MODIFICATION OF NEPALI TYPE PEDAL LOOM

PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report **"**MODIFICATION OF NEPALI TYPE PEDAL LOOM" is the bonafide work of "C.VIJAY, S.KANNAN, S.KARTHIK, M.R.VEDHARAMANI" Who carried out the project work under my supervision.

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Abstract

Nepali type pedal loom is a semi automated handloom, the drive is given by pedal and it drive the entire action of the loom and we face so many problems. So to overcome it we have modified the loom.

During the course of project we would be seeing the pedal drive system working and the force required for the operation of the loom and also the problems faced by the workers. And of we are going to see the various methods to find the force. After finding the force we know the values of the normal condition of the force that required for operating it. It was found to be difficult for the workers to operate the loom, so we have modified the loom to help the workers to operate the loom in a much better way than normal condition of the loom. We have increased the productivity of the loom, speed and reduced the force required to operate the loom. We have also made it as a bi-driven in both electricity and man power, so there would be good productivity even when current fails. After modification we found that the force required for operating has been reduced and increase in productivity and speed of loom.

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INTRODUCTION

Napeli type pedal loom is a semi-automated loom where all the operations are done by the pedalling alone (picking, shedding, take up). This loom best suits for the rural industries especially for the women workers. These women work for long to get a small amount of productivity of the fabric. This loom is ably used to produce cotton fabric. Loom parameters are as follows, loom width: 56 inch. This loom gives out many problems to the workers they face body problems for a very small productivity and earn a less money for what they work.

The mechanism behind the working of the Nepali loom is that, the drive is given by the pedal to bottom shaft by means of chain link and from bottom shaft to fly wheel also by chain link. From bottom shaft to picking is got by the beating bowl (under picking mechanism).

A pedal in this loom is the main driver for the production of the fabric. This pedal drives its entire force to various operations as shedding, picking, take up. Pedalling action drives these parts and helps in producing the fabric. The production of the fabric is done only by the means of pedalling. The human force is most required one in production of fabric. We have included more no of photos to say how the drive to the individual action is given by the pedalling action.

1.1 Objectives:

- To measure the Force required to operate the loom

  The force required to operate the loom various from person to person, since it is a pedal loom.

- To modify the loom - reduce the force required to operate it.
- To modify the loom to be driven by both electric and manual operation.
- To compare the difference of the different drive that operates the loom.

2. LITERATURE REVIEW

2.1. Normal Hand Loom

Handloom is a basic weaving machine which is used to make plain weave fabric and other few more complicated designs as jacquard. Handloom mechanism is that it works totally by the means of man power, which is that weaver should open the shed by pedal action and insert pick by hands. The detailed action of how it works and its parts are as follows.

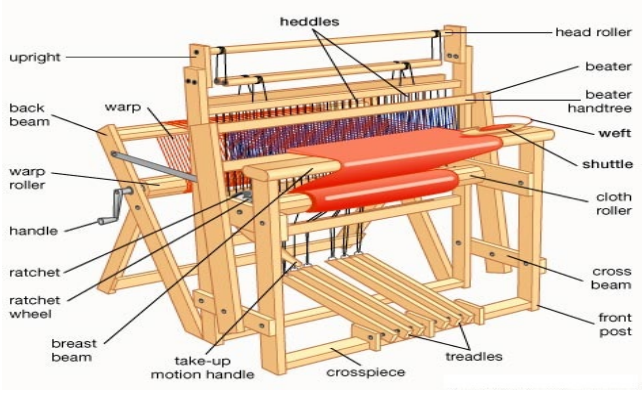

Fig: 1

When all these part work together only the fabric could be obtain. This is how a normal handloom works and fabric is obtained. The mechanism of operating the loom is that by pedalling the treadles to open the shed and pulling the handle for picking and forming the fabric.

2.2. NEPALI TYPE PEDAL LOOM

Napeli type pedal loom is a semi-automated loom where all the operations are done by the pedalling alone (picking, shedding, take up). This loom best suits for the rural industries especially for the women workers. These women work for long to get a small amount of productivity of the fabric. This loom is ably used to produce cotton fabric. Loom parameters are as follows, loom width: 56 inch. This loom gives out many problems to the workers they face body problems for a very small productivity and earn a less money for what they work.

Fig: 2

2.3. Mechanism

The mechanism behind the working of the Nepali loom is that, the drive is given by the pedal to bottom shaft by means of chain link and from bottom shaft to fly wheel also by chain link. From bottom shaft to picking is got by the beating bowl (under picking mechanism). The mechanism is as follows in the simple figure below.

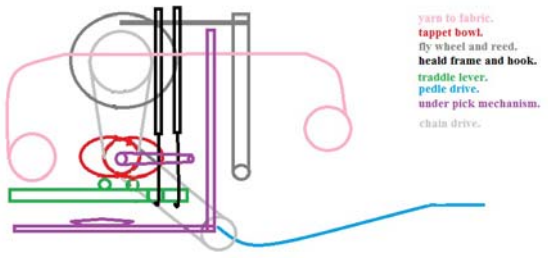

Fig: 3

2.4. Pedals

A pedal in this loom is the main driver for the production of the fabric. This pedal drives its entire force to various operations as shedding, picking, take up. Pedalling action drives these parts and helps in producing the fabric. The production of the fabric is done only by the means of pedalling. The human force is most required one in production of fabric. We have included more no of photos to say how the drive to the individual action is given by the pedalling action.

Fig: 4

Fig: 5 shows the drive given by the pedal to bottom shaft of the loom

Fig: 5

2.5. Picking mechanism

The picking mechanism used here is under pick mechanism which is found in power loom. Here picking mechanism uses two hand lever mechanisms where the force is transferred from one to other. The main drive is got from beating bowl which is attached to bottom shaft of the loom. Fig: 6 show the drive from bottom shaft to picking stick.

Fig: 6

2.6. Take Up Motion

Usually the take up motion to the loom is got by two methods that is 7 and 5 wheel take up motion. Here in nepali type pedal loom we use 5 wheel take up motion. The drive is got from beater by means of pulling pawl. The take up motion decides the fabrics picks per inch and type of weave of the fabric. Take up motion is used to pull the fabric is formed by the actions of weaving. The fabric which leaves the reed gets to breast beam and then winds to the cloth roller along with emery roller which helps in griping the fabric. The cloth roller is attached to one of the wheel of 5 wheel take up drive.

The 5 wheel drive is designed in such a way that never unwinds the formed fabric from cloth roller and it could be unwind only by external force of removing the pushing pawl. The pushing pawl is that which holds the 5 wheel to prevent from in winding and to give tension to the fabric that is formed.

Fig: 7

3. Methodology

3.1 Ways of finding force.

The ways behind to find the force required to operate the loom is based on certain factors as follows taking pedal drive into consideration we could find the force applied on the loom by women workers.

Initially finding the angular velocity and acceleration the force applied in the pedal could be found by certain formulas.

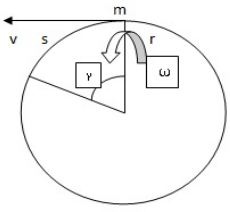

Fig: 8

The transfer of drive is that linear motion to rotational motion.

Where;

v = velocity of the sprocket,

s = distance moved by the sprocket,

m = mass,

r = radius of the sprocket,

γ = angle made by the sprocket,

ω = angular acceleration.

Newton's laws of motion are three physical laws that form the basis for classical mechanics. They describe the relationship between the forces acting on a body and its motion due to those forces. They have been expressed in several different ways over nearly three centuries, and can be summarized as follows:

1. **First law**: The velocity of a body remains constant unless the body is acted upon by an external force.
2. **Second law**: The acceleration **a** of a body is parallel and directly proportional to the net force **F** and inversely proportional to the mass *m*, i.e., **F** = *m***a**.
3. **Third law**: The mutual forces of action and reaction between two bodies are equal, Since this is pedal operated the force could be found as follows

The transfer of motion is from liner to rotational force

N= V⁄0.262D

Where:

N =Rotational speed of shaft (rpm)
V =Linear velocity of object (ft/min)
D =Diameter of sprocket or pulley (ft)

Consider a body of mass m moving in a circle of radius r with an angular velocity.

When the body has rotated through an angle, it has covered a distance s along circumference of the circle.

3.2 Formulas used to find.

- **Velocity** of the sprocket
  - v = s/t = γr/t

  Angular velocity w is the quotient of angle and time;
  - w = γ/t
- To find the **acceleration**
  - a = v/t
- To find **force** applied
  - **F = m x a**

To find the **shuttle speed**

- Speed of shuttle = PPM x Width in inch x Crank shaft rotation meters / sec
  150□ (starting of shuttle) x 36

Shuttle flight and its timing

150□ – Starting

180□ – Leaving shuttle box

210□ - Enters the shed

270□ – Leaves the shed

300□ – Enters the opposite shuttle box

330□ – Shuttle is checked by swell spring

3.3 FOOT PUMP METHOD TO FIND FORCE:

Foot pump method to find the force by means of attaching foot pump to the pedal of the loom.

- The idea for finding the pedaling force is that we could use the foot pump.
- The key idea is that to connect the foot pump cylinder to the existing pedal of the loom.
  - After connecting to pedal, it is operated and found for the lb/in^2 value in gauge by blocking the air flow in tube of the foot pump.
  - Now the lb/in^2 value is converted to Kg.

Fig: 9

The conversation factor for converting the Psi value to Kg force/cm^2

1 kg force/cm^2 = 14.2 Psi

1 Psi = 0.07042 kg force/cm^2

4. Calculations for before modification of the loom at normal condition.

The motion transfer is that from linear motion to rotational motion

Force calculation

As the sprocket moves, with radius, time, and angle we could find the velocity of the shuttle. They are as follows.

Fined data:

- Radius of the sprocket (r) = 6 cm
- Angle made by the sprocket (□) = 90□
- Mass of the force acting on (m)
  Average weight applied by women = 15 kg
- time taken by the sprocket = 0.50 sec

v = s/t = r/t = 90 x 6 **= 1080 cm/sec**
0.5 s

With the fined velocity we could find the acceleration as per the relation that velocity divided by time.

a = v/t = 1080/0.5= 2160

As per the Newton's law of motion force = mass x acceleration

4.1 F = m x a = F = 15 * 2160 = 32400 N = 32400/9.81*60 = 55.04 N

4.2 Production survey (theoretical value)

As per the survey taken from CNSS women workers, an average of 5 women workers for a shift of 8 hours in the loom and the production rate is found to be around 10 meters. Since this is a pedal loom it could be found by the manual vision inspection of the productivity and not necessary that it could be found by the practical calculations.

4.3 Shuttle speed calculation (Experimental value).

Shuttle speed = $\frac{30 \times 56 \times 360}{150 \times 36}$

= 112 yards / min

4.4. Force found by foot pump method value.

- The conversation factor for converting the Psi value to Kg force/cm^2

  1 kg force/cm^2 = 14.2 Psi

  1 Psi = 0.07042 kg force/cm^2

  So therefore the experimental value **before modification** of the loom is found to be

  60 Psi

  60*0.07042 = **4.218 kg force/cm^2**

Fig: 10

5. MODIFICATION PROCESS

Loom is modified in certain parts to make it work in an effective manner and to reduce the force of operation required by the human operator. The modifications and its reason are as follows.

- Picking mechanism (changing double hand to single hand under picking mechanism)
- Adding barring sets at joints as to reduce friction.

Barring are placed at the parts of

- Picking mechanism bottom hand – picking stick 2 sets of barring
- Tappet bowl
- Beating bowl

- Adding slow speed motor to run the loom (when worker exhaust).

5.1 Picking mechanism

The loom posses the under pick mechanism where initially it had a two hand driver system, which required more force to operate the loom. The drive is got to the picking mechanism as follows, the betting bowl in the bottom shaft drives the first hand of mechanism, the first then drives the second hand and then to picking stick. This takes more force since the drive distributes from one to other to activate the picking stick and there would be some loss in transfer of energy. But a single hand requires only a less force to operate the picking stick and there won't be any loss in energy transfer since it is given straight drive from betting bowl.

FIG 11 before modification

Fig: 12 after modification

5.2 Adding Bearing Set

Bearing set is been added to limit down the friction made by the parts movement, of stroking up and down. Here we are using a ball bearing to cut down the friction produced by the parts in the loom in order to achieve easy operation of loom. The parts which are been added with bearing set is as follows.

5.2.1. Under Picking mechanism bottom lever (hand mechanism)

Fig: 13

Before modification, in two hands lever system bush was used at the joints of the lever to the frame which also produced some amount of friction. So to overcome this problem we have replaced the bush type to bearing type and also made the way of movement to be easily moved to transfer the energy to the picking stick. Here the bearing used is a ball bearing which helps for an easy movement of stroking up and down, for the activation of picking stick.

The following image gives the full view of the attached bearing in the bottom lever.

Fig: 14

5.2.2. Tappet Bowl

Tappet bowl is the part which helps in the shedding process. The motion to the tappet is got by the bottom shaft rotation. Tappet helps in shed opening and closing of the warp yarns. Only when tappet moves up and down weft would be inserted and fabric could be formed well. The iron bush used before modification made the heald frames to vibrate and tend to breakage of warp yarn. The tappet bowl needs a smooth drive to rise and lower the heald frame. So to overcome the problem we used ball bearing to give the smooth drive to the frame so there won't be any vibrations and breakage of warp yarn.

Fig: 15

Fig: 16

5.2.3 Beating Bowl

Beating bowl is the part which helps in picking that is insertion of weft yarn and form fabric. Before modification the beating bowl it used a cast iron piece which was still and beating the picking stick. This cast piece produced more heat and friction for driving the picking stick and had loss in energy transfer. So to overcome it we have used ball bearing to reduce the friction and other problems to operate the loom so that it would have smooth drive to the picking stick and no loss in energy transfer.

Fig: 17 before modification

Fig: 18 after modification

5.3 Attaching Motor Drive:

A slow speed motor helps in driving the loom to get a good productivity of fabric and good efficiency in production. We have added a slow speed which avoids over vibration of the loom and fly out of shuttle from loom.

The configuration of motor attached is as follows.

Motor speed : 960 rpm.

Hp : 0.5.

Make : Lawkim & Godrej.

Motor Pulley dia : 5 cm.

Groove type : V – belt type.

A slow speed motor is attached to the frame of top reversing rollers. The motor would balance the load and helps to drive the loom better and without any sort of fly and vibrations.

The drive between the motor and the loom is given as the motor pulley drives the fly wheel of the loom. Fly wheel is been given groove of v type so that it can be driven by the motor. The energy transfer from motor to the fly wheel and from fly wheel to the bottom shaft as said initially in the drive system of the loom.

Fig: 19

6. Calculation of shuttle speed after modification:

Pedal drive

Shuttle speed = $\frac{40*56*360}{150*36}$

= 149 yards / min

Motor drive

Shuttle speed = $\frac{63*56*360}{150*36}$

= 235 yards / min.

6.1. Calculation of force reduction after the modification of the loom:

By the means of foot pump method we have found the values as follows

The PSI values as per the foot pump gauge is 40

Fig: 20

As per the formula to convert the psi values to kg/cm^2 is

40*0.07042 = 2.8 kg force/cm^2.

7. Difference between Nepali loom and ordinary power loom.

Ordinary Power loom:

The major components HI of the loom are the warp beam, heddles, harnesses, shuttle, reed and takeup roll. In the loom, yarn processing includes shedding, picking, battening and taking-up operations.

- *Shedding*. Shedding is the raising of the warp yarns to form a loop through which the filling yarn, carried by the shuttle, can be inserted. The shed is the vertical space between the raised and unraised warp yarns. On the modern loom, simple and intricate shedding operations are performed automatically by the heddle or heald frame, also known as a harness. This is a rectangular frame to which a series of wires, called heddles or healds, are attached. The yarns are passed through the eye holes of the heddles, which hang vertically from the harnesses. The weave pattern determines which harness controls which warp yarns, and the number of harnesses used depends on the complexity of the weave. Two common methods of controlling the heddles are dobbies and a Jacquard Head.
- *Picking*. As the harnesses raise the heddles or healds, which raise the warp yarns, the shed is created. The filling yarn is inserted through the shed by a small carrier device called a shuttle. The shuttle is normally pointed at each end to allow passage through the shed. In a traditional shuttle loom, the filling yarn is wound onto a quill, which in turn is mounted in the shuttle. The filling yarn emerges through a hole in the shuttle as it moves across the loom. A single crossing of the shuttle from one side of the loom to the other is known as a pick. As the shuttle moves back and forth across the shed, it weaves an edge, or selvage, on each side of the fabric to prevent the fabric from raveling.
- *Battening*. As the shuttle moves across the loom laying down the fill yarn, it also passes through openings in another frame called a reed (which resembles a comb). With each picking operation, the reed presses or battens each filling yarn against the portion of the fabric that has already been formed. The point where the fabric is formed is called the fell. **Conventional shuttle looms can operate at speeds of about 150 to 160 picks per minute.**

With each weaving operation, the newly constructed fabric must be wound on a cloth beam. This process is called taking up. At the same time, the warp yarns must be let off or released from the warp beams. To become fully automatic, a loom needs a filling stop motion which will break the loom, if the weft thread breaks.

Nepali type pedal loom:

As said before Nepali type pedal loom works as if as the normal power loom as said above in about power loom. Here we have attached a motor of slow speed which helps in giving more productivity then the normal pedalling type of the loom, but not so much production as the power loom. Nepali type pedal loom with motor operation can give about **63 PPM** which is half of the normal power loom speed.

So the difference between the normal power loom and the Nepali type pedal loom is that it's the half the speed and it doesn't have any stop motions as the power loom. We have added such a motor that stops when switched off it stops suddenly in time. So that if any breaks in yarn we could stop it. But one thing is that one human should be present when ever the loom is operated. Now all the actions are same as that of the power loom action.

8. Comparison of pedal drives before and after modification:

When compared to the pedal drive before modification of the loom, drive system after modification is easier then the previous one that exists in the loom. After modification there were so many changes right from speed of the loom. Shuttle speed has increased to some good extent say as. **Before modification shuttle speed for pedal drive is 112 yards / min and now after modification it is 149 yards / min.**

9. RESULTS AND DISCUSSIONS:

RESULTS BEFORE MODIFICATION:

- Force values before modification of the loom is found to be

F = m x a = F = 15 * 2160 = 32400 N = 32400/9.81*60 = *55.04 N = 5 kg/cm^2*

Shuttle speed:

- **Shuttle speed = $\frac{30 \times 56 \times 360}{150 \times 36}$**

= *112 yards / min*

- **Force found by foot pump method (experimental value):**

The conversation factor for converting the Psi value to Kg force/cm^2

1 kg force/cm^2 = 14.2 Psi

1 Psi = 0.07042 kg force/cm^2

So therefore the experimental value **before modification** of the loom is found to be

60 Psi

60*0.07042 = ***4.218 kg force/cm^2***

RESULTS AFTER MODIFICATION:

- Shuttle speed:
- **Pedal drive**

Shuttle speed = $\frac{40*56*360}{150*36}$

= ***149 yards / min***

- **Motor drive**

Shuttle speed = 63*56*360

150*36

= ***235 yards / min.***

- **Force by foot pump method:**

The experimental value **after modification** of the loom is found to be

40*0.07042 = 2.8 kg force/cm^2, for pressure value of 40 PSI.

DISCUSSION:

Nepali loom is a modern semi-automated handloom we have found the force required to operate the loom which was difficult to operate it. Initially the force required was found to be 4.2 kg/cm^2 we have reduced it to 2.8 kg/cm^2. After modification it was easy to operate the loom than before modification, we modified in such a way that is bi-driven by both electricity and man power and will have a good productivity even when current fails.

9.1. Comparison of pedal and motor drives:

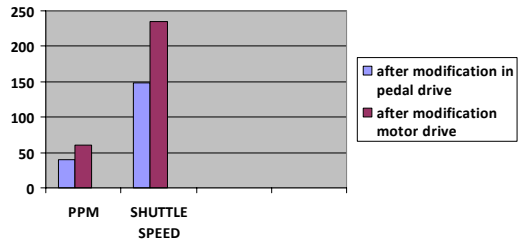

Fig: 21

9.2. Comparison of all drives:

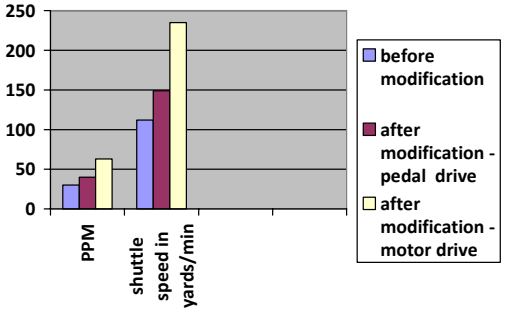

Fig: 22

10. CONCLUSION

- Nepali type pedal loom is modern type hand loom which could be operated by means of pedalling action.
- The operation of the loom use easy when compared to handloom, but when considering men power it is not as easy as we thought.
- So we have modified in such way that it should not affect the men by any means, we have increased the efficiency of the loom by modifying the mechanism of picking, main drive and motion activates of the loom.
- Now men use only less energy to produce the fabric in the loom.
- There is also increase in productivity of the loom.
- Considering the electricity problems of today we have modified in such a way that it is bi-driven by both electricity as well as men power.
- Whenever electricity fails we could use man power to obtain the fabric. So the loom is perfect for productivity.

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