DESIGN AND ANALYSIS OF PICKING & CHECKING MECHANISM OF SHUTTLE LOOM

1 .Patel Dhaval Rasikbhai

M.E. Mechanical (CAD/CAM) , Mechanical Engineering Department ,
Hasmukh Goswami College of Engineering ,
Gujarat, India

ABSTRACT

Shuttle loom is one of the oldest machine for weaving of cloth, and is the vital machinery for power loom industry in India. With this basic loom it is possible to weave nearly all type of cloths very efficiently. This ancient machine is still used by many weavers in India, so they face many problems because of high power consumption and more losses of energy, than any other machinery for this industry To obtain minimum power consumption, detailed analysis of another auxiliary mechanism called checking, which is also related to picking mechanism, is required. The mechanism operates by applying brakes to the shuttle, which is at very high speed, and prepare the shuttle for next cycle of picking mechanism. It uses spring loaded swells to retard the shuttle. Due to retardation, velocity of shuttle decrease to zero. If these brakes are not released then picking mechanism needs to generate more power to strike picker on the shuttle. Hence it is extremely necessary to design and develop a mechanism to compliment the checking mechanism and to move in the direction of achieving minimum power consumption.Detailed study is done on the working of checking mechanism of the present loom. The aim of this project is to develop Picking shaft for better Performance in twisting moment. The aim of this project is to develop a checking mechanism which releases the spring loaded swell at the time of initialization of picking mechanism and load that spring to brake the shuttle when picking mechanism ends.

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Keywords *: Shuttle loom machine , Picker , Shuttle , Picking mechanism , Picking Shaft , Checking mechanism*

1. Introduction

Weaving is a method of fabric production in which two distinct sets of yarns or threads are interplaced at right angles to form a fabric or cloth. The longitudinal threads are called the warp and the lateral threads are the weft or filling. The method in which these threads are inter woven aects the characteristics of the cloth. Cloth is usually woven on a loom, a device that holds the warp threads and inserts weft threads into it. The warp and filling threads interplace with each other is called the weav Weaving is a method of fabric production in which two distinct sets of yarns or threads are interplaced at right angles to form a fabric or cloth. The longitudinal threads are called the warp and the lateral threads are the weft or filling. The method in which these threads are inter woven aects the characteristics of the cloth. Cloth is usually woven on a loom, a device that holds the warp threads and inserts weft threads into it.

The warp and filling threads interplace with each other is called the weave. Loom is a device used to knit fabric or cloth. Its function is to hold the longitudinal threads or warp threads and to insert laternal thread or weft threads into warp threads. Process of inserting weft threads into warp threads is known as weave.There are different types of loom available to wave cloth and it is classified in following paragraph. For power loom machinery, shuttle loom is the basic and former weaving machine for all types of fabrics. In shuttle loom weft is inserted by a shuttle that traverses back and forth across the loom width.

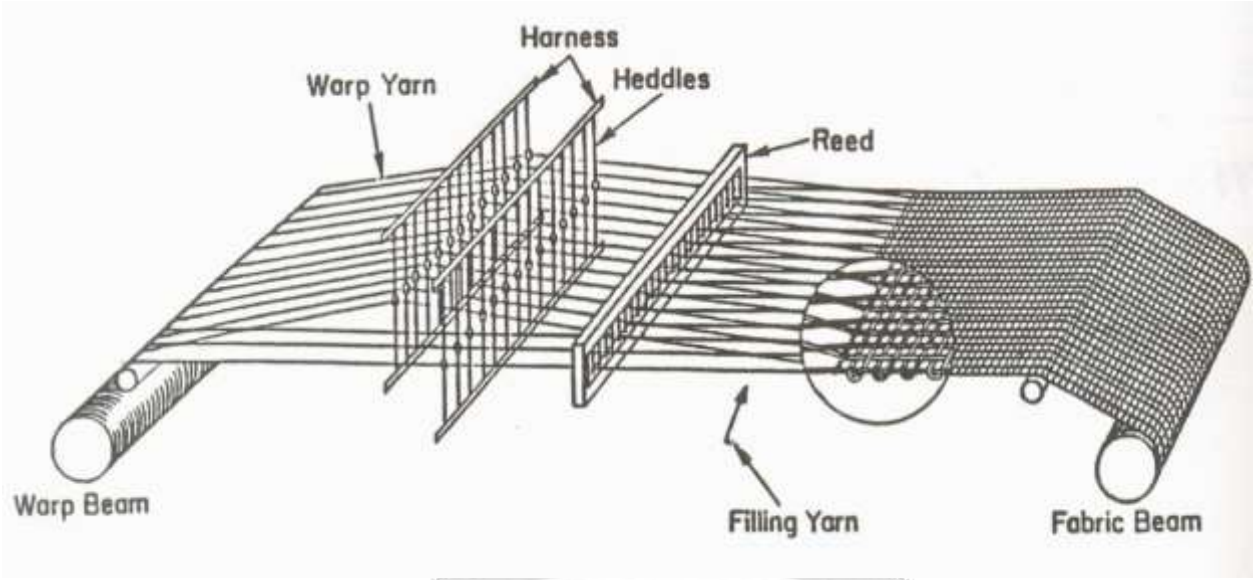

Figure 1. Power loom

2. Literature Survey

- Shuttle Loom is widely used in Indian Power loom industry due to its versatility to weave nearly all kind of fabrics. The only problem with this machine is that the speed is low compared to the other weaving machines. It can be enhanced by improving the speed of shuttle loom .This needs to increase the speed of picking mechanism which plays the main role in weaving of fabric. Detailed study was done on the working of the picking mechanism of present loom. Experiments have been carried out to study the motion of a shuttle in the present machine. Kinematic and Dynamic analysis are done for the present loom.Cam profile has been generated and Kinematic and Dynamic Analysis are carried out for the designed cam. A prototype is manufactured and from the practical experiment it has been observed that the accuracy, speed and force of picking mechanism have been increased.

- Start-up marks are considered as one of the major defect in woven fabric, it occurs when the loom is restarted after loom stoppage due to various reasons. This defect is more prominent in high speed weaving looms especially with elastic warp yarns and is caused to deteriorate the fabric quality.This research paper deals with the mathematical analysis of the startup mark generation in elastic tape on narrow fabric loom. Mathematical analysis was carried out for both continuous operation condition and under stopping condition of the narrow fabric loom.

- This paper proposes a fast accelerating method for the weaving machine drive system, which an open winding of the induction motor is used and connected in series to an inverter and a switching unit.Generally, the star(Y)-delta switching method is used in the start-up mode in order to suppress the rush current in general applications. However, in weaving machine, the rush current is required in the start-up mode in order to increase starting torque. If the starting torque is not enough to the induction motor, deficiencies of fabric cloth which is called "start-up marks" will happen. We proposes the Delta - Y switching method that achieve high rush current in order to increase starting torque for weaving machine drive system.

- The motion law of the rapier and the characteristics of rapier loom's weft-insertion mechanism were analysed. According to the special requirements to loom's weft insertion mechanism for weaving three-dimensional fabric, a new rapier weft-insertion system was designed. The weft-insertion system with computer-controlling and servo-cylinder driving was applied to control the rapier's movement on the three dimensional loom. This method not only simplifies the weftinsertion mechanism, but also achieves weft-insertion with variable travel, and improves the flexibility and reliability of weft-insertion system.

Problem Definition

The Shuttle loom is weaving machine use to make different types of fabric. With this basic loom it is possible to weave nearly all type of cloths very efficiently. This ancient machine is still used by many weavers in India, So they face many problems because of high power consumption and more losses of energy. To improve the production rate, it is mandatory to increase the speed of picking mechanism, which plays main role in weaving of the fabric.

To obtain minimum power consumption, detailed analysis of another auxiliary mechanism called checking, which is also related to picking mechanism, is required. The mechanism operates by applying brakes to the shuttle, which is at very high speed, and prepare the shuttle for next cycle of picking mechanism. It uses spring loaded swells to retard the shuttle. Due to retardation, velocity of shuttle decrease to zero. If these brakes are not released then picking mechanism needs to generate more power to strike picker on the shuttle. Hence it is extremely necessary to design and develop a mechanism to compliment the checking mechanism and to move in the direction of achieving minimum power consumption.

In picking mechanism, the operation should smooth and jerk in running condition. Picking is classified as smooth picking and harsh picking according to its performance while running. The existing design of shaft for Picking mechanism of shuttle loom is not smooth in operation. The Quality of fabric is affect due to jerk running condition of Picking mechanism.

Research Objectives

- To design and develop a new Checking mechanism to move in the direction of achieving minimum Power consumption.
- To make new design of Shaft which will give smooth running condition of Picking mechanism of Shuttle loom mchine.
- To prepare the 3D CAD model of Shaft for Picking mechanism.
- To perform analysis of new Shaft design Compare it with Present Shaft design

3. Checking mechanism

The objective of the shuttle checking is to retard the shuttle nullifying its kinetic energy to zero. The shuttle checking mechanism is shown in the Figure. The incoming shuttle gets rubbed on the spring loaded swell and thereby the frictional force slows down the shuttle velocity. The velocity of the incoming shuttle is reduced around 30% by the action of swell. The shuttle is finally stopped as it collides with the picker, which is cushioned by a suitable buffer system. The arrangement is shown in figure.

Shuttle mass and checking

The mass of the shuttle gradually decreases as the pirn weaves down. However, the checking force remains unaltered, and hence the effectiveness of checking the shuttle must have to be better. As the shuttle mass is gradually reduced the impact velocity of the shuttle will also be less. In according to Shuttle mass of Shuttle loom machine , the checking system should be effcient to allow for variation in the shuttle speed due to reduction of its content. Furthermore It should be able to allow for any variation in the shuttle speed due to friction and other resistances during its trajectory through the shed.

Ideal checking conditions

For better operation of checking some usual conditions should be fullfilled. They are

1. The shuttle should be retarded at the same position after every picks.
2. The retardation between shuttle and picker should be kept as small as possible.
3. The impact velocity of the shuttle with the picker need to keep smaller.

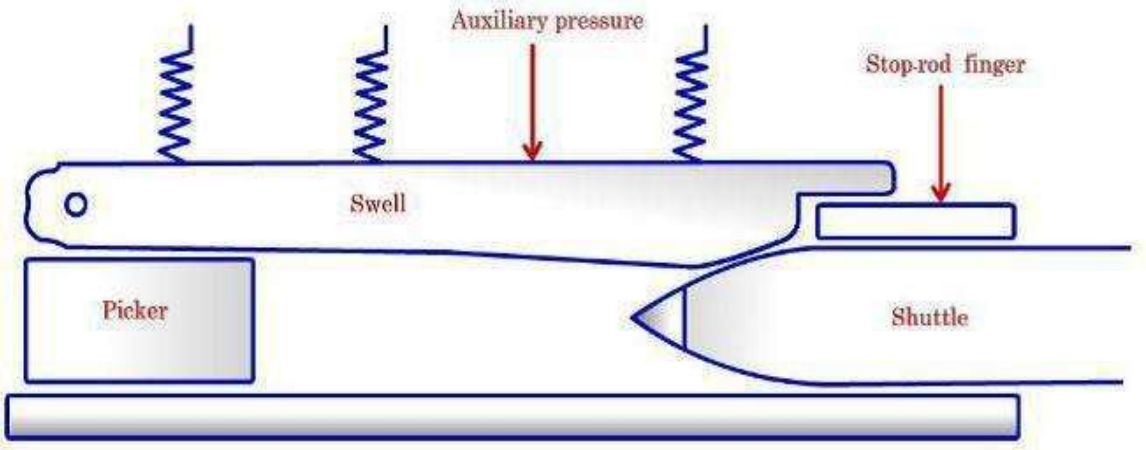

Figure 2. Checking mechanism

Shuttle movement for picking mechanism

Following data contains details for proposed loom. This specifications are for Arun Industries,which is under shuttle loom category.
Weight nearly - 1000 kg
Speed range - 120 to 150 P.P.M
Material - Mostly casting
Shuttle Length = 0.4064 m
Shuttle weight = 0.450 kg
Loom Speed = 140 R.P.M

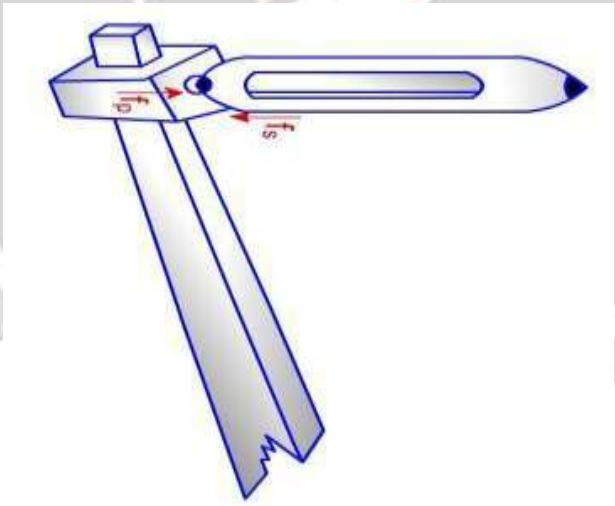

Figure 3. Forces acting during Shuttle strikes the Picker

Spring Design For Checking Mechanism

To achieve the checking mechanism need we have to put a spring which apply force on the swell. That force should be capable to slow down 30% of shuttle velocity . To reduce that much velocity spring should apply 63 N force on swell. so, design of spring should be done under that loading condition. The deflection of spring is considered by slider displacement of proposed mechanism. To design this spring, spring index is taken most common one. Spring is designed by trial and error method. All parameters are calculated as follows.

Input Parameters,
Deflection = 40mm

Axial Load (P) = 69 N

Stiffness (k) = 1.575

Spring Index (C) = 8

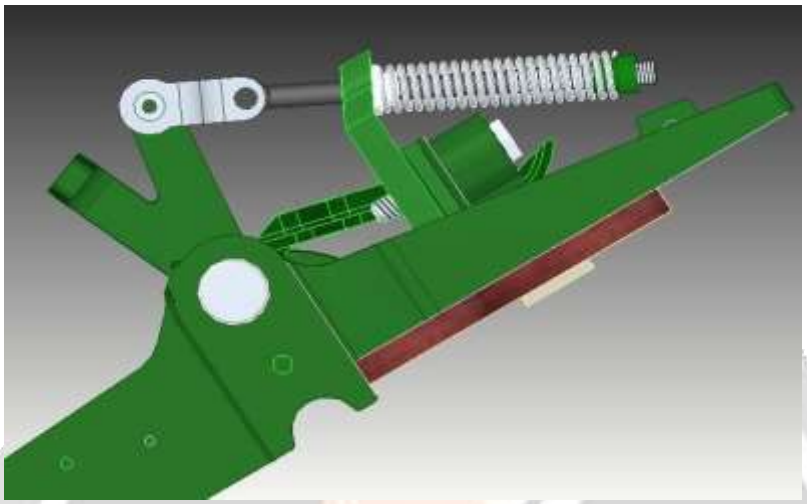

Figure 4. Model of Proposed mechanism

4. Picking Mechanism

For picking mechanism, the operation should smooth and jerk free in running con-dition. Picking is classified as smooth picking and harsh picking according to its performance while running. When the fabric is very much thin then picking must be smooth. Smooth picking is achieved by designing the component under high factor of safety so that it can sustain extra forces. This extra forces are generated when shuttle is misplaced by its path of free flight. If shuttle is not placed exactly at its prescribed starting position then it disturbed the static equilibrium forces in shaft. Picking Shaft is under twisting moment so its better to design circular shaft earlier, its cross section was hexagonal.Shuttle is flying on its path which is predefined on sley. In case of shuttle disturbed from its way then whole sley assembly, which is oscillating, will have unbalanced forces which disturbs force equilibrium at sley assembly support bearings mounted on tappet shaft. Single groove ball bearing is preferred for this support so here choose bearing unit to simplify assembly of sley on tappet shaft and make picking smooth.

To modify shaft for better performance in twisting moment its cross section is changed to circle from hexagon. Present shaft is over weighted to sustain twisting moment with hexagonal shape. Its inscribed circle diameter is 39.26 mm. Present shaft is shown in figure. For the same length and same loading condition the diameter and the X-section of shaft is changed. The shape is changed from hexagonal to circle and diameter is changed from 39 mm to 25 mm. The model for proposed mechanism is shown in figure.

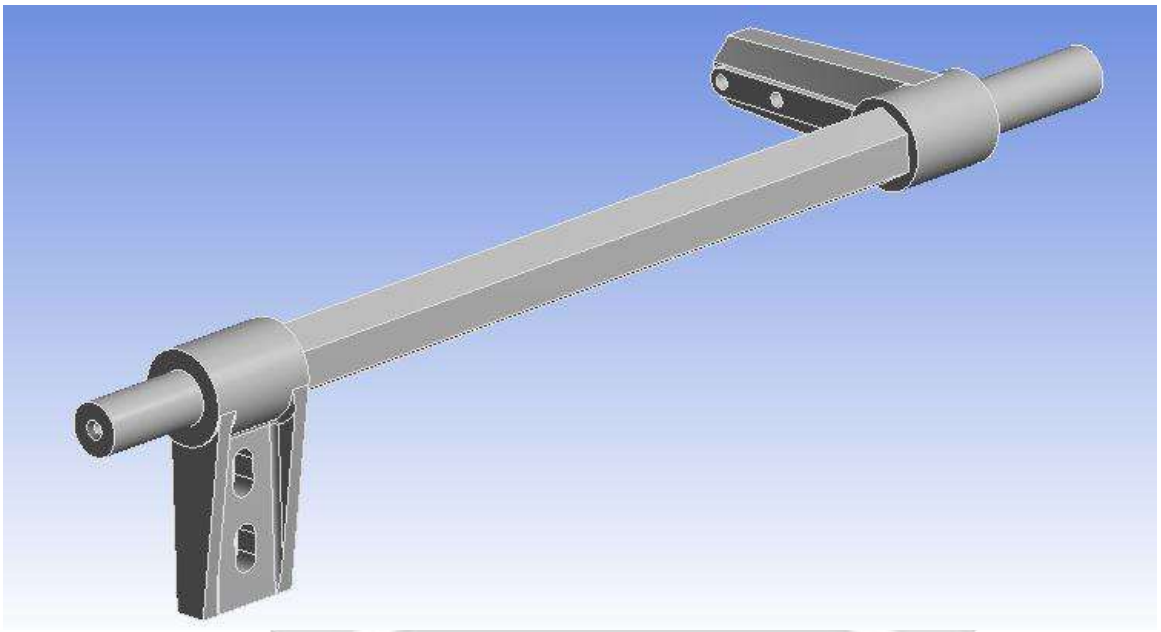

Figure 5. Model of Present Shaft

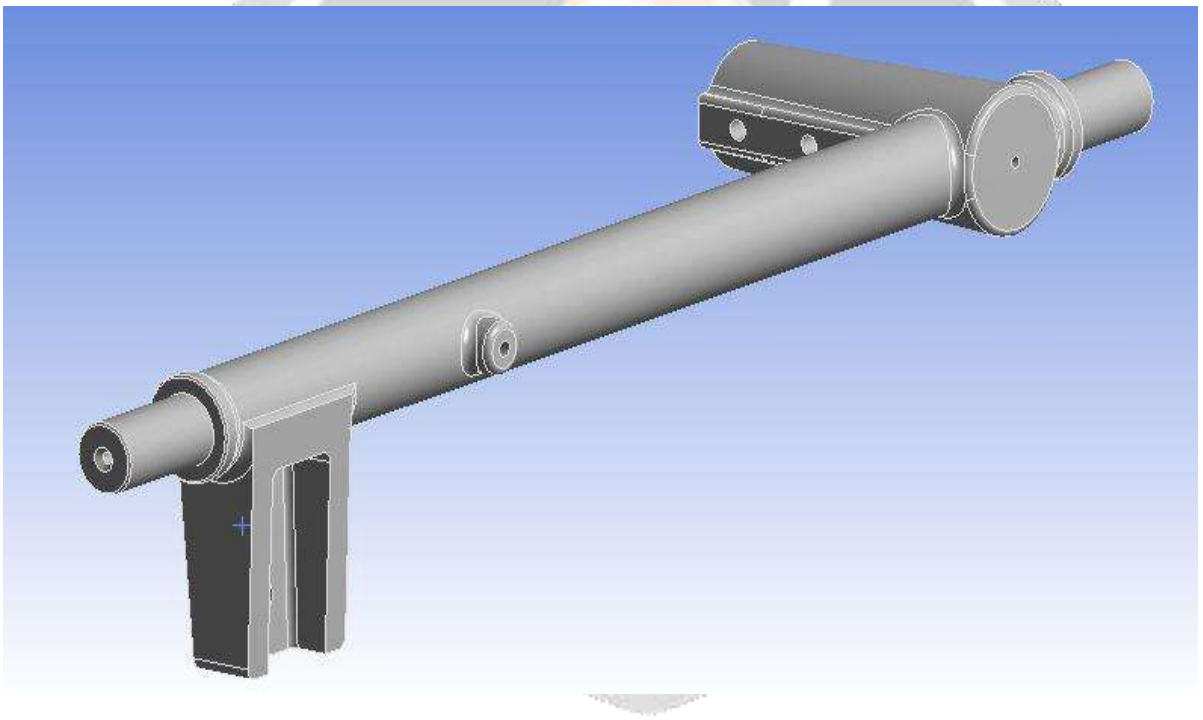

Figure 6. Model of Proposed Shaft

5. Conclusion

The Shuttle loom machine face many problems because of high power consumption and more losses of energy, than any other machinery for this industry. To improve functionality of shuttle loom various parameters are identified for picking and checking mechanism. Both picking and checking are interrelated with each other.Here, checking of the mechanism is developed from scratch to reduce picking force transmitted by picker to shuttle. To also improve the production rate, it is mandatory to increase the speed of picking mechanism, which plays main role in weaving of the fabric. The Picking and Checking mechanism directly affected Quality of fabric.

Hence it is extremely necessary to design and develop a Checking mechanism to move in the direction of achieving minimum Power consumption.

The operation of Picking mechanism is not smooth in running condition of Shutte loom machine. To also improve the Performance of Shuttle loom machine require to make Smooth running condition of the Picking mechanism of Shuttle loom. To obtain smooth picking mechanism, picking shaft has been replaced to work under torsional loading condition. For the picking shaft present and proposed models are verified by FEA Tool, Ansys, to check stress concentration under twisting.

In order to get smooth and less expensive picking mechanism, checking mechanism is developed here to brake and release the swell to stop shuttle. For present mechanism picker need to generate 260 N force to accelerate shuttle. With this proposed mechanism picker need to develop 190 N force to accelerate shuttle. Which is to improve life of Shuttle and Picking stick, which are most commonly failed parts.

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