Advances in Automobile Engineering
ISSN: 2167-7670

Liu, Adv Automob Eng 2017, 6:2
DOI: 10.4172/2167-7670.1000163

Short Communication OMICS International

Energy Saving Potential of the Independent Metering Fluid Power System

Kailei Liu*

School of Mechanical Engineering, Jiangsu University of Technology, Changzhou, Jiangsu, China

Introduction

Electro-hydraulic proportional control valves are widely applied for motion control in the electro-hydraulic fluid power system. Normally, a sliding spool is used in the proportional control valve to control the flow direction and flow rate passing through the valve, as a result, the meter-in and meter-out orifices are mechanically connected [1]. The sliding spool makes the system robust and easy to control, but a number of types of losses have been produced with this kind of valve [2]. Therefore, the conventional electro-hydraulic proportional spool valve control system provides precise motion control, but cannot achieve energy saving performance [3].

In order to obtain high efficiency and flexibility of the electro-hydraulic proportional control system, Ulery proposed an integrated hydraulic circuit by combining cartridge valves into a manifold to act as a control valve [4]. Jansson and Palmberg go a step further, used four electro-hydraulic proportional valves to control an actuator in the electro-hydraulic fluid power system [5]. The four-valves configuration breaks the mechanical linkage of meter-in and meter-out orifices, as a result that can provide more controllability and energy savings. There are also other valves configurations can realize the independent metering technology. Each of the configurations is based on the independent control of the meter-in and meter-out orifices.

As the independent metering system is a multi-input and multi-output system, it requires more hardware configurations and complex control methods. Many researchers have developed the electro-hydraulic control methods in independent metering system for obtaining steady flow rate and energy saving performance, as well, including hybrid control algorithm [6], load feedback method [7], energy-saving adaptive robust motion controller [8], for example. The hydro-mechanical pressure compensation method has been successfully applied in the conventional fluid power system as it reacts directly and rapidly on disturbance variables [9]. The hydro-mechanical pressure compensation method is adopted in the design of independent metering system for excavator's manipulator, and the analysis results indicated that the independent metering system with hydro-mechanical pressure compensation offers more significant energy savings than the conventional load-sensing system [10].

Conclusion

Different valves configurations have their own pros and cons, and optimal valves configuration depends on the applications and specific working conditions. In the future, obtaining the energy saving performance while achieving the precise motion control performance of the independent metering fluid power system will still be a research direction.

Funding Disclosure

This research is funded by National Natural Science Foundation of China (Grant No. 50875228).

References

1. Hu H, Zhang Q (2002) Realization of programmable control using a set of individually controlled electrohydraulic valves. International Journal of Fluid Power 3: 29-34.
2. Eriksson B, Palmberg JO (2011) Individual metering fluid power systems: Challenges and opportunities. Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering (JSCE) 225: 196-211.
3. Shenouda A, Book W (2005) Energy saving analysis using a four-valve independent metering configuration controlling a hydraulic cylinder. SAE Commercial Vehicle Engineering Conference, Chicago, Illinois, USA.
4. Ulery TJ (1989) Advanced hydraulic control valves for agricultural machinery applications. Agricultural Engineering, 70: 14-15.
5. Jansson A, Palmberg JO (1990) Separate controls of meter-in and meter-out orifices in mobile hyraulic systems. SAE Technical Paper, No. 901583.
6. Hu H, Zhang Q (2002) Development of a programmable E/H valve with a hybrid control algorithm. SAE Technical Paper, No. 2002-01-1463.
7. Tabor KA (2005) A novel method of controlling a hydraulic actuator with four valve independent metering using load feedback. SAE Technical Paper, No. 2005-01-3639.
8. Yao B, DeBoer C (2002) Energy-saving adaptive robust motion control of single-rod hydraulic cylinders with programmable valves. Proceedings of the American Control Conference, 2002 May 8–10. Anchorage, AK: IEEE.
9. Sitte A, Weber J (2013) Structural design of independent metering control systems. In: 11th Scandinavian international conference on fluid power. Linkoping University Electronic Press, Linkoping. p: 261–270.
10. Liu K, Gao Y, Tu Z, Lin P (2016) Energy-saving analysis of the independent metering system with pressure compensation for excavator's manipulator. Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering (JCSE) 230: 905-920.

***Corresponding author:** Kailei Liu, School of Mechanical Engineering, Jiangsu University of Technology, Changzhou, Jiangsu, China, Tel: 86-511-84401015; E-mail: liukailei@163.com

Received March 21, 2017; **Accepted** April 10, 2017; **Published** April 14, 2017

Citation: Liu K (2017) Energy Saving Potential of the Independent Metering Fluid Power System. Adv Automob Eng 6: 163. doi: 10.4172/2167-7670.1000163