An Approach for Energy Saving of Pneumatic System
without Speed Controller

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ABSTRACT

Reduction of the energy consumption of the equipment is being attempted in each industry field in order to protect the global environment. The protocol incorporated that the goal of prevention from global warming conference held in Kyoto in December, 1997. Efficiency improvement over 8% is also required on the pneumatic system. Main things of the reduction measures of the air consumption are as follows. (1) Air consumption in the pneumatic driving system is reduced. (2) Reduction of the pressure loss is done, and air leakage countermeasure. (3) Pressure reduction of the air blow is advanced. This study is to propose the method of drive does not use the speed controller. Since the speed control valve is not used, the relationship between adjustment of the speed, size of load mass and the level of supply pressure was examined experimentally. As the result, the drive using this method was possible, and it was proven that the air consumption was also less than conventional driving method.

KEY WORDS

Energy conservation, Air consumption, Pneumatic cylinder, Driving system

INTRODUCTION

Pneumatic system has greatly contributed to the development of the industry. Pneumatic system supported factory automation as a final controlling element of automatic machine for labor saving. A demand of the pneumatic equipment keeps the increase. On the other hand, the efficiency improvement of industrial product is done for the global environment protection. The United Nations Framework Convention on Climate Change conference was opened in Kyoto in December 1997. The flat in the energy consumption from the level 1995 almost. In carbon
dioxide excretion plane of the energy resource, the reduction of about 7% is changed to the goal from the level in 1995. Therefore, it is expected that prepares and positively propel the concrete measure which also realizes energy saving on pneumatic equipment. Air consumption in the pneumatic system will be reduced on the point like the following. (1) Air consumption in the pneumatic driving system is reduced. (2) A realization of the low-pressure drive. (3) Effective utilization of the exhaust air. (4) Reduction of the pressure loss is done, and air leakage countermeasure. (5) Pressure reduction of the air blow is advanced.

Meter-out circuit and meter-in circuit are well known pneumatic cylinder driving circuit. These two driving circuits attach speed control valve. There are many cases in which they are made to operate by the decompression in the conventional driving circuit of the supply air by speed control valve using the low-pressure air. It is difficult that the reduction of the air consumption is attempted, while the speed control valve by such usage is attached.

Two measures have already been proposed as reduction method of the air consumption of the pneumatic system. Primary methods are the measures for cutting off the supply air in point of time in which the piston reached the stroke end (Fig.1 is shown the supply pressure changes.) The rise of the supply pressure after it reaches the stroke end is useless drive. Then, the reduction of the air consumption is attempted by the piston reaching the stroke end, and cutting of the supply air.

The second methods are measures for supplying the air necessary for reaching the stroke end by controlling the time of air supply. On the methods, already, authors carried out the examination by the simulation from the experiment using the fixation orifice. From the results, the factor which controlled the response of the pneumatic cylinder clarified being size of the load mass and proportion of the air quantity necessary for the drive, time of air supply and restriction area.

This study reports experimental results of driving circuit only using solenoid valve of the marketing instead of fixation orifice used in previous report. Using the driving circuit does not use speed control valve, the purpose of this study reduces air consumption of the pneumatic system, and it clarifies being a practical driving circuit. Response of the conventional driving circuit and response of the drive does not attach the speed control valve are shown in Fig.2. From Fig.2, the sufficient drive is possible even in the driving circuit does not attach speed control valve, and it is proven that the reduction of the air consumption is also possible in order to low-pressure drive.

EXPERIMENTAL APPARATUS

The schematic diagram in Fig.3 shows the experimental apparatus of the pneumatic cylinder system with energy saving which is used in this study. The pneumatic cylinder in this system has the diameter of the piston 50[mm], the stroke of 600[mm], the piston rod in both sides, and is capable of driving load mass in the range of m (8.6[kg]) to 5m. This m is the mass of the movable part. The friction force acting on the pneumatic cylinder is not so large because it moves the load with linear bearings. The electric timer adds DC voltage 24[V] during the requested time to operate the 5 ports solenoid valve.
INFLUENCE OF SUPPLY PRESSURE AND LOAD MASS

Fig.4 is a result of the influence of the supply pressure. It is also correspondent to the supply pressure; through there is the delay in the starting, the time of arrival to the stroke end changes. Fig.5 is the response in which the load mass changes. The delay in the starting increases, when the load mass increases, because the supply pressure is fixed. The influence by load mass change greatly appears on this driving method. The air consumption in proportion to the size of the load is carried out.

RESPONSE OF SWITCHING OPERATION BY SOLENOID VALVE

The time of air supply was manipulated in order to decrease the air consumption. This experimental result is shown in fig.6. The pressure change of the supplier is different by the time of air supply. The time of arrival to the stroke end greatly does not change. The pressure in the exhaust side is also pressure changes. The pressure in the exhaust side also rises, when the time of air supply is lengthened. In addition, the reduction of the air consumption is possible, if to lower the pressure in this exhaust side is possible. The response was examined in the time of air supply necessary for reaching the stroke end, in order to realize this driving method.

This result is shown Fig. 7. The response as the time of air supply is short from the figure, the supply pressure is high, and supply pressure in reaching the stroke end lowers. That is to say, the air consumption can be reduced by setting the time of smallest air supply necessary for the drive by heightening of the supply pressure. The reduction of the air consumption is possible, if this driving method is used.
In Fig.8, the air consumption by the result of Fig.6 is shown. Though in figure, the load mass is 8.6 [kg], the air consumption decreases with that the supply pressure is high. Like this, it can realize even in that the exhaust center solenoid valve is used as the method in which the pressure in the exhaust side lowers. This result is shown in Fig.9. It is necessary to also lower the pressure of the pressure in the exhaust side, if the reduction of the air consumption does be considered.

CONCLUSIONS

Air consumption reduction by the pneumatic system circuit without speed control valve was tested. The results are summarized like the following.

[1] In the driving circuit without speed control valve, the speed regulation ranges become narrow.

[2] The reduction of the air consumption is possible, if the appropriate supply pressure is chosen, when the holding force is not required after the drive.

[3] The air consumption is less than the conventional drive, if the solenoid valve size of the marketing is appropriately selected, and it can be correspondent to various load mass.

ACKNOWLEDGEMENTS

We would like to acknowledge that this research as a part of a joint project with SMC Co., Ltd.

REFERENCES


