Design & Development of Semi-Automated Multi-Crop Thresher

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Abstract—Presently majority of villages in rural India do not get un-interrupted electric supply with close to 10 hours of load shedding many agriculture activities have to be done manually. We have produced a semi-automated multi-crop thresher for crops (wheat/jowar/bajra/barley) and specially corn which will be operated using bi-cycle. Also we have added a automatic screening mechanism to it so that the threshed produce will also be screen an cleaned automatically and the farmer will directly get the grains ready to pack saving lot of human energy time and cost. The present project focuses on solving the problem faced by the farmers in separating the grains from the different crops.

Key words: Multi-Crop Thresher

I. INTRODUCTION

Different crops occupying an important position in the agricultural economy of any country. Threshing is one of the most crop processing operation to separate the grains from the heads of crop and prepare the grains for selling. Different types of threshers are available in the market like spike tooth, chaff cutter type, cylindrical drum with screen type etc. it means for threshing of by hand scraping or beating with sticks and rubbing to crop heads.

The farmers use the manual methods due to unavailability of suitable machinery for threshing crops. During manual crops production, the most time and labour-consuming operation is the threshing crops by beating the crop heads with stick or rubbing wear heads against a rough metal surface or power tiller treading machine. The aim of project is to fabricate a machine which will separate the seeds from the different crops. In our project the threshing unit operates on the principle of axial flow movement of material. The crops is threshed in a closed threshing unit by rotating blades, where seeds are separated from heads and remove through blower. Finally the cleaned seeds are collected in a Tray.

II. LITERATURE GAP

After careful review of papers it was found that various researchers have studied and researched individual crop threshers suitable for certain crops only, no universal thresher was proposed. Secondly no researchers focused on multi operations thresher, where in the same thresher to be use for different operations thresher, where in the same thresher to be use for different operations. Also we have added a automatic screening mechanism to it so that the threshed produce will also be screen an cleaned automatically and the farmer will directly get the grains ready to pack saving lot of human energy time and cost.

In machine design the component in two categories.

A. System Design :-

B. Mechanical Design :-

IV. DESIGN METHODOLOGY

In our attempt to design a special purpose machine we have adopted a very careful approach, the total design work has been divided into two parts mainly;

- System Design
- Mechanical Design

A. System Design :-

In system design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangements of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; weight of machine from ground etc.

B. Mechanical Design :-

In design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are readily available in market this simplifies the assembly as well as post production servicing work.

V. CALCULATION

A. Motor Selection
1. PHASE INDUCTION MOTOR

Make :- Godrej - boycie
230 VOLS. 50 Hz,
Power = 0.25 Hp (0.185 Kw )
Speed = 1440 rpm (Synchronous)
Frame Size = 70
Current = 1.70 AMP
Torque = 0.17 Kg . M
Details Of Frame Size = 80
(Back flange mounted)

![Image of Single Phase Induction Motor]

**TORQUE ANALYSIS :-**

Torque at spindle is given by:-

\[ P = \frac{2\pi N T}{60} \]

where :-

- \( T \) = Torque at spindle (Nm)
- \( P \) = Power (Kw)
- \( N \) = Speed (rpm)

\[ \Rightarrow T = \frac{185 \times 60}{2\pi \times 1440} \]

\[ \Rightarrow T = 0.79 \text{ N.m} \]

Considering 100 % overload;

\[ T_{design} = 2T \]

\[ T_{design} = 1.56 \text{ N.m} \]

**B. Selection Of Bearing**

Spindle bearing will be subjected to purely medium radial loads; hence we shall use ball bearings for our application.

Selecting : Single Row deep groove ball bearing as follows.

<table>
<thead>
<tr>
<th>Series 6</th>
<th>Is No</th>
<th>Bearing of basic design No (SKF)</th>
<th>d</th>
<th>D1</th>
<th>D</th>
<th>D2</th>
<th>B</th>
<th>Basic capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1717AC03</td>
<td>6003</td>
<td></td>
<td>17</td>
<td>19</td>
<td>35</td>
<td>33</td>
<td>10</td>
<td>2850 4650</td>
</tr>
</tbody>
</table>

**P = X F_r + Y F_a**

Neglecting self weight of carrier and gear assembly

For our application \( F_a = 0 \)

\[ \Rightarrow P = X F_r \]

where \( F_r = Ra \)

As; \( F_r < e \Rightarrow X = 1 \)

\[ \Rightarrow P = 198.54 \text{ N} \]

Calculation dynamic load capacity of bearing.

\[ L = \left( \frac{16}{P} \right)^5 \] where \( p = 3 \) for ball bearings

When \( P \) for ball bearing

For m/c used for eight hr of service per day;

\[ L_H = 12000- 20000hr \]

But ; \[ L = \frac{60 n L_H}{10^6} \]

\[ L = 600 \text{ mrev} \]

Now: \[ 600 = \left( \frac{C}{(198.54)^5} \right)^3 \]

\[ \Rightarrow C = 1674.55 \text{ N} \]

\[ \Rightarrow \text{As the required dynamic capacity of bearing is less than the rated dynamic capacity of bearing.} \]

\[ \Rightarrow \text{Bearings is safe.} \]

**C. Design of Input Shaft**

**MATERIAL SELECTION:-**

Ref:- PSG (1.10 & 1.12) + (1.17)

<table>
<thead>
<tr>
<th>DESIGNATION</th>
<th>ULTIMATE TENSILE STRENGTH N/mm²</th>
<th>YEILD STRENGTH N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN24</td>
<td>800</td>
<td>680</td>
</tr>
</tbody>
</table>

Table No 1:- Input Shaft Selection Table

\[ \Rightarrow F_s \text{ allowable} = 0.18 \times 800 = 144 \text{ N/mm}^2 \]

\[ \Rightarrow T_{design} = 1.28 \text{ N.m} \]

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

Check for torsional shear failure of shaft,

\[ T_e = \frac{f_s d^3}{16} \]

\[ f_s \text{ act} = \frac{16 \times 1280}{\Pi \times 14^3} \]

\[ f_s \text{ act} = 2.37 \text{ N/mm}^2 \]

As: \( f_s \text{ act} < f_s \text{ all} \)
Input shaft is safe under torsional load.

D. Design of Thresher Shaft

\[ T_{\text{design}} = \frac{2.4}{2} / 15 = 0.08 \text{ N-M} \]

Selection of intermediate shaft material

Ref. - PSG Design Data.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Ultimate Tensile Strength N/mm²</th>
<th>Yield strength N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 24 (40 Ni; 2 Cr 1 Mo 28)</td>
<td>1100</td>
<td>880</td>
</tr>
</tbody>
</table>

Using ASME code of design:

Allowable shear stress:

\[ F_{\text{all}} = 0.30 \times \text{Sul} = 0.30 \times 880 \]

\[ = 264 \text{ N/mm}² \]

\[ F_{\text{all}} = 0.18 \times \text{Sul} = 0.18 \times 1100 \]

\[ = 198 \text{ N/mm}² \]

Considering minimum of the above values:

\[ F_{\text{all}} = 198 \text{ N/mm}² \]

Minimum section diameter on rotor shaft = 8m

Considering pure torsional load:

\[ T_{\text{design}} = \frac{I}{6} \times F_{\text{all}} \times d³ \]

\[ 
\Rightarrow F_{\text{all}} = \frac{16 \times 0.08 \times 10^3}{16 x 8³} 
\]

\[ F_{\text{all}} = 0.8 \text{ N/mm}² \]

As, \( F_{\text{all}} < F_{\text{all}} \Rightarrow \) I/P shaft is safe under torsional load.

VI. ADVANTAGES, DISADVANTAGES & APPLICATION

A. Advantages:

1. Energy fuelled in ways that do not use up natural resources or harm the environment, no pollution.
2. Energy derived from sources that uses an entirely unconventional energy conversion device with minimal energy input.
3. Better effectiveness over conventional method utilizing human effort or continuous supply of electric energy.
4. High on useful work done low on power consumed.
5. Low installation cost.
7. Low maintenance.

B. Disadvantages:

1. Dynamo and flywheel will increase the cost.
2. Noise will increase – but very slightly.

C. Applications:

1. Domestic electricity generation applications in homes.
2. Can be modified appropriately to suit rural areas by merely modifying the excitation arrangement.

VII. FUTURE SCOPE

Size of thresher unit can be increased to increase productivity. Number of blades can be increased on thresher drum. Larger screen can be used. DC motor can be used to operate the machine in absence of electricity.

VIII. CONCLUSION

An innovative mechanism for threshing, screening and fodder cutting was developed that can be operated either manually or by use of motor. The motor drive is operated by use of the belt drive, this drives the fodder cutting mechanism and then the chain drive mounted on the same shaft will drive the thresher mechanism, which will then drive the screen mechanism which will vibrate to operate the screens for separation. The blower is driven using the 230 volt AC motor. The system design was done to decide the arrangement of various components where as the mechanical design was done to determine the size of the components. The subsequent process will be manufacturing, assembly and testing of the unit to prove the utility and efficiency of the machine.

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