Tension Monitoring of Let-Off Motion in Power Loom

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Abstract— this paper is related to the automation for tension monitoring of warp during manufacturing of fabric (cloth) in power looms. If tension is not maintained properly it affects the quality of fabric (cloth). The aim is to improve the quality of clothes and make it defect free. In this we replace the conventional system of the chain and weight by the braking system and the bevel gear with dc motor. Because in conventional system negative let off motion, the tension on warp is maintained manually which is not accurate. This is done by adjusting the wt. on cantilever manually so most of human errors occur. To reduce those errors we made this system.

Key words: Yarn, Shuttle, Warp, Weft, Ratchet

I. INTRODUCTION

A. Power Loom

A loom is a machine used for weaving yarn in textiles. There are many types of looms, including the hand, frame loom, and shuttle loom. A power loom, yet another type of loom, is a mechanized tool that uses a drive shaft for power. Invented by Edmund Cartwright in Great Britain in 1784, the power loom allowed manufacturers to create textiles much more quickly than with hand-driven looms. This improvement helped the power loom become one of the defining machines of the industrial revolution.

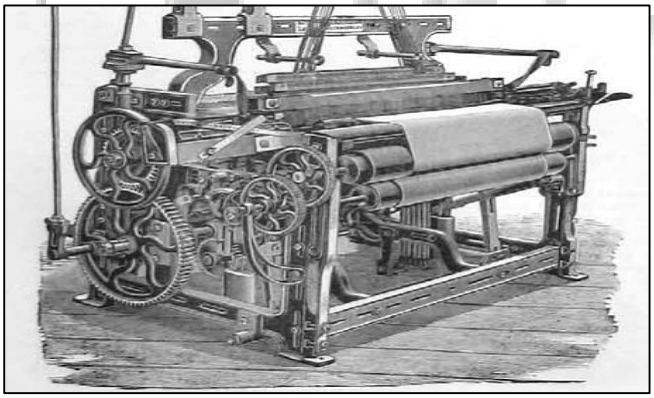

Fig. 1: Power Loom

A loom works by holding lengthwise threads, called the warp, under tension. The vertically-oriented threads are attached to two or more harnesses which move up and down, separating warp threads from each other and creating a space called the shed. Another thread, called the weft, is wound onto spools called bobbins, which are placed in a shuttle and passed through shed, which creates the weave. In the early 20th century, the shuttle less loom, also known as the rapier loom, was invented. This type of power loom moves the weft through the shed using jets of air or water, steel rods, or a dummy shuttle that leaves a trail of yarn rather than using a weft.

B. Positive Let Off Mechanism

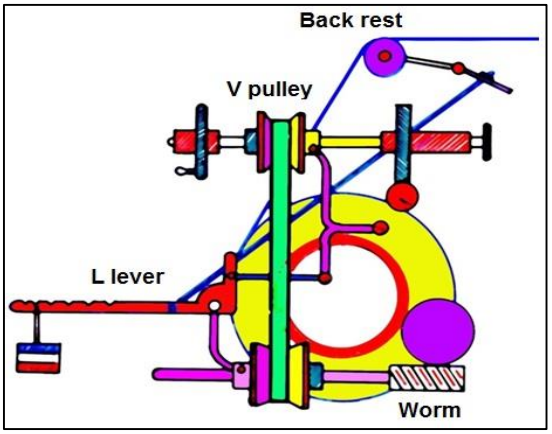

Fig. 2: Positive Let-Off Motion

The beam turning mechanism is shown in the figure. The beam is driven by ratchet on a short vertical shaft, which also carries the worm, which drives the worm wheel. A pinion on the same shaft as the worm wheel drives the large beam wheel, which is fixed, to one of the beam flanges.

A pawl operator turns the ratchet wheel by the driving rod, which gets motion of the sley sword. Each time the slay comes forward the oscillating collar is connected to fixed collar & there is engagements of pawl with ratchet .As the tension in the warp sheet is increased, the floating rest will move downwards and the rod carrying the fixed collar will move to the right and the rod R1 will move to move the driving rod to the left.

This will bring the fixed collar to the oscillating collar. As a result, the force of imparted oscillating collar and fixed collar is more. The pawl drives so more ratchet wheel teeth. So the beam motion is more and more warps are withdrawn to the increased tension.

C. Negative Let Off Motion

Fig. 3 Conventional Negative Let-Off Motion

Let-off is to supply warp thread in the weaving zone at a predetermined rate. Negative let-off is a mechanism for controlling the rotation of the beam on a weaving, warp knitting or other fabric forming machine where the beam is pulled round by the warp against a breaking force applied to

the beam. Negative let-off mechanism is a very simple and manual mechanism. It is suitable for light and medium weight fabrics. It is mainly used in old looms and for weaving of plain cotton fabric.

The warp beam ruffle is wrapped around by chain. The one end of the chain is fixed at the machine frame whereas the other end is connected to fulcrum made device to the weight lever, which is pivoted and a dead weight is placed which can be moved along the length of the weight lever.

In this system the tension of the warp is regulated by the friction between chain and the beam ruffle. The friction is controlled by dead weight on the weight lever and the distance of deadweight from the pivot. Heavier the dead weight and longer the distance of it from the pivot lesser the let-off.

The warp beam diameter gradually decreases as weaving proceeds. So it's necessary to increase the let-off rate. If the dead weight is kept on the same place, the let-off rate will remain unchanged. So an experienced worker is required to change the dead weight gradually with the change of the warp beam dia. As a result irregular tension occurs and the rate of yarn breakage may increase.

II. PROBLEMS WITH CURRENT SYSTEM

1) The former turn is theoretically correct but it is practically complicated, since the construction of this let off motion is such that it is solely employed for the purpose of keeping the warp in tension and it does not in any definite manner.
2) Dark and light shades in the cloth.
3) Irregular delivery in the warp.
4) Difficulty experienced by the weaver when taking back the warp on the beam after picking out.
5) Regulating the tension on the warp, in order to start up without showing shady place in the piece.
6) Amount of attention demanded from the weaver to adjust the weight as required by the decrease in diameter of warp on the beam.
7) It is found that decrease in the diameter of the warp changes much more quickly during the last cut than during the first. This defect is more noticed in last portion of the cloth produced.

III. MATERIALS AND METHODOLOGY

It is found that as the time goes the amount of the yarn on the beam decreases so that there is the decrease in the diameter of the beam. So it is requiring increasing the speed of the beam so that the tension in the yarn in made constant. In the convention system there is the chain and weight are attached to the let off beam. Initially the beam is fully loaded by the weight and as the decrease is the beam the weight is moved towards the beam so that there is the decrease in the load on the beam and the speed of beam increases due to the tension present is the yarn. But the movement of the weight is done manually by experience. In that sometimes if there is any mistake is happen then there is the breaking of the yarn is take place.

We replace this system by using the disc brake and the bevel gear attached to the dc motor. In that the braking system is does the function as the chain do in the old system and the bevel gear with dc motor is does the function as that of the weight.

A. Braking System

Fig. 4: Hydraulic disk brake

In this system we use the disc bake which is mounted on the shaft of the diameter as that of the shaft diameter of the beam. This shaft is connected to the beam shaft by means of the coupling. The breaking system is connected to the small motor containing the cam on its shaft. The cam is rotated and it releases the brake in specific time.

The intensity of the releasing the brake increases as the speed of the cam motor increases. So we get the required motion of the beam. The disk brake with cam motor and lever is used for the rough tuning of the operation.

B. Bevel Gear and DC Motor

Fig. 5: Bevel gear with DC motor

We also use the bevel gear on the same shaft as that of the disc brake. The pinion of the bevel gear is coupled to the motor shaft. The use of this arrangement is to increase the speed of the beam as the diameter of the shaft decreases. This can be achieved by using the microcontroller which gives the signal to the dc motor.

After completion of 9090 pulse microcontroller changes the voltage for the dc motor. So the speed of the dc motor increases and we get the required motion of let-off beam.

C. Microcontroller

In this system as the diameter of the beam decreases it is require that the speed of the beam continuously increases. This can be done by decreasing braking effort of the motor by decreasing the voltage step by step. Also the braking frequency of the disk brake is required to be increases by increasing the motor speed which operates the lever. To do these two things the microcontroller is used.

For the microcontroller the input data is obtained by a proximity sensor which counts the rotation of the wheel. One revolution of wheel produces one pick that is entering of one weft in the warp.

So the relation is,

1 revolution - 1 pick - 1 pulse
1 inch - 52 pick (generally) - 52 pulse
1 meter - 2047 picks - 2047 pulse
1hour - 4.44m cloths produce - 9090pulse

After one hour that is after 9090 pulses the setting will changes. That increases the speed of the motor which increase the frequency of the braking of the disk brake. Also decrease the voltage of the DC motor to minimize the braking effort.

The program is done for the microcontroller which operates the controller. By taking the trial, values of the voltage of both the motor can be determined and according to these values all the program can be done.

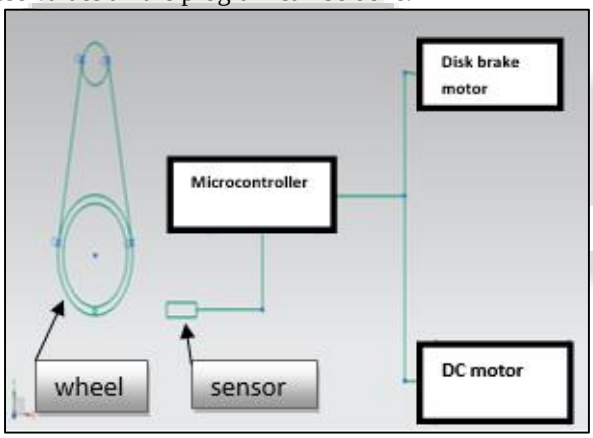

Fig. 6 Layout of the working of microcontroller

IV. DIMENSIONS AND CALCULATION

A. Specification of let off beam

1) Diameter of shaft=100mm
2) Diameter of flange=440mm
3) Thickness of flange=15mm
4) No. of pitch =30
5) Distance between two successive pitch=15mm
6) Distance of shaft between two flange=1145mm
7) Tangential force acting on the beam F=423.746N
8) Torque acting on beam T=57.205

B. Specification of the disk brake

1) Hydraulic Disc brake

- Yamaha FZS
- Diameter=280 mm

2) Specification of bevel gear and motor

- Motor= 1hp
- No. ok teeth on bevel gear=
- No. of teeth on pinion=
- Shaft diameter=45mm
- Shaft length=650m

V. EXPERIMENTAL SETUP

Fig. 7: Experimental setup

A. Advantages

- Improvement in product quality: Proposed equipment has significant impact in improving the quality
- Increase in production: The proposed equipment increased in production is almost 2.5 to 3 times per loom.
- Reduction in raw material consumption: Raw material consumption is reduces due to reduction in breakages of the yarn in shuttle power loom.
- Positive let off motion better adopted for requirements of heavy and medium cloth.
- Requires less attention of weaver.

VI. CONCLUSION

In conventional system there is a chance of the breakage of yarn this is reduced in our system because of the system is continuously operated by the microcontroller which is well programmed. Also there is no need of regular attention of weaver on the machine. So the tension is regularly maintained according to the required rate. It is for one hour 4.44m cloth is required to pass through the machine which is maintained by this system. So the production rate of the power loom increases because there is no breakage of the yarn.

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