PROPOSAL OF A COMPONENT TO REDUCE PRESSURE PULSATION IN OIL-HYDRAULIC SYSTEM

Yasuo SAKURAI*, Betty ETINOT**, Norikazu HYODO***, Kenichi AIBA***

*Division of Mechanical Engineering, Faculty of Engineering, Ashikaga Institute of Technology
268-1 Oomaecho, Ashikaga, Tochigi, 326-8558 Japan
(E-mail:ysakurai@ashitech.ac.jp)
**Graduate School of Engineering, Ashikaga Institute of Technology
***Tokyo Keiki Corporation
Sakaecho, Sano-shi, Tochigi, 327-0816 Japan

Abstract. This paper deals with proposal of a component to reduce pressure pulsation in oil-hydraulic system. In an oil-hydraulic system, since a positive displacement pump is generally employed, pressure pulsation is generated, which causes oscillation, noise and so on. In general, to prevent it, an accumulator is interposed to suppress it. However, when using an accumulator, regular maintenance is necessary to maintain its performance. Therefore, it seems to be necessary to develop an oil-hydraulic component to prevent pressure pulsation with simple structure and without regular maintenance. In this study, a component to reduce pressure pulsation in oil-hydraulic system is proposed. The component is fabricated and some experiments carry out to make clear the basic characteristics of this component. Based on the experimental results, it becomes clear that the fluctuation range of the pressure pulsation becomes one-tenth by the use of the proposed component.

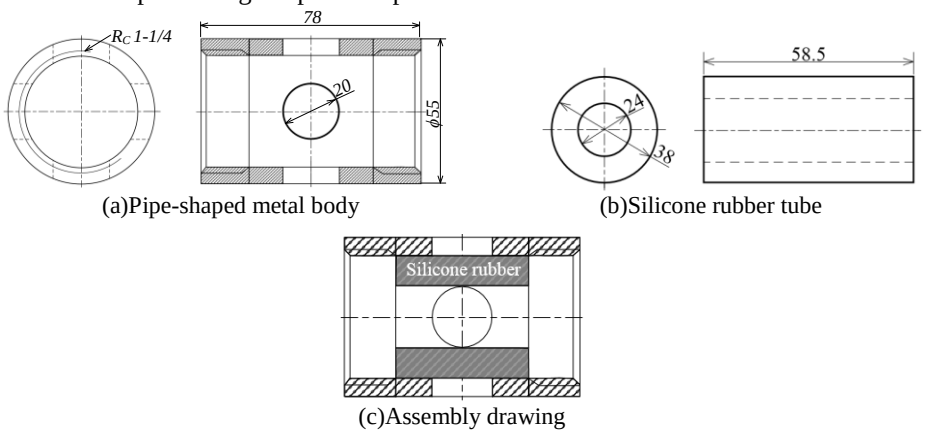
Keywords: Oil-hydraulics, Component, Pressure pulsation, Silicone rubber, Piston pump

INTRODUCTION

In oil-hydraulic system, pressure pulsation is generated due to the use of positive displacement pump and causes oscillation, noise and so on [1]. In general, an accumulator is interposed to suppress the pressure pulsation. However, as accumulators contain gas, regular maintenance is necessary to prevent its performance deterioration due to gas leakage. Therefore, it is required to develop an oil-hydraulic component to prevent pressure pulsation with simple structure and without regular maintenance.
In this study, a component to reduce pressure pulsation in oil-hydraulic system is proposed. The component is fabricated and some experiments carry out to investigate the basic characteristics of this component.

STRUCTURE OF PROPOSED COMPONENT

Figure 1 shows the structure of the proposed component. This component consists of a pipe-shaped metal body and a silicone rubber tube. The silicone rubber tube is inserted into the body. The side of the body has 4 holes, and the surface of the silicone rubber in the body is exposed to the atmosphere through these holes.
When the pressure is increased, the part of the silicone rubber expands and prevent the increase of the pressure. Then, the energy is stored as elastic energy in the silicone rubber. The elastic energy is transferred back to the oil when the pressure is decreased. This energy transfer prevents a decrease in pressure. These processes are assumed to be effective for preventing the pressure pulsation.



(a)Pipe-shaped metal body (b)Silicone rubber tube

(c)Assembly drawing

FIGURE 1. Structure of proposed component

EXPERIMENT AND DISCUSSION

Experimental apparatus to investigate pressure pulsation in an oil-hydraulic system is shown in Fig.2, which is composed of a piton pump, a metering valve and a bubble eliminator to reduce the influence of air in oil. By adjusting the opening area of the metering valve, the pressure at the pump discharge port set about 3.5MPa, which is often used in oil-hydraulic systems in machine tools.
Experimental results of pressure pulsation are shown in Fig.3. As seen from this figure, the variation width of the pressure pulsation is about ±0.29MPa. The rotational frequency of the pump is 25Hz and the number of the pump piston is 9. As a results, the peak of the pressure in frequency analysis represents at the integer multiple of 225. From the result of frequency analysis in Fig.4, the peak can be clearly seen at 410Hz, 1456Hz, 2913Hz. These frequencies are almost the integer multiple of 225.

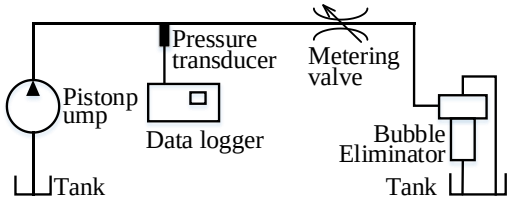


FIGURE 2. Experimental apparatus

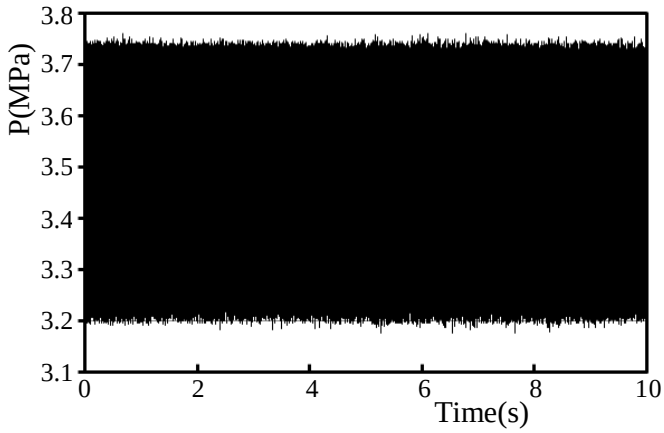


FIGURE 3. Experimental results

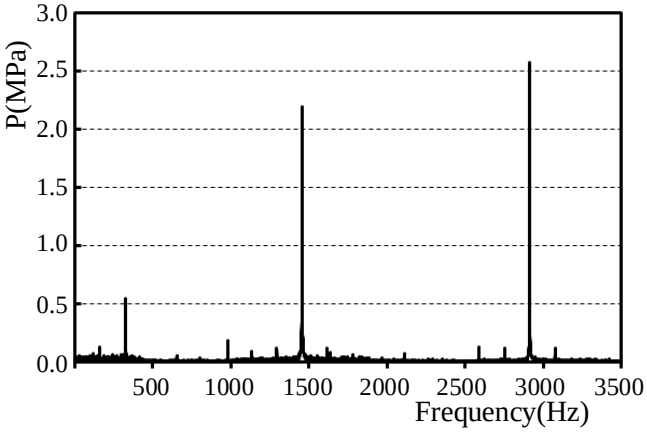


FIGURE 4 Frequency analysis

Experimental apparatus to investigate the performance of the proposed component is shown in Fig.5.
The experimental results of the pressure at the downstream of the component are shown in Fig.6. As seen from this Figure, the variation width of the pressure pulsation is about ±0.028MPa, and it is clear that the pressure pulsation is reduced. From the result of frequency analysis in Fig.7, the peak at 1456Hz and 2913Hz becomes small. Consequently, it becomes clear that the proposed component for reducing the pressure pulsation is effective.

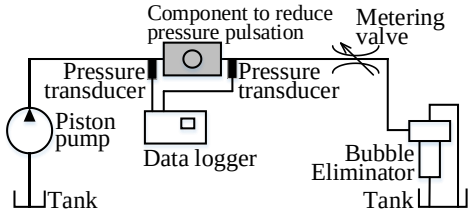


FIGURE 5. Experimental apparatus to investigate performance of proposed component

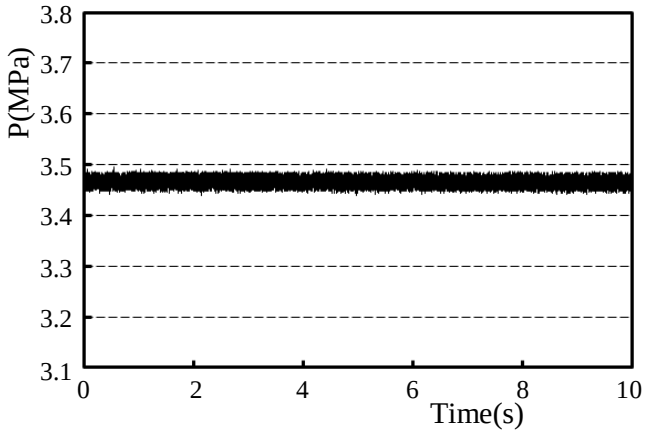


FIGURE 6. Experimental results (pressure at downstream of component)

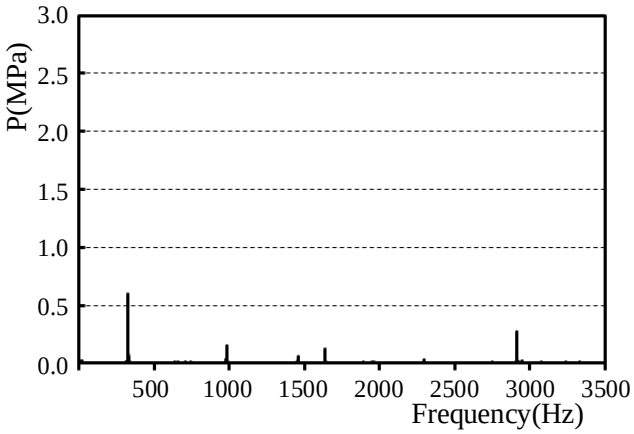


FIGURE 7. Frequency analysis

CONCLUSIONS

In this study, a component to reduce pressure pulsation in oil-hydraulic system was proposed and confirmed its performance through some experiments. As a result, it becomes clear that the proposed component works effectively to reduce pressure pulsation.
Next step is to investigate the relation between the design parameters of the proposed component and its performance. Furthermore, it seems to be necessary to confirm the durability of the proposed component.

ACKNOWLEDGMENTS

Authors would like to thank Mr. Xiaocheng Wang, graduate student of Ashikaga Institute of Technology, for his contribution in experiments.

REFERENCES

1. e.g. LOW, S., K, NAKANO, Y., KATO, H., Suppression of Chatter Marks due to Pulsation of Hydraulic Oil Pressure in Surface Grinding, Journal of the Japan Society for Precision Engineering, Vol. 55, No.3, 1989, p.514-519. (in Japanese)

