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ALL IN ONE TYPE FLUID FLOW SERVO SYSTEM USING SOLENOID VALVE AND ISOTHERMAL PRESSURE VESSEL

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ABSTRACT

Abstract-In general, it tends to become a complex and expensive structure in the controlling of flow rate. In this paper, a simple structure and compact flow rate servo system is shown. It is easy to carry by integrating needed element, that is, the solenoid valve, the isothermal pressure vessel, the pressure sensor and one board controller of on-off method, although, the external compressor is needed. The signal measured with the pressure sensor is sent to the controller, and the proper control signal is feedback to the switching transistor according to on-off timing of the solenoid valve. In this method, the small pressure fluctuation caused by switching action of solenoid valve can not be avoided, however, this pressure fluctuation enables to examine the actual output flow rate by on-line sampling the pressure and calculation using micro processor on controller. So we execute continuous flow rate control by this compact system alone, and are able to change the output flow rate freely according to manual set up or external control signal. For the evaluation of this system, the blowing up device is adopted to confirm the accuracy of flow rate that is constantly controlled ball height apart from seat.

KEY WORDS

Solenoid valve, Isothermal pressure vessel, Flow rate control

INTRODUCTION

For the air pressure servo system, a highly accurate response to change of target value and change of load is requested. In this research, the flow accuracy measured by the small pressure fluctuation caused in the container by using the solenoid valve and the isothermal pressure vessel is shown and it aims at the development of the air pressure flow rate servo that outputs the desired flow rate.

EXPERIMENTAL-APPARATUS

In the device, the supply air pass through the solenoid valve of on-off works, isothermal pressure vessel that suppress the temperature change of the air, and the output flow is delived to devices. The pressure sensor is installed in the pressure vessel, the measured value is sent to microcomputer, and the proper control signal is fed according to the value to the solenoid valve as the timing of the valve open and close

Figure 1 shows the experimental apparatus of this research.

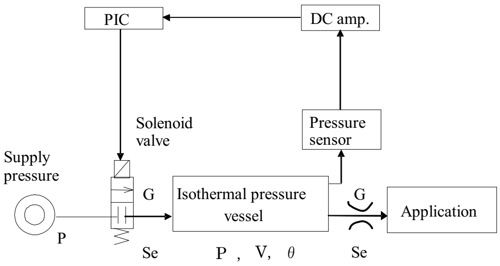

Figure 1 Scheme of experimental apparatus

CONTROL METHOD

The pressure fluctuation generated by the opening and closing drive of the solenoid valve depends on the supply pressure and the output flow rate. In a word, the both of output flow rate and the supply pressure fluctuation can be acknowledged from the pressure fluctuation. Therefore, a stable output of the desired flow rate to the target becomes possible. The control of the ripple rate is used as a control method. This control method decides an appropriate rate of the ripple in consideration of the error margin with the target value. The set value upper bound and the lower bound are provided from the rate of the ripple, and the opening and closing timing of the solenoid valve is controlled.

EXPERIMENT RESULT

Figure 2 shows the pressure fluctuation by the control of the ripple rate. Moreover, the error between experiment and desired value and the ripple between experiment and desired value are shown in Table.1 respectively.
The output flow rate as constant desired flow rate of 44L/min is shown in the Figure 2.

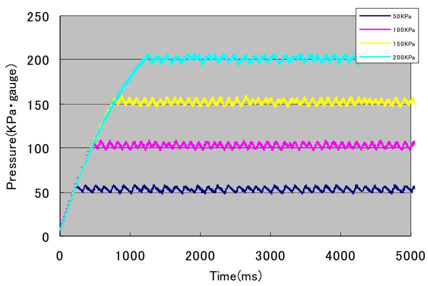

Figure 2 Pressure wave of ripple rate control

	50KPa	100KPa	150KPa	200KPa
The error between experiment and desired value	3.163	2.921	2.450	1.265
The ripple between experiment and desired value	8.214	8.305	7.891	8.735

Unit:[KPa・gauge]

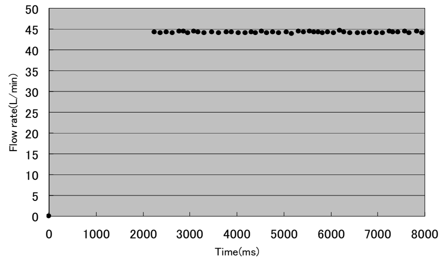

Figure 3 Flow rate by ripple rate

Figure 4 shows the shape of waves of the flow rate when the flow is changed from28L/min to 44L/min by changing load resistance installed in this device. It is understood that the change of the flow rate is stable when the target value is uniformity from the result of Figure 4.

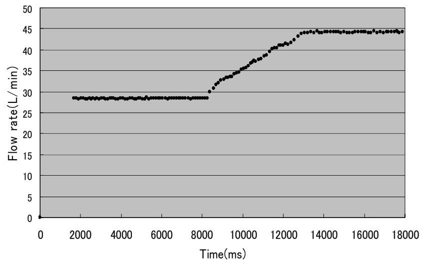

Figure 4 Follow of sample pressure from 100KPa into 200Kpa

CONCLUSION

In this research, the flow rate can be controlled directly with the solenoid valve, by measuring the change of the pressure generated by the opening and closing of the solenoid valve, and the flow rate can meet the desired. The pressure that is an intermediate variable in the system of the flow servo can be used as the control variables. Althogh the effect of changing the unknown supply pressure is not tested, it is expected that the system can adapt change of supply pressure. The error margin of the average flow rate was able to confirm about 2% and highly accurate responses from the result of the experiment.

REFERENCE

1. Toshihiro YOSHIMITSU, Osamu OYAMA, Tosiharu KAGAWA, Flow Rate Servo Using Solenoid Valve and Isothermal Pressure Vessel