

Suppression of Vibration and Noise of Picking Mechanism in Power Loom



Prahalad S. Badkar, M. M. Benal

Abstract: In textile industry, Power looms are operated by electric power to weave patterns or thread into cloths. In power looms, due to rotating and sliding component results into vibration, excessive noise, fatigue failure and other premature failure of machine components. In this review paper identifies, various vibration causing components of shuttle power loom and summarized on the modification and analysis carried on shuttle Power Loom for minimization vibration and Noise.

Keywords: Picker, Shuttle, Picking Mechanism, Vibration, Noise

I. INTRODUCTION

The machine used in the yarn fabric is made by interlacing yarns of two sets both are right angles to each other. Long yarn is called warp, and the crossing yarn is called filling or weft. All fibers used for weaving will first spin into yarn. Yarn producing raw materials are products of protein fibers such as wool, silk, and cellulose fibers, cotton and jute.

The shuttle loom that uses a shuttle that contains a reel of filler yarn the shuttle moves through the loom and during this process leaves a filling trail at a speed of about 110 to 225 picks per minute. A shuttle is appropriately designed to store a holder for filler yarn that carries the weft thread during weaving with a loom. The shuttles passed back and forth through the shed, between the threads of the warp thread and the weft threads.

Five basic processes are involved in weaving a fabric, both by hand loom and power loom. In the first, called "let off", the warp is kept under tension and supplies the yarn at a constant rate while the weaving process proceeds. This is followed by shedding, which involves raising and lowering the warp threads in certain variable sequences that are determined by the planned structural design or fabric construction. In the third procedure, known as picking or weft insertion, the filling threads are inserted through the open space, called shed, formed by the upper and lower groups of warp threads. In the next step, by performing the beating up, each filled line is forced against the previous line to create a compact fabric.

In the final procedure, which is called taking up, the completed fabric is drawn on a roll, ready for shipping. Following Figures 1, 2 and 3 shows the power loom and its parts such as, cam and bottom shaft of loom and Picking mechanism of loom respectively. The machinery and equipment used in the textile factory are highly diverse in its nature and most of them emit high noise levels and vibration [9] due to the frequent operation of noise generating units such as fast moving mechanical components. The importance of noise control [8] is becoming increasingly important in the textile industry as global statistics inform the seriousness of workers' hearing problems in the textile industry. A man should be able to hear 1-130 dB and frequencies from 20 Hz to 20 kHz.



Fig.1 Shuttle Power Loom

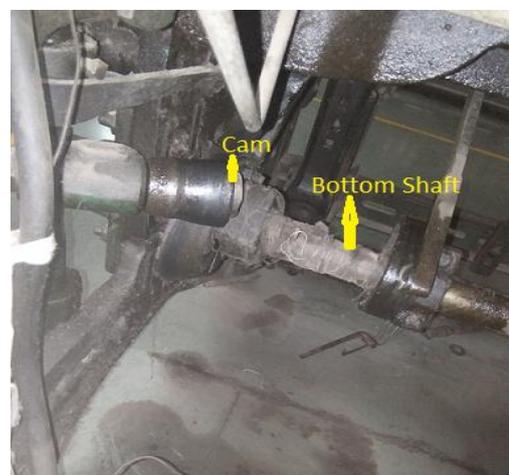


Fig.2 Cam and Bottom shaft of Shuttle Power Loom.

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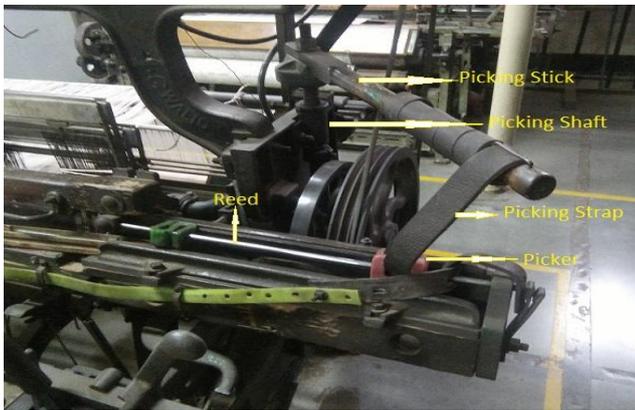
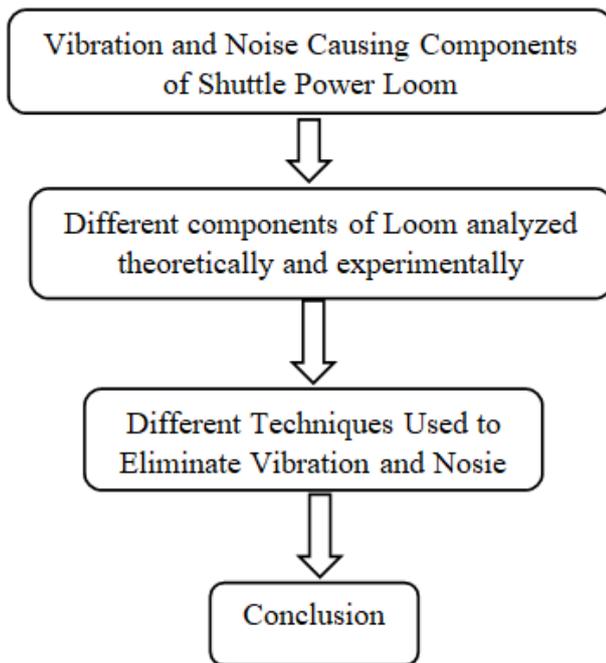


Fig.3 Picking Mechanism of shuttle Power Loom.

II. THE METHODOLOGY



III. LITERATURE REVIEW

Following are some of the important reviews of different researchers and scientists in the field of textile machine vibrations.

P. R. Lord et al. [1] the paper presented for designer to help the overcome some of the shortcomings the system. During a running condition of shuttle loom, creates vibration and noise from the traditional picking mechanism. It is verified by measuring the speed and power values on several loom cycles. The possible causes of behavior are discussed from theoretical perspective and simple classical theories.

This shows that the loom is considerably irregularity with picking mechanism during running. The mechanism is not fully controlled, which causes vibration and noise. The system namely picking mechanism needs more improvement. Principles applied to picking mechanism are not accurate and there are various aspects, under dynamic circumstances with evidence of cam profile and mechanism of elasticity.

The picking stick check is source severe stress as well as vibration and needs a more operative method of stick checking is necessary. The bottom shaft assembly of mass and elasticity affects the system the alacrity and cause the

variation in cycles of running loom. These elements are shown to be significant in accomplishing a regular pick that remains dynamically resembling both sides.

F. D. Hart et al. [2] “the general mathematical model of the picking mechanism of fly-shuttle loom and dynamic analysis” (F. D. Hart August 1976, 835) were conducted. The mechanical separation among the cam and pick ball in the flyshuttle loom reasons for the impact and vibration that can lead to significant noise emissions. The removal of separation is analyzed by the mathematical model, which simulates the system's dynamic response characteristics. Factors considered are to be equivalent to stiffness, mass, and system damping, amplitude of excitation, the effect of pre-loaded given through a holding spring. Operational conditions as well as system parameters gives the separation that anticipated by inspecting the contact force established between cam and follower.

The most common approach involves modeling, the formulation of displacement equations and the consideration of conditions that permits the contact force among the actuating and driven components to zero. This paper deliberates the general modeling of the picking mechanism of the flyshuttle loom, which creates minimum contact due to the relationship among dimensionless system parameters and eliminates the occurrence of mechanical separation.

This study can be concluded that the in flyshuttle loom care should taken for choosing a retaining spring to eliminate the separation between cam and pick ball. If the spring is too soft compared to the overall stiffness of the mechanism, separation can still occur; and if the spring is greatly harder than the required value, then unnecessary wear can be caused by excessive contact between the two components. Near area resonance, system damping may have a beneficial effect on preventing separation.

Sadao Aso et al. [3] The experimental investigation of the actual noise level produced by power loom, the method used to reduce the noise level and explore the possibility of controlling the noise generated by the power looms in a factory. This paper measures the sound level and sound pressure level generated by a power loom and calculates the sound power. It also explores noise sources, describes some methods to eliminate noise and to insulate.

A piece of glue was fixed on the surface of the stopper and a suitable spring was changed to reduce the impulsive. Then the noise made by the picking mechanism in the high-frequency range decreased 4-5 dB. After the gearing was insulated with a cover, radiated noise by gearing driving part has fallen by 4-8 dB in the mid and high frequency range. This indicates that the sound produced by power loom can be greatly reduced by adjustment of the power loom and insulating the sound source.

Experiment was conducted at the workshop of the University of Tokyo. The room floor is built by 81 m² (9 m x 9 m) with concrete. The roof is made of wooden planks under a sheet of zinc. There is no ceiling. The four sides of the room are mortar walls panelled with boards. There are no windows for two sides and are trapezoid. The other two sides have windows and rectangles in shape.

Noboru Inui and Hidenori Yokoi[4] the measurement were carried out for the oscillating frequencies for the ground and the neighboring homes when many looms were simultaneously running to test the properties of the impact vibrations to the ground and the impact of the vibration near the waving mill.

Experimental results have shown that:

1) The natural frequency of wooden houses is 2-3 Hz in horizontal vibration. For a low frequency, if the ground is so soft to resonate. The forced vibration of the loom with 2 - 3Hz housing would be seriously causing environmental problems.

2) The Countermeasure of this problem is only to mount looms on floating labs.

3) If the ground is firm with frequency 2-3 Hz is not easily resonate, this type vibration is limited to the small area. The use of developed vibration-free devices is considered effective in this context.

Characteristics measurements were made with many shuttle looms with running condition and counter-measures were proposed to reduce floor vibrations.

The floor creates forced vibration for running looms provides considerably more complex waves, including high frequency components. Similarly, the Fourier Spectrum and Power spectral density do not show the only large peaks in their measured waves and also shows more complex waves, especially in the vertical direction. The main frequency in the horizontal direction is 2.6 Hz, with 2.8 Hz in the vertical direction.

This can be predicted by the results that the ground and horizontal frequencies of floor have characteristics that resemble each other and they are easy to resonate.

T. Ishida , A. Umeda[5] carried some attempts to minimize the sound for a shuttle weaving mill by remodeling the sound sources using the sound-proof cover. It has been shown that significant reductions in sound level have been achieved from the picking mechanism using the enclosure. Sound-proof looms have been developed based on stated remarks.

Different efforts to minimize shuttleloom sound with use of different types of sound-proof materials as a loom enclosures and remodeling of the loom components. It was first needed to control the sound caused by the motion of picking mechanism. To reduce the level of sound. Some efforts were made to reduce the shuttle's kinetic energy.

“Shuttle velocity control from multi-pressure Swell” A multipressure swell device is set on a 110 cm wide empty loom with 160 velocity of 160 r.p.s. Speed is measured with camera stroboscope.

Multi-pressure swell has been shown to be effective in gradually lowering the shuttle velocity throughout the length of shuttle box. Noise reduction at the initial velocity of 11 m/s is 2 dB (A). Further noise reduction achieved replacing

the material of fabric stick bumper into elastic material with further reduction of 1 dB (A).

Shuttle velocity reduction through the change of eccentricity The influence of the shuttle velocity on noise fall for 140 cm wide empty loom with speed 180 rpm compared to following speeds 11.5 and 10.2 m/s. The velocity of 11.5 m/s is normal speed and the speed of 10.2 m/s has been accomplished with modification of beating up motion, i.e. the length of the crank arm changed from 0.06 mm to 0.07 mm, to get more time to shuttle for shuttle passage. Results obtained are shown in the Table 1.

Table 1: Shuttle Velocity and Noise Level

Shuttle Velocity in (m/s)	Noise Level in dB	
11.5 (Crank arm length 0.06 mm)	98 dB (A)	96 dB(C)
10.2 (Crank arm Length 0.07 mm)	95 dB (A)	94 dB(C)

However, after the crank arm was remodeled, on the side of the frame remote from the motor the amplitude of the vibration increases due to the unbalanced movement of the sley. So if eccentricity changed, For Sley movement balancing is required.

Soundproof Protection used for Loom

The composite material board was used for a 140 cm wide empty loom, which provides a good result among materials investigated for the picking mechanism to provide the soundproof shield. From enclosure of the first soundproof loom, the sound pressure to discharge from the opening, and it was reduced through the absorbing material of the sound and also using the shutter. Table 2 provides numerous practical conditions were considered for sound levels at 180 rotation/min with 140 cm wide loom.

Table 2: Noise reduction using cover

Condition	Noise Level in dB	
(1) Loom without cover	98 dB(A)	96 dB(C)
(2) Loom with cover	96 dB(A)	95 dB(C)
(3) As (2) but without shuttle	94 dB(A)	95 dB(C)
(4) As (2) with remodeled stick bumper	94 dB(A)	93 dB(C)
(5) As (4) but without shuttle	93 dB(A)	93 dB(C)

Based on results found from the first soundproof loom, with thickness of 3 mm damping sheet and 25 mm of polyurethane foam layer were used and for second soundproof prepared with size of 3.2 mm thick steel. Results and details derived from the Series investigations. These results based on the speed 180 rotation / min and size of 140 cm wide empty loom. Refer the Table 3

Table 3: Technical details and results

Condition	Original					1 st			2 nd		
	1	2	3	4	5	1	2	3	1	2	3
Cover for picking device	no	no	no	no	no	op	op	op	op	op	op

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Cover for gearing	no	op	op	op	op						
Cover for picking cam	no	op	op	op							
Remodelling of stick bumper	no	op	op	op	op	no	op	op	op	op	op
Velocity reduction of shuttle	no	no	op	op	op	no	no	no	op	op	op
Change in picker material.	no	no	no	op	op	no	no	no	no	op	op
Instead of gear system, Timing is belt used.	no	op	op	op							
Prevention of picking-cone bounce	no	no	no	no	op	no	no	no	op	op	op
Change in picking cone material.	no	op	op								
levels of Noise in dB(A)	98	98	95	94	94	96	94	93	89	89	89
Levels of Noise in dB(C)	96	96	94	96	93	95	93	93	93	92	91

Note: (op) operational, (no) non-operational.

Sadettin Kapucu et al. [6] proposed the method for elimination of residual vibration of shedding mechanism, which connect between heddle shaft and cam mechanism. A design of cam is carried with blends of three functions cycloid, a ramped versine and a ramp. This superimposed function redesigned using system's natural frequency and damping ratio to result into zero residual vibration of the heddle shaft.

The Differential equation of motion derived for shedding cam-linkage mechanism. This equation of motion solved for the cam profile. The new cam profile results into high contact forces at cam surface and removes the residual vibrations.

R. Devarajan[7] design modification and analyzed for the following components such as picking system, shedding mechanism, beat- up system to achieve smooth picking and effective braking at higher speeds.

After modifications following results reveals that picking force and Pick retardation reduced by 14 and 23% respectively. And sley eccentricity by 7.1 % increase. Sound level at picking bowl reduced from 102 dB to 9 dB and at shuttle box 109dB to 105 dB.

IV. CONCLUSION:

Discussion on literature review, it observed that, the operation of picking mechanism and shedding mechanism is not smooth in running condition of the Shuttle Power Loom. To improve the Performance, minimize noise and vibration of Shuttle Power Loom requires some design modification of the picking machine components.

REFERENCES

1. P. R. Lord, M. H. Mohamed "An Analysis of the Picking Mechanism of a Textile Loom" ASME Journal of Engineering for Industry, MAY 1975.
2. F. D. Hart, B. M. Patei, J. R. Bailey "Mechanical Separation Phenomena in Picking Mechanisms of Fly-Shuttle Looms" ASME Journal of Engineering for Industry, AUGUST 1976
3. Sadao Aso, Rikuhiro Kinoshita, Heihachi Uematsu and Kiyohumi Sasaki, "Noise Generated by a Power Loom" Journal of the Textile Machinery Society of Japan, 1965
4. Noboru Inui, Hidenori Yokoi "Vibrations Caused by Looms" Journal of the Textile Machinery Society of Japan, Vol.2 6, No. 3, P170-179(1973-3)
5. T. Ishida, A. Umeda "Some Attempts at Reducing the Noise of Shuttle Looms" The Journal of The Textile Institute, Taylor and Francis, 78:5, 450-463, 18 Dec 2008.

6. Sadettin Kapucu, M. Taylan Das, Ali Kiliç "Cam Motion Tuning of Shedding Mechanism for Vibration Reduction of Heald Frame" Gazi University Journal of Science, 21.09.2009
7. R. Devarajan "An Analysis on Increasing The loom speed", International Journal of Trend in Scientific Research and Development, Volume - 2 | Issue - 5 | Jul-Aug 2018
8. M.K.Talukar "Noise Pollution and its control in textile industry" Indian journal of fibre & Textile Research vol26 June 2001 .PP 44-49.
9. Umang S. Modi, B. A. Modi "Design and Analysis of Picking Cam for High Speed Shuttle Loom" National Conference on Machines and Mechanisms (iNaCoMM2013), IIT Roorkee, India, Dec 18-20 2013

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