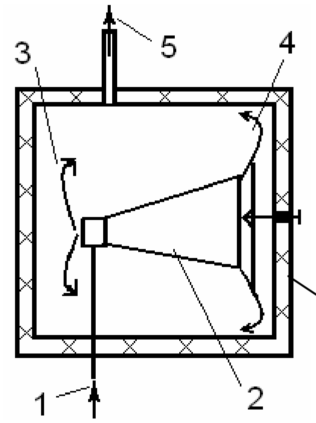

Fig. 1. An isothermal pressure governor: 1 - branch pipe of heat input of gas distillate it is high-pressure; 2 - vortex tube; 3 - "cold" gas stream; 4 - "warmer" gas stream; 5 - gas discharge of low pressure; 6 - thermostatic body

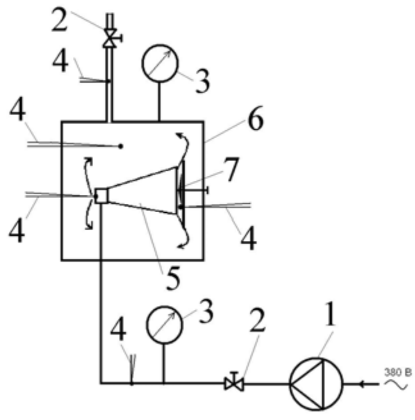

Fig. 2. The installation diagram on study of an isothermal pressure governor of gas: 1 - compressor; 2 - faucet; 3 - manometer exemplary; 4 - thermoelectric couple; 5 - vortex tube; 6 - thermostatic body; 7 - throttle of "warmer" stream

The study was conducted on compressed air. During experiment were metered: pressure and temperature of air on a going into the device, temperature of "cold" and "warmer" gas stream from a vortex tube, pressure and temperature of air on escaping of a governor, temperature of air inside the thermostatic body of a governor, pressure of an atmosphere, temperature of a cold junction. For measuring temperature the thermoelectric couples with definition of the indications on a digital millivoltmeter with scale interval 0,01 mV were used. The excessive pressure of air was metered by exemplary manometers of an absolute consistency 0,6.

The results of experimental study of an isothermal pressure governor of gas are rotined on a fig. 3.

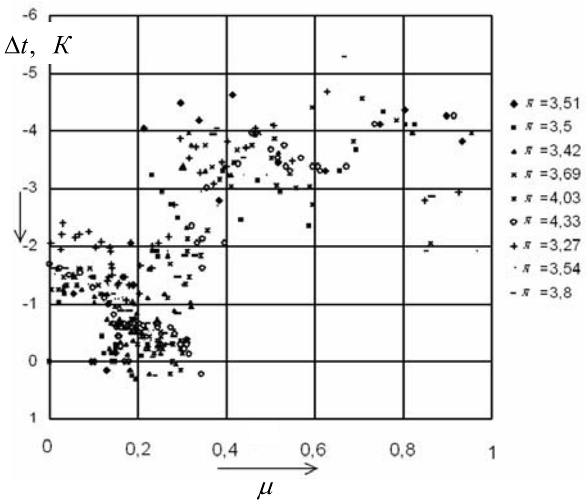

Fig. 3. Study of an isothermal pressure governor ($\Delta t = T_2 - T_1$ – decreasing of temperature of gas on escaping of the device, T_2, T_1 – temperature of gas on a yield and regulator inlet accordingly, K)

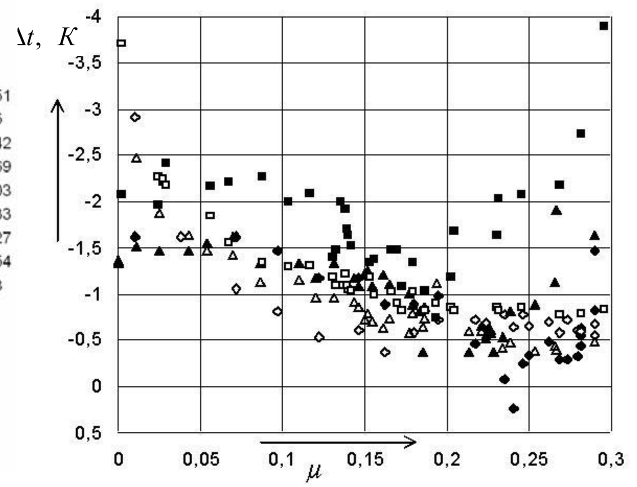

Fig. 4. Analysis of results of studies with pressure of gas on a yield of the device p_2=0,111 МПа, not painted over badges - under the formula (1), painted over - experiment: ■, □ – π = 3,27;▲, △ – π = 3,54; ♦, ◊ – π = 3,8

On the held studies (the fig. 3) is visible, that temperature of a working stream at drop of stress of gas is saved practically by constant with the relative consumption of a "cold" stream $\mu = 0,1...0,4$. The drop of temperature of gas on escaping of a governor in optimal conditions of activity of a vortex tube $\mu = 0,2...0,3$ compounds no more than 0,5 grades, that does not exceed inaccuracy of experiment. As a result of generalizing experimental studies (the fig. 3) was detected, that the calculation of temperature on escaping of the device can be conducted on following trial-and-error dependence:

$$T_2/T_1 = 0,9822 \cdot \pi^{0,0025} \cdot \mu^{0,0019} \cdot \Theta_x^{-0,14} \quad (1)$$

Here Θ_x - relative temperature of a "cold" stream of a vortex tube. In the formula (1) values of extents at π And μ on two order are less, than value of an extent at Θ_x. It is connected, on visible, that the magnitude of relative temperature Θ_x of a "cold" stream depends on pressure drop in the device π and relative consumption μ of a "cold" stream of a vortex tube [4]. The results of comparison of experimental studies and calculation under the tendered formula are rotined on a fig. 4. The analysis of results of studies (fig. 4) has shown, that the formula (1) gives satisfactory coincidence with the experimental data, specially in the field of optimal activity of the device $\mu = 0,2...0,3$ for the studied range of drop of pressure of gas.

In further it is necessary to optimize a construction of an isothermal pressure governor of gas with the purpose of expansion of area of optimal activity of the device, to reveal influencing on his activity of a governor of the geometrical sizes, to study activity of the device on an inhomogeneous gas stream, to elaborate mathematical model of a governor etc.

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