NOVATEUR PUBLICATIONS
International Journal Of Research Publications In Engineering And Technology [IJRPET]
ISSN: 2454-7875
VOLUME 2, ISSUE 5, May -2016

REDUCING VIBRATIONS OF HAND OPERATED POWER TOOLS WITH VIBRATION ISOLATION AND REDUCTION MECHANISM

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ABSTRACT:

In this paper, we given a solution for an operator who works on ceiling or roofs standing in up-right position with the power tool in hand during drilling and hole sawing operations .We given design solution for flexible shaft power tool with hydraulic viscous fluid damper and elliptical spring. This paper gives an outline for various methods of vibration isolator and damper. In reality, people who worked with power vibrating tools exposure with the vibrated syndrome that effect their normal life especially who involved for long time period. Hand arm vibration (HAV) is a widespread hazard in many industries and occupations involving the use of handheld power tools or hand fed machines. This paper describes a research and observation on the vibrating hand tool.

KEYWORDS: Hand arm vibration (HAV) Syndrome, Hydraulic viscous fluid damper, Flexible shaft power tool.

I.INTRODUCTION

Drill bits are always having circular cross sections in order to create cylindrical holes. The hand held drilling machine will transfer the vibrations in workers arm i.e. Hand-arm vibrations (HAV). These vibrations are caused mainly due to handling of hand held power tools, hand guided equipment and by holding materials processed by machines. Many researchers worked on this problem in last decade. The studies carried out have shown, repeated exposure to such vibration causes severe effect on human body like hand-arm vibration syndrome (HAVS), white finger or Reynaud's syndrome, carpel tunnel syndrome and tendinitis. Fingers will experience adverse effect due to this and the symptoms include lack of sensation, pain, and blanching.

The hand held power tools find applications in most of the industries all over the world. The vibrations generated are unstable and depends upon the type of application and force requirement and the working conditions. The challenge for the researchers is to design the power tools with minimum vibration, better performance and minimum cost. Plenty of designs have been proposed by the researchers to control the vibrations without any effect on performance of the tools. In this paper authors have tried to provide yet another solution to address the problem.

II. LITERATURE REVIEW

Lars Skogsberg [1] has discussed that, industrial tools are normally designed with the main parts made of metal. From a vibration point of view this means that most tools can be regarded as rigid bodies, especially because the dominating frequency normally is equal to the rotational frequency of the tool spindle or the blow frequency for a percussive tool. These frequencies are below 200 Hz. Handles however cannot always be regarded as rigidly connected to the tool. There are several examples of weak suspensions designed to reduce vibration transmitted to the hands of the operator. He said that, there are three basic principles for vibration control and they are control the magnitude of the vibrating forces, make the tool less sensitive to the forces, and isolate the vibration in the tool body from the grip surfaces.

Alan R. Klembczyk [2] has addressed the methods of implementing isolation shock absorbing and damper with dynamic systems and structures. Authors have implemented the successful integration for reduction of shocks and vibrations. The process of reducing vibrations is complex and has several factors to be considered. It is really needful for the researchers and system engineers to be prepared with detailed understanding of control and isolation schemes. The need of the time is to choose the proper technique out of wide range and to implement it effectively.

Haruhiko Kurino [3] has implemented the damper system to address the said problem. Author has carried out the study and found that an ingenious passive hydraulic damper for structural control is having better

performance than semi active damper. The implemented damper system will absorb the vibration by desire variation in damping coefficient. Another advantage of this is valve controlled pressure balance between two hydraulic chambers without need of any external power resource. Authors have found the implemented system effective for absorbing the vibrations to noteworthy level.

Seri Rahayu K [4] has carried out work on vibration of power hand tools and discomfort experience among industrial workers'. He stated that, people who worked with power vibrating tools exposure with the vibrated syndrome that effect their normal life especially who involved for long time period. Hand-arm vibration (HAV) is a wide spread hazard in many industries and occupations involving the use of hand held power tools or hand-fed machines. This paper describes a research and observation on the vibrating hand tool. The objective of this study is to measure and compare the grip strength and hand arm vibration. The result analysis showed that most of workers have been suffered and experience one or more syndromes in their job. Workers facing with pain and discomfort experience such as tingling and numbness in the fingers, white fingers symptom, suffering from weakness in hand grip and injury at neck, shoulder, arm, or hand have been asked to the respondents. This research also do the analysis about the effects of the vibration to the workers' hand depend on the duration of handling the power hand tool.

D. Lee & D. P. Taylor [5] have proposed the fluid damper technology for reduction of vibrations. The viscous dampers are always resisting structure motion by means of force proportional to relative velocity between the ends of the damper. The life of the properly designed has no practical life limit as it is having the nothing to wear out or deteriorate over. The viscous dampers, when designed properly have negligible leakage or liquid storage device.

Edward F. Burton [6] his invention relates flexible shaft power tools such as drilling, grinding and erasing machines and its directed primarily to improving and simplying the control means for the electrical power drive and making such machines safer and more convenient to operate. In his improvement of flexible shaft power tool consists of providing an elongate flexible electrical conductor means which is operatively connected to the power circuit of the drive motor, the conductor means extending along the length of the flexible casing and preferably wrapped there around. An electric switch mounted directly on the power head of the tool, with the conductor means connected to the switch so that the operator ,while holding the power head in one hand, may operate switch with a finger, thus enabling him to locate the tool exactly in the desired position and then without moving the tool or his hand ,set the tool in operation

III. PROPOSED SYSTEM

Fig.No.1 shows proposed arrangement of flexible shaft multifunction power tool with elliptical spring mount and hydraulic viscous fluid damper.

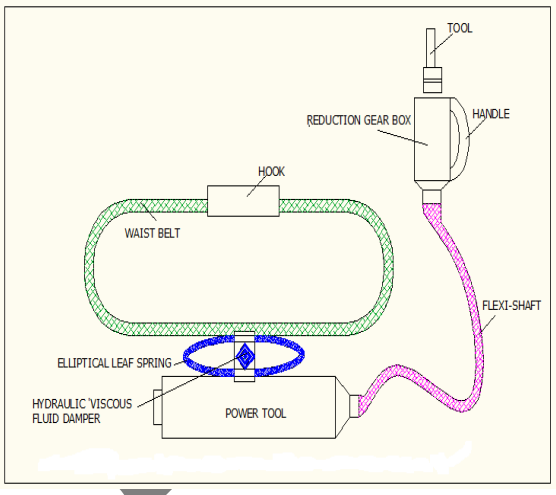

Fig.No.1

PART – A: MULTI-FUNTION FLEXI-SHAFT POWER TOOL:

The flexible shaft tools moves the spinning end of rotary part of motor in to small hand piece. The mechanical energy generated is utilized for spinning of hand tool. The motor is placed away from the vibrating tool designed for better control and better movement. In this tool, the motor is placed away from the worker. It provides less vibration as the gearbox and flexi shaft is used. The movement of the tool can also be controlled as motor is placed away.

SPECIFICATIONS OF MOTOR FOR POWER TOOL:

VOLTAGE	230 V
POWER	450 WATT
SPEED	15000 RPM
REDUCTION GEAR BOX	SPIRAL BEVEL 1:3 REDUCTION
WEIGHT	1.6 KG

Flexible shafts are mechanical power-transmission devices used to transmit rotary motion through bends and curves. They can be routed over, under, and around obstacles which would be otherwise impossible for a solid shaft — and costly for universal joints.

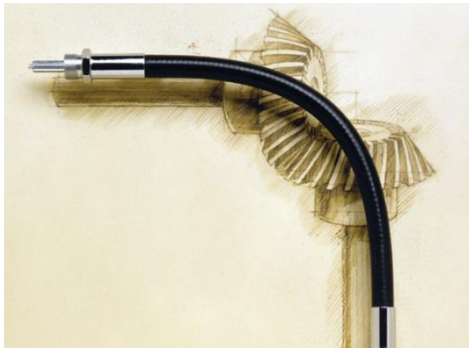

Fig.No.2

The solid shaft requires difficult assembly where as the flexible rotary shaft reduces the requirement of tight installation tolerances. Flexible shafts are made of layers of high-tensile wire wound over each other at opposing pitch angles. The expansion and contraction of the flexible shaft occurs depending upon applied torque. If the outer layer of the shaft is contracts, then inner layer will expand. Due to this the dynamic interference occurred between the layers. Hence it results in high torsional stiffness of shaft of approximately hundred times greater than the sum of individual layers stiffness. The alignment problems are reduced in flexible shafts as they did not need the tight tolerances. Due to this advantage the positioning of motor drive will be more flexible. It can be used with full 180° offset with better efficiency. Coupling or joints can provide the offset of 5 to 30° and hence the efficiency will be reduced up to by 40 to 50%. The flexible shafts were found better than gears, joints, belts and pulleys due to the high efficiency of 85 to 95%. Because of these variances in size paired with high yield strength, flexible shafts are used extensively in the aerospace, medical, automotive, and other industrial markets.

PART B: VIBRATION ISOLATION AND REDCTION MECHANISM:

DESIGN PRINCIPALS:

Vibrations are generally created due to forces. The basic principles to control the vibrations are:

- Control the magnitude of the vibrating forces.
- Make the tool less sensitive to the vibrating forces.
- Isolate the vibrations

The strategies adopted for reduction and isolation of vibrations are as follows:

I. Elliptical leaf spring mounts between motor body and belt.
II. Hydraulic viscous fluid damper at the spinal cord location of mounting to isolate and eliminate any machine vibrations reaching the body.

ELLIPTICAL LEAF SPRING MOUNT:

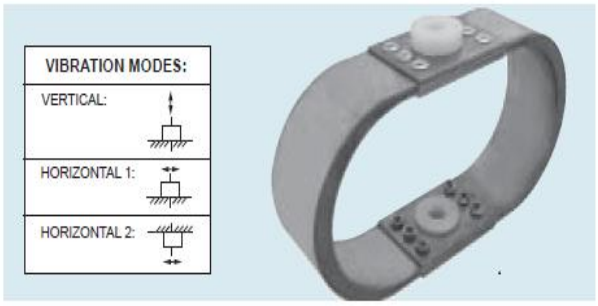

Fig. No.3

HYDRAULIC VISCOUS FLUID DAMPER:

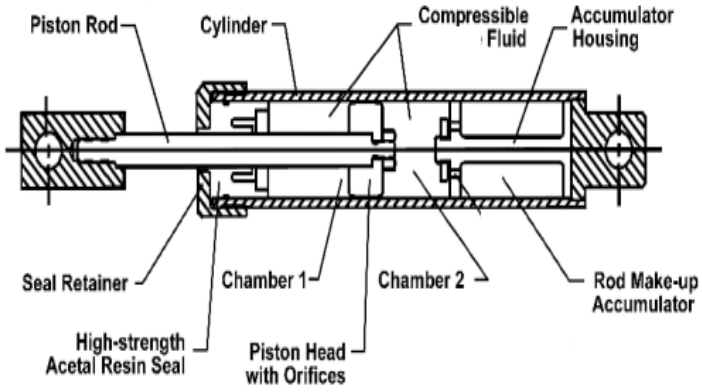

Fig. No.4

Hydraulic viscous fluid damper a the spinal cord location of mounting to isolate and eliminate any machine vibrations reaching the body

DESIGN METHOD OF VIBRATION ISOLATOR:

The vibration isolator to be designed to isolate the machine vibrations from the waist belt will be done by two methods:

a) Method1: By use of elliptical leaf spring mounts, where in high strength but highly flexible polymer (poly-butylene) sheets sandwiched in high grade spring steel (en48D) will be used for mounting the machine on to the waist belt. These mounts will absorb the vibrations generated during drilling operations.

b)Method 2: The use of the hydraulic viscous damper will be done in such manner that the base of the damper will be connected to the waist belt just at the centre of the two elliptical spring mounts where as the top will be connected to the machine base. The damper shall comprise of the following arrangement:

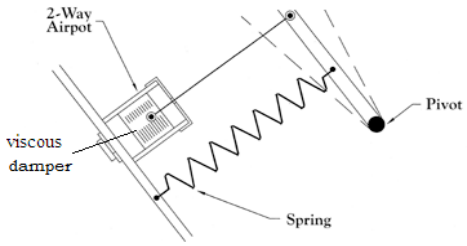

Fig.No.5: Proposed design of vibration isolator

IV. CONCLUSION:

In this this research paper, it is proposed to carry out design of waist belt mounted flexible shaft power tool which is suitable for operator of Indian origin and it will support 230V with power of 450 WATT. This work is mainly focused for drilling operations up to drilling of 12 mm diameter and round shape hole sawing up to 50 mm diameter. We also proposed to carry out design of elliptical leaf spring mounts and hydraulic viscous fluid damper for these operations only.

In the machining operations like drilling and hole sawing, the machine is no longer to be held in hand so the fatigue resulting from balancing a 4 to 4.5 kg load is greatly reduced. As the motor is no longer hand held, hence the major source of vibrations is taken away form the palm and hand area, hence minimal vibrations are transmitted. Due to the use of elliptical spring mounts and the viscous fluid damper,the range of vibration level will be reduced and hence fewer vibrations lead to lesser audible noise.

V. REFERENCES:

[1] Lars Skogsberg, *"vibration control on hand-held industrial power tools"*, Product Ergonomics, Atlas Copco Tools & Assembly Systems, Stockholm, Sweden.

[2] Alan R. klembczyk, *"Introduction to shock and vibration isolation and damping systems"*, Taylor Devices,Inc.90

[3] Haruhiko KURINO, Yoshinori Matsunaga, Toshikazu Yamada and Jun Tagami, *"High performance passive hydraulic damper with semi active characteristics"*, 13th World conference on Earthquake Engineering, Canada, paper no.33, August 2004.

[4] Seri Rahayu K, **"***Vibration of Power Hand Tool and Discomfort Experience among Malaysian Industrial Workers"*, second international conference on ergonomic, Malaysia, vol.2, 2013.

[5] D.Lee&D.P.Taylor, *"Viscous damper development and future trends"*, Taylor Devices, Inc. - N. Tonawanda, NY, USA.

[6] Edward F. Burton, *"Flexible shaft power tool"*, United States patent, 2840673, June 1958.

[7] S.Adewusi, S.Rakheja, P.Marcotte and M.Thomas, **"***Distributed vibration power absorption of the human hand arm system in different postures coupled with vibrating handle and power tools"*, International journal of Industrial ergonomics 43(2013), pp.363-374.

[8] Stephen C. Oberheim, **"***Semi active anti vibration systems for hand held electrical power tools"*, United States Patent, US 8,960,323 B2, Feb.2015.

[9] Gerhard Meixner, *"Handheld power tool with a handle vibration damped by compensating means"*, United States Patent, US2010/0206594 A1, Aug.2010.

[10] K Miyashita, S shiomi, N Itoh, T Kasamatsu and H Iwata, *"Epidemiological study of Vibration syndrome in response to total hand tool operating time"*, British journal of Industrial medicine 40(1983), pp.92-98

[11] Snowdon J. C., *"Isolation and Absorption of Machinery Vibration"*, AcusticaVol.28, No.6, 1973, pp.307-317

[12] Snowdon J. C.,*" Vibration Isolation: Use and Characteristics"*, Technical Report 128, National Bureau of Standards, May 1979

[13] S.kogsberg L, *"Power tool design for good ergonomics"*, Product Ergonomics, Atlas Copco Tools & Assembly Systems, Stockholm, Sweden.

[14] Martin E. Cobern & Mark E. Wassell, *"Laboratory Testing of an Active Drilling Vibration Monitoring & Control System"*, APS Technology, Texas. Inc.2005

[15] J. S. Rao & K. Gupta, *"Theory and practice of mechanical vibrations"*, New Age International (P) Limited, publishers, 2014.