International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, February 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Reducing the impact and operating conditional Mechanical vibrations on Hydraulic valves: a Review

Bhoomika B. Borade[1], Prof. M.V.Kharade[2]

1) (M.E.) Machine Design, Mechanical Department,
Dr.J.J.Magdum College of Engineering, (India)
2) Assistant Professor, Mechanical Department,
Dr.J.J.Magdum College of Engineering, (India)

ABSTRACT

This paper deals withtheliterature review ofimpact of mechanical vibrations also operating conditional mechanical vibration on the environment, particularly on hydraulic valves. The main sources of such vibrations and their effects on hydraulic systems are indicated. Some documents setting down standard requirements for resistance to vibrations and to the noise generated by vibrations are cited. Two ways of reducing the impact of mechanical vibrations on the valve are proposed and a theoretical analysis, constituting the basis for selecting a material for an effective vibration isolator for the valve, is carried out. All literature survey related to the mechanical vibration produce in valve and isolators should do.

Keywords — Direction control valve, Hydraulic system, Isolators, Noise, vibration

I.INTRODUCTION

Vibrational behavior of fluid power systems is a very important aspect regarding life-time of the components and especially noise problems within hydraulic circuits. Vibration emitting and noise generating elements in hydraulic systems are valves.

The impact of mechanical vibrations on the environment, particularly on hydraulic valves is one major problem in industry. Two ways of reducing the impact of mechanical vibrations on the valve are proposed and a theoretical analysis, constituting the basis for selecting a material for an effective vibration isolator for the valve, is carried out.

A running engineering machine is a source of mechanical vibrations with a wide spectrum of frequencies, including low frequencies. The vibrations act on the operator inside the machine, on all the machine subassemblies and subsystems and indirectly, on the surrounding environment. For the sake of the health of the machine's valves, it is essential to identify the mechanical vibrations to which they are subjected. Such vibrations often may disturb the operation of the entire hydraulic system of a mobile machine. A disturbance in the operation of such a system is reflected in a change in the pressure fluctuation spectrum. The disturbance may lead to deterioration in the accuracy of positioning the actuators, to uneven operation, shortening of the

machine's life and sometimes to a higher level of low-frequency noise emitted. Low-frequency vibrations and noise have a particularly adverse effect on hydraulic valves and the human being. In hydraulic valves they may excite the vibration of their control elements (such as the slide and the head). This occurs when the frequency of the external mechanical vibrations is close to that of the free vibrations of the valve control element. In the case of a human being, the vibrations via the skin mechanoreceptors transmit specific information to the central nervous system, causing reflex reactions of the human body. The vibrations are accompanied by noise, also with low-frequency components. The noise is the subject of EU standard regulations. Hydraulic equipment producers, however, rather seldom specify the operating requirements concerning the resistance of their products (e.g. valves) to mechanical vibrations.

In the recent past there has been a significant increase in the use of hydraulics in our industries. The use of oil hydraulic system as a means of power transmission in modern machines evolved a few decades earlier in the western world. But its application in Indian industries is of comparatively recent choice and hence, there is great deal of urgency and importance to master the art of its application and maintenance. Hydraulic system are not extensively used in machine tools, material handling devices, transport and other mobile equipment, in aviation system, etc. At the movement there exists a big gap between the availability and requirement of trained manpower in this vital field of modern engineering in India. To bridge the gap, it is essential that our design and application engineering and maintenance personnel from the lowest to highest level are given extensive, on the job training so that operation efficiency of machineries using a hydraulic system as the prime source of power transmission can be maintained at an optimum level. Apart from fluid power system designer, a good maintenance and millwright mechanism should also have first-hand theoretical knowledge to enable him to tackle practical problems encountered during installation, operation and maintenance of hydraulic equipment.

The purpose of this test is to determine any mechanical weakness and/or degradation in the specified performance of specimens and to use this information, in conjunction with the relevant specification, to decide upon the acceptability of the specimens. In some cases, the test method may also be used to demonstrate the mechanical robustness of specimens and/or to study their dynamic behavior. Categorization of components can also be made on the basis of a selection from within the severities quoted in the test.

The objective of this study is to minimize a vibration in hydraulic system especially in hydraulic valve using various isolators like rubber pads of different thickness, washer, damper etc. and analyses the system by using FFT analyzer and MATLAB software.

II.LITERATURE REVIEW

There has been lot of work carried out related to reducing vibration on hydraulic system, but it is not possible to include all work here. Only most relevant work is mentioned here. Mainly research is done for reducing vibration on hydraulic pump and effect of vibration on environment by using different types of isolators.

In 2014, M. Stosiak publishes paper on “Ways of reducing the impact of mechanical vibrations on hydraulic valves”. This paper deals with the impact of mechanical vibrations on the environment, particularly on hydraulic valves. The main sources of such vibrations and their effects on hydraulic systems are indicated. Some documents setting down standard requirements for resistance to vibrations and to the noise generated by vibrations are cited. Two ways of reducing the impact of mechanical vibrations on the valve are proposed and a

theoretical analysis, constituting the basis for selecting a material for an effective vibration isolator for the valve, is carried out.

In order to reduce slider vibrations one can introduce shock damping washers (made of a material characterized by high stiffness c and damping k) into the distribution valve housing, between the housing and the centering springs. In the case of distribution valves with single-step electric (e.g. proportional) control, this approach has constraints because of the maximum values of the controlling forces generated by the proportional electromagnets, and the required slide stroke. Another possible way of reducing distribution valve housing vibrations, and consequently of slider vibrations, is to mount the distribution valve on flexible washers whose equivalent stiffness and equivalent damping can be calculated for the set excitation parameters and the mass of the vibrating valve. The materials used reduce slider or housing vibrations, the anti-vibration insulation effectiveness is not satisfactory. Therefore, mainly for the purposes of isolating distribution valve housing vibrations, one should search for other materials, using the criteria defined by relations which they were generated.

In 2005, Harald Ortwig publish paper on 'Experimental and analytical vibration analysis in fluid power systems'. This paper deals with vibrational behavior of fluid power systems is a very important aspect regarding lifetime of the components and especially noise problems within hydraulic circuits. Vibration emitting and noise generating elements of primary evidence especially in hydraulic systems are pumps. In completed hydraulic circuits it is often seen that even vibration and noise-optimized pumps show noise problems due to the inter-activeness of all system components built in. Noise problems can be investigated with several vibration and noise measurement methods, which are mostly based on the analysis of the noise relevant frequency spectre of the vibration emitting source and the evaluation of frequencies which are of maximum influence. A precise analysis of the phenomena gives the basis to eliminate one or more of the dominant noise frequencies with the help of hydraulic silencers.

In 2012, Ning Chenxiao and Zhang Xushe publish paper on Study on 'Vibration and Noise for the Hydraulic System of Hydraulic hoist' which analysis on all kinds of the vibration source and noise mechanism, this paper points out the vibration and noise harm, cause and source of the hydraulic hoist hydraulic system. Furthermore it puts forward to effective and specific measures to reduce the vibration and noise of the hydraulic hoist hydraulic system which can also be widely applied to vibration and noise control of other hydraulic system.

Vibration and noise of Hydraulic hoist hydraulic system is more complex, not only the unbalanced force, inertia force, friction resistance caused by a variety of mechanical vibration and noise, but also and the pressure and flow pulsation, cavitation, hydraulic shock caused by different types of fluid vibration and noise. According to different sources, measures should be taken from the hydraulic system design, manufacturing, installation, using and to adopt a reasonable reduction and other aspects to control the vibration and noise generate and transmit to a minimum range. Vibration and noise of hydraulic system generating mechanism is similar, these measures can also be widely used in various types of hydraulic system of vibration and noise reduction

In 2017, Mr. Madhukar M. Sirsikar, Prof. Hemant G. Patil, publish paper on Experimental investigation ofreducing vibration of hydraulic surface grinding machine while reversing the table which deals with Hydraulic Surface Grinding Machine used for fine surface finishing of job. It consists of base, column, reciprocating table with magnetic chuck, spindle with grinding wheel, electric motor and hydraulic system with electric motor.

Vibration produce bad effect on machine as well as produce chattering effect means bad surface finish on work piece. It is necessary to investigate causes and respective measures to control the vibration. There is an excessive jerk or vibration while reversing the table besides regular working vibration. This type of jerk/impact force produces vibration at the end of table traverse and remains for certain distance. At the point of reversing of table, its amplitude is high and getting normal or damped to normal working position. The present paper focus on different parameters and its effects to reduce the jerk or vibration while reversing the table. Vibration in grinding machine is hard to measure while reversing the table. Such vibration occurs due to impulsive force of table. This vibration further damped by varies means. The vibrations of table of hydraulic grinding machine are minimizing by controlling the speed and pressure of fluid. Vibration in grinding machine is hard to measure. It is observed from the formation of waviness on the work piece and grinding wheel. The major causes of vibration in grinding machine are misalignment and unbalancing. These unwanted vibrations will reduce the life of both machine and tool, resulting in loss of production. Vibration measurement is done by different approaches. This paper explains the vibration measurement done by vibro-meter. The vibrations are minimized by introducing dampers, made of rubber and springs. The vibration is isolated due to the elasticity and energy absorbing property of rubber. The vibrations of table of hydraulic grinding machine are minimizing by controlling the speed and pressure of fluid.

Vibration control of hydraulic surface grinding machine is done by various techniques. In this case hydraulic system with proportional control valves, proper damping and machine parts tolerances. These parameters control the jerk or bump efficiently at reversing the table. The dampers are made up of the rubber or elastomer. The dampers used to minimize the kinetic energy of table along with the time or traverse of table. As well as the hydraulic system with various proportional control valves absorbs the excess energy of hammering of fluid while reversing. The results obtained by implementing the above methods are better. The amplitude of the vibration will get shorter and the wave diminishes early. It shows that severity of vibration is less by using above methods.

The complete solution of vibration of hydraulic surface grinding machine is not feasible. The vibration occurs not only by the reciprocating table but also by moving the table in feed while reversing. It means to control the vibrations while reversing the table, to consider the vibrations in both directions. In this topic this paper focus on the vibration only along the table is moving. Here we calculate the frequency and amplitude in one direction only and study the respective measures to minimize the vibration. The main objective is to reduce the amplitude and the length or time of wave so that the grinding time will be less and the surface finish of the job would be in tolerance.

International Standard, Norme Internationale: Environmental testing –Part 2-6: Tests – Test Fc: Vibration (sinusoidal)Edition 7.0 2007-12 this deals with part of IEC 60068 gives a method of test applicable to components, equipment and other articles which, during transportation or in service, may be subjected to conditions involving vibration of a harmonic pattern, generated primarily by rotating, pulsating or oscillating forces, such as occur in ships, aircraft, land vehicles, rotorcraft and space applications or are caused by machinery and seismic phenomena. This standard consists basically of subjecting a specimen to sinusoidal vibration over a given frequency range or at discrete frequencies, for a given period of time. A vibration response investigation may be specified which aims at determining critical frequencies of the specimen. The

relevant specification shall indicate whether the specimen shall function during vibration or whether it suffices that it still works after having been submitted to vibration. It is emphasized that vibration testing always demands a certain degree of engineering judgment, and both the supplier and purchaser should be fully aware of this fact. However, sinusoidal testing is deterministic and, therefore, relatively simple to perform. Thus it is readily applicable to both diagnostic and service life testing. The main part of this standard deals primarily with the methods of controlling the test at specified points using either analogue or digital techniques, and gives, in detail, the testing procedure. The requirements for the vibration motion, choice of severities including frequency ranges, amplitudes and endurance times are also specified, these severities representing a rationalized series of parameters. The relevant specification writer is expected to choose the testing procedure and values appropriate to the specimen and its use.

In 2016 Baoquan Kou, Yiheng Zhou, Xiaobao Yang, Feng Xing, and He Zhang publish paper on Electromagnetic and Mechanical Characteristics Analysis of a Flat-Type Vertical-Gap Passive Magnetic Levitation Vibration Isolator.In this paper, we describe a flat-type vertical gap passive magnetic levitation vibration isolator (FVPMLVI) for active vibration isolation system (AVIS). A dual-stator scheme and a special stator magnet array are adopted in the proposed FVPMLVI, which has the effect of decreasing its natural frequency, and this enhances the vibration isolation capability of the FVPMLVI. The structure, operating principle, analytical model, and electromagnetic and mechanical characteristics of the FVPMLVI are investigated. The relationship between the force characteristics (levitation force, horizontal force, force ripple, and force density) and major structural parameters (width and thickness of stator and mover magnets) is analyzed by finite element method. The experiment result is in good agreement with the theoretical analysis.

III.CONCLUSION

From the literature survey it can be seen that reducing the impact of mechanical vibrations on the hydraulic valve has been a hot research topic for many researchers, because unwanted vibration may cause fault in the system and also reduce efficiency of machine.The researchers started from developing theories related to general behavior of vibration in hydraulic system and further moving to reduce a vibration by different methods, also use various isolators for sufficiently reduce the vibration. Researchers compare isolators of different material, different thickness and different size as well as shape like cubodial, cylindrical and found best form that. Also developed single degree of freedom equation to analysis the result and compare result with experimental work. And it is found that the results come approximately same for experimental, theoretical and numerical, so it is more comfortable to analysis the system by use of some software.

REFERENCES

Journal Papers:

[1] M. Stosiak ,"*Ways of reducing the impact of mechanical vibrations on hydraulic valves*".*ACME-240*; No. of Pages 9, 2014

[2] H. Ortwig, *Experimental and analytical vibration analysis in fluid power systems*, International Journal of Solids and Structures *42 (2005) 5821–5830*.

[3] N. Chenxiao, Z. Xushe, *Study on vibration and noise for the hydraulic system of hydraulic hoist*, in: Proceedings of 2012 International Conference on *Mechanical Engineering and Material Science (MEMS), 2012*.

[4] *Experimental investigation of reducing vibration of hydraulic surface grinding machine* while reversing the table,Mr. Madhukar M. Sirsikar, Prof. Hemant G. Patil,*2017 IJNRD Volume 2, Issue 6 June 2017*

[5] *Electromagnetic and Mechanical Characteristics Analysis of a Flat-Type Vertical-Gap Passive Magnetic Levitation Vibration Isolator*, Baoquan Kou, Yiheng Zhou, Xiaobao Yang, FengXing,He Zhang,*2016 Hindawi Publishing* Corporation Shock and Vibration *Volume 2016, Article ID 5327207*, 12 pages, Accepted 5 Dec.2016

[6] M. Stosiak, *Vibration insulation of hydraulic system control components, Archives of Civil and Mechanical Engineering 11 (1) (2011)* 237–248

[7] Oil hydraulic system: principles and maintenance – page1, 143-197 Active Vibration Control of Excavator Working Equipment with ADAMS, Guofu Ding Zhongyan Qian Shuangxia Pan

Books:

[8] G. K. GROVER, *Mechanical vibration* (N.C.Jain, Uttar Pradesh, Second Edition1972)

[9] PN-EN 60068-2-6:2008, Environmental research – part 2–6: tests – Fe test: vibration

[10]. DIN IEC 68 Part 2–6, Fundamental environmental test procedures, sinusoidal oscillation

[11] PN-EN ISO 4413:2011, Hydraulic drives and controls – general guidelines for systems