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DESIGN EVALUATION AND ANALYSIS OF HARVESTING COTTON BOLLS MECHANISM IN MOIST AND UNEVEN CONDITION

Jay S.Patel[1], Jigar S. Patel[2], Himanshu D. Patel[3] Vishv S. Patel[4]

[1]*Student, Mechanical Department, HGCE*
[2] *Assistant Prof., Mechanical Department, HGCE*
[3] *Assistant Prof., Mechanical Department, HGCE*
[4]*Student Mechanical Department, HGCE*

Abstract — *The title of project "Design evaluation and analysis of harvesting cotton bolls mechanism in moist and uneven condition", itself indicates the outer theme of the project. The mechanism which has harvesting continues cotton bolls are being design, analyse, manufacture and install as per the requirement of ATC, Ahmadabad.*
Detailed study is done on the working of picking mechanism of the present mechanism. The aim of this project is to develop portable and lightweight mechanism harvest the cotton bolls under various climate condition and not stuck with cotton bolls fibre. To improve the production rate of this machine, many changes can be done with respect to mechanical or farming aspects to achieve minimum power consumption. To improve the production rate, various researchers have contributed for this work.

Keywords- *Portable cotton picker, cotton bolls harvesting mechanism, picking machine, moist weather in cotton bolls, picker*

I. INTRODUCTION

Clothing is the prima facie requirements of the life in which cotton is the most important crops throughout the history of India and India was the world's second largest producer, consumer and exporter of cotton in the year 2011-2012 and 2015-2016. In India entire cotton is handpicked by human labor.

Figure 1 Cotton boll

There are many cotton boll picking machine already exist in market but due to mechanism of cotton harvesting it loses the mechanism in different ways.

1.1 Cotton boll harvesting

Cotton bolls is generally picked by two methods i.e. hand picking (manual) method and picked by mechanical pickers. In hand picking method, due to non-availability of labors during peak season results in various losses and also affects the subsequent farm operations. On other side mechanical pickers reduce the drudgery involved in cotton picking and helps in achieving timeliness of operation. Now a day's mechanical cotton pickers are commonly used for cotton harvesting in developed countries.

1.1.1 Classification of Cotton boll Picking Machine

- Portable
- Pneumatic
- Chain Mechanism
- Gripper Mechanism

- Harvester
- Stripping
- Spindle

II. LITERATURE SURVEY

The Picking and Checking mechanism are important mechanism of harvesting machine. The different types of literature are referred for study and development of Picking and checking mechanism. The cotton bolls picking machine working and mechanism easily understand by using different literature review. The detail study of Picking and checking mechanism is easily done by using different literature review.

2.1. Problem Definition

The portable cotton boll picking machine use to harvest cotton boll. With this mechanism it is possible to pick and deliver cotton boll continually without blocking the mechanism and also work under extreme weather conditions such as dry, moist and in morning dew. This machine is still used by many farmers in India but they face many problems because of moist condition block the machine by wiping cotton on chain mechanism and stuck the machine by cotton thread.

Existing mechanism is also quite complex for manufacturing and also the parts are difficult to make and assembly is time consuming and required high maintenance. To improve the production rate, it is mandatory to change the design and parts of mechanism and decrease the speed of machine, which plays main role in machine and harvesting the cotton. Hence, it is extremely necessary to design and develop a mechanism to compliment the picking cotton and to move in the direction of achieving minimum power consumption. The existing design of chain mechanism of picking is not smooth and creates high noise pollution and also it is failure in moist condition

2.2. Research Objectives

The objectives of the thesis are listed as follow.

- Design of cotton bolls picking mechanism which able to picking and delivering operation of cotton ball.
- To pick the cotton bolls under various climate condition and without failure mechanism.

III. PARTS OF MECHANISM

1. Picking head round: It is a rotational rolling element that rolls on bearing
2. Linkages: Middle off centric shaft, transmission shaft, brass bush and picking teeth are the linkage of mechanism
3. Supporting parts: Offset shaft holding LH, RH, Main roller holding RH, plastic strip

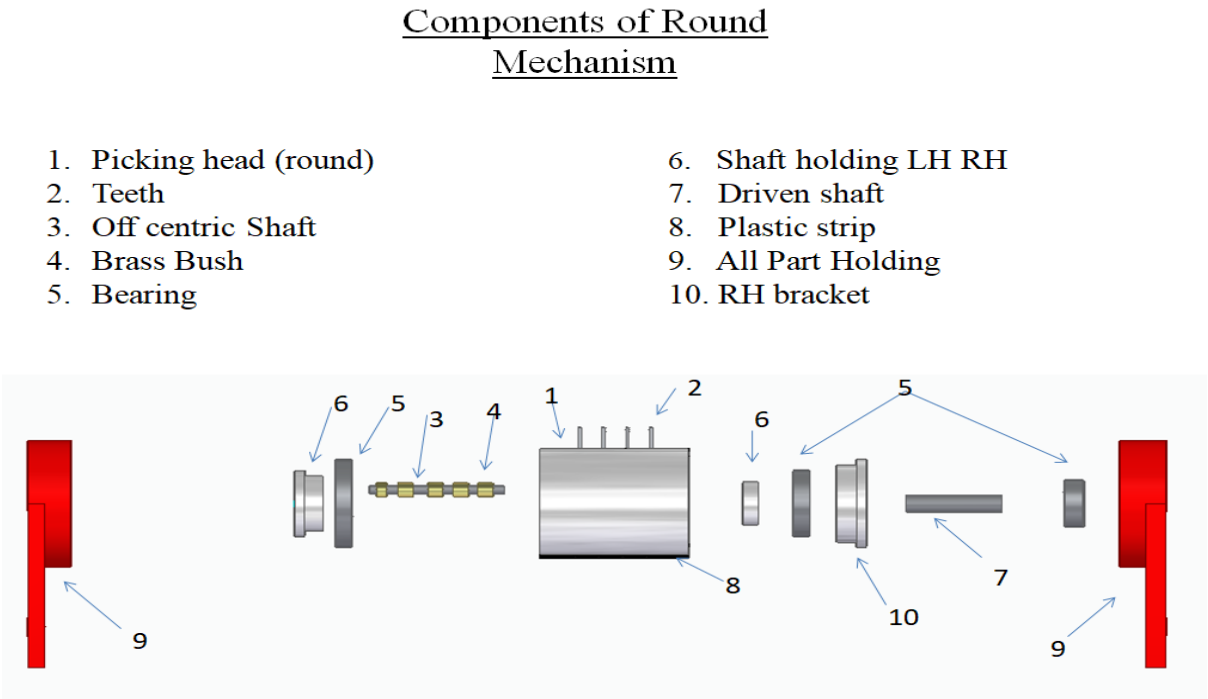

Figure 2 Parts of mechanism

IV. PICKING MECHANISM

4.1. Properties of Cotton Bolls

The various physical properties of cotton boll size, volume, density, moisture content and colour were measured and show in research paper.

Size (Equivalent diameter)

The equivalent diameter was calculated from length, width and thickness of open cotton boll. The mean diameter was 64.79 mm and average ranged from 61.05 to 70.10 mm

Equivalent diameter = $(lbt)^{\frac{1}{3}}$

Where, l, b and t are the maximum, intermediate and minimum perpendicular dimension respectively.

- **Volume**

A cylindrical box was used for determination of volume of cotton boll. Cotton boll was pressed into the cylindrical box and height of boll was measured. Volume of boll was determined from the height of the boll in the cylinder. Following equation was used for determination of volume of cotton boll. The mean volume of cotton boll was 37640.17 mm3 and average ranged from 33379.42 to 43196.91 mm3.

Volume = $2\pi rh$

Where, r = radius of cylindrical box, mm

h = height of cotton boll pressed into the cylindrical box, mm

- **Density**

The density of cotton boll was determined by dividing weight of cotton boll with its volume. It was expressed in gm/mm3. Density of cotton boll was calculated by dividing theoretical weight of cotton boll with its volume. It average ranged from 0.000170 to 0.000187 gm/mm3.

- **Colour**

Cotton boll colour was measured on High Volume Instrument system using a colorimeter. Colorimeters determine whiteness, greyness and yellowness of the cotton boll.

- **Time**

Average cotton cultivated in one acre of farm

1quintal =1000kg

Average cotton boll weights = 6.6gm (By considering three samples of cotton in three categories and they are Small, Medium, Large).

One cotton boll requires = 1sec (approx) Therefore 1quintal cotton requires = 4.2hours of operations = 252 minutes It is very much less than the time consumed by the workers.

4.2. Existing Mechanism Used For Cotton Bolls Picking

- Chain teeth type mechanism specification

In chain mechanism teeth are attach with the chain rivet chain rotate on nylon roller and sprocket. Teeth made by ms sheet material from die punch press. Power transmits by variable motor trough 2 gear and gear ratio 40:12. Motor rotate with two intensity high and low. . It is a hand operated machine and has a pair of chain with small sharp edged teeth and sprockets and is operated by a lightweight 12 volt battery Cotton gets entangled with the chain and is collected and guided into the collection bag.

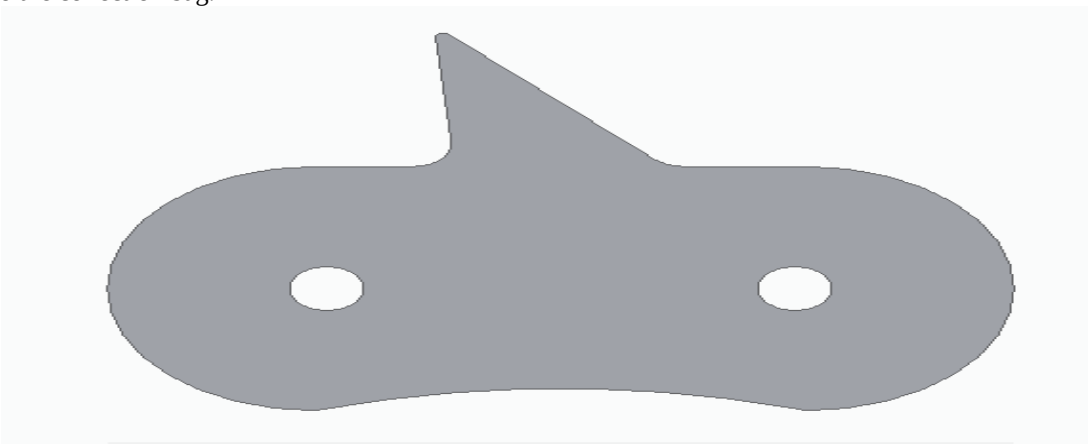

Figure 3 Teeth for Picking Cotton

➢ Impeller For Air Type Machine

This mechanism use in pneumatic machine and it is use for compress air. Machine required IC engine for run the machine and as a fuel use kerosene 1liter per hour. Main disadvantage of this machine high fuel consumption, much trash around 10% high weight of machine about 15kg and weekly maintenance.

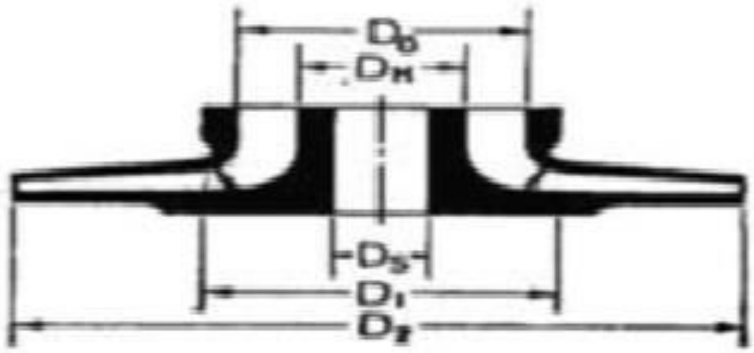

Figure 4 Impeller

➢ **Spindle Mechanism**

Spindle mechanism use in harvester machine it is very popular in USA, Australia, Canada, and in many developed Country. The mechanism top view shown in Figure 3.6 in which picker spindle is pick cotton bolls and doffer is collect the cotton bolls in mechanism. Other coordinate parts spindle moisture applicator, CAM, plant compressor and spindle moisture applicator tubes.

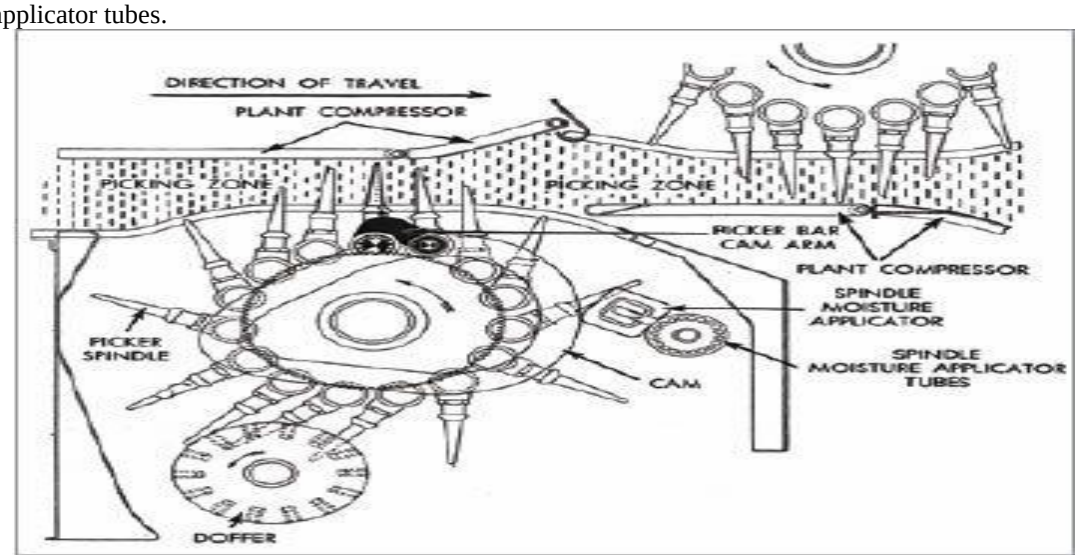

Figure 5 Spindle Mechanism

➢ **Tractor Mounted Mechanism**

Tractor mounted mechanism used in many countries and it is easy to handle. Mechanism is mounting and holds with tractor.

Figure 6 Tractor Mounted Machine

4.3. Factors Affecting Picker Mechanism

- Machine Speed
- The Shape of Picker
- Time of Picking (curriculum)
- Mass of Picker
- Initial Gap Between Picker and Outer Body of Machine
- Weather Conditions

4.4. Causes of Failure for Picking Mechanism

- Picker size
- Cotton fibre
- Weather conditions

4.5. Machine specification

In hardware different machine use different input for mechanism and machine

- Battery

In this project we have use battery to operate our machine, in this machine battery is the main source for the other components to perform their functions. Battery runs 9 hours continually. The motors get power from the battery.

- D.C Motor

In this project we have use D.C Geared to operate the mechanism. By the use of motors, the mechanism are rotating and performing their functions.

- Collection Tank

Now in this cotton collection tank the cotton which is picked by the machine is get collected and stored in it.

- Rollers

Roller is main part of our machine. These rollers are operated by the geared motors. In our machine this rollers consist of belts which is used for picking operations.

- IC Engine

IC engine use in pneumatic machine for compressor and it is run about 5000rpm and force created by compressor around 3.5N and velocity is 12.73m/s.

4.6. Design parameters of picking mechanism

P = diameter of round roller (40mm)
C = off centric shaft center from roller center (5mm)
b = picking teeth length from center (22mm)
e = roller length (45mm)
d = driven shaft diameter (7mm)
Picking teeth rotate on off centric shaft and diameter of rotation is 45.54 cotton required 5mm to 7mm length for picking so in mechanism 5 mm offset the center of off centric shaft and 7mm teeth out from roller and 3mm under the roller degree 124.27 it is shown in figure 4.1 and 4.2.And in assembly 10 parts attached for develop mechanism it is shown in figure 4.3. This design is based on maximum cotton volume to be pick.

- Rolling motion arrangement

Rolling motion is achieved by using bearing. The external gear of slewing ring is in mesh with pinion. Pinion is rotated by gear motor drive and gear motor is fixed on the top frame. By the help of DC motor, rotating motion of is transmitted to external gear of slewing ring which make bottom frame to rotate with respect to top frame.

- Picking and delivering arrangement

For picking operation, offset shaft type of mechanism is adopted. Teeth mainly used for pick the cotton boll. Here also the cotton boll is to be picked and released with help of off center shaft and picking teeth. This center shaft is connected with LH and RH holding parts. In this mechanism, the teeth rotate on off centric shaft and its connection between teeth and bushes, it is maintain gap between shaft and two teeth.

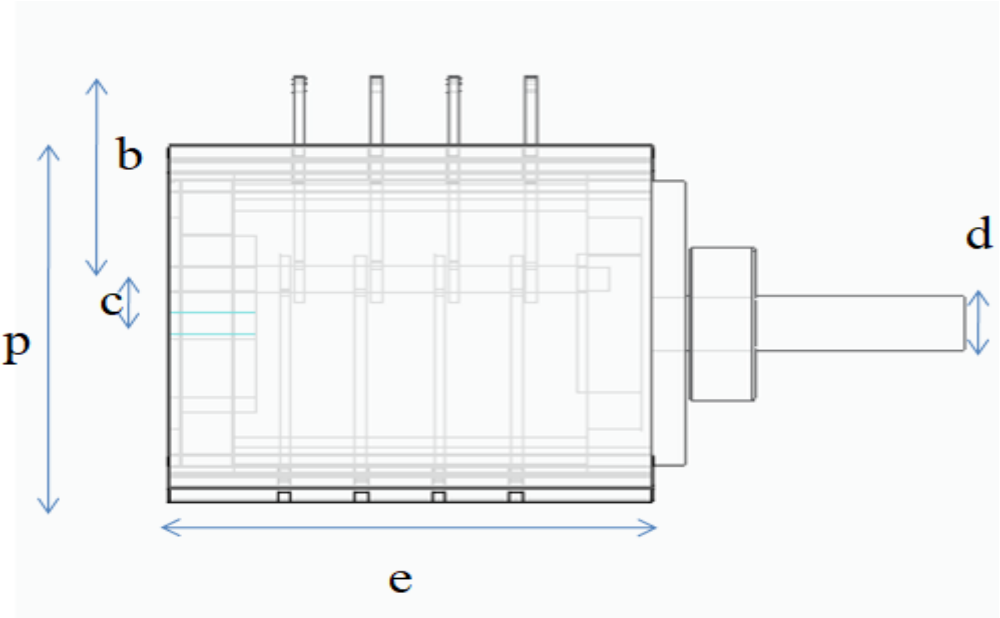

Figure 7 Round off Centric Mechanism Dimension

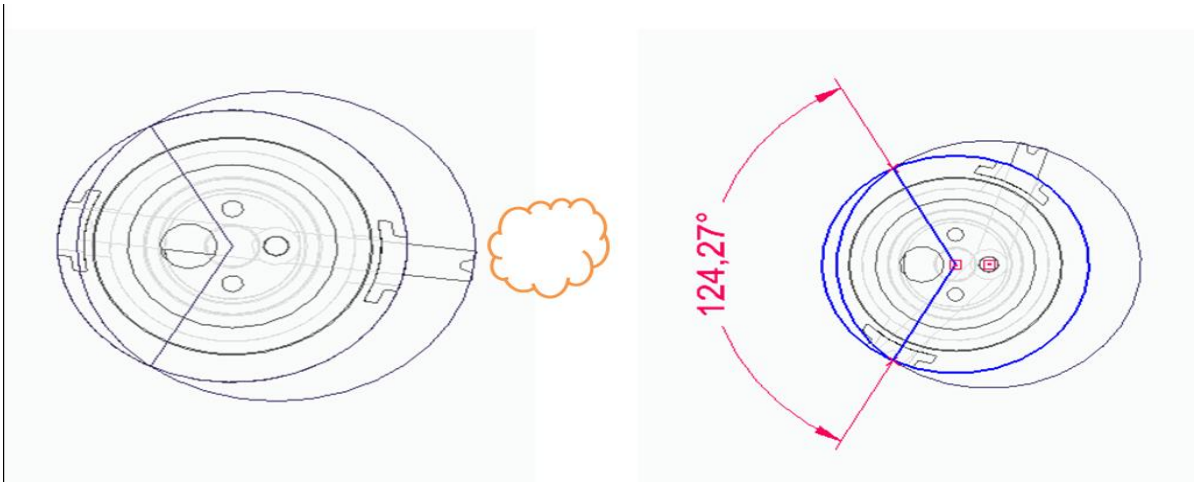

Figure 8 off Centric Shaft Dimensions

Table 1 Parameters of New Design

Technical descriptions	**Parameters**
Overall dimension (l*b*h), mm	74*46*40
Number of teeth for picking	8
Number of shaft	2
Maximum speed of motor	600-800rpm
Battery	12v
Number of operator	1
Mechanism weight, (gm)	100
Number of bearing	3

➢ **Design of mechanism assembly**

In design of mechanism assembly derived that assembly of all parts and assembly divided in to three groups left, middle and right. It is shown in figure 2.

- **Design of left side assembly**

Left side assembly is connecting middle assembly by bearing Z2089 and assembly contains three parts LH bracket (6), LH bearing (5) and middle shaft (3) is shown in figure 2.

- **Design of middle assembly**

Middle assembly is design to rotate the teeth on middle shaft and shaft is stay and connected with left bracket on off center hole. The part is round roller (1), picking teeth (2).

- **Design of right side assembly**

Right side assembly is driven assembly it is help the rotate whole mechanism through pulley. This assembly contains five parts RH bracket (10), RH bearing (5), small RH bracket (6) and transmission shaft (7).

V. CONCLUSION

Based on the above study, the portable Cotton Picker advantages are concluded as follows

- Portable cotton picker can improve cotton harvesting efficiency without failure the mechanism by wrapping the cotton on mechanism.
- The problems that labors or farmers face during picking will be completely eliminate.
- This new developing mechanism is easy to manufacture and cost of mechanism is much lower than other mechanism.

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