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DESIGN AND DEVELOPMENT OF MULTI CROP CUTTER MACHINE POWERED BY ELECTRIC MOTOR CONCEPT

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Abstract- *The small scale farmers who have land area of less than 2 acres this machine will be beneficial for them. This machine is compact and can cut multi crops at a time. It has cutting blades which cut the crop in a scissoring type of motion. It runs on electric motor of 1.5 HP, this power from engine, is provided through pulley and gear box arrangement to the cutter. A collecting mechanism is provided for the collection of crops to one side of it after cutting. The pulley arrangement is to provide power to this mechanism. It is easily maintainable as this compact harvester is manufactured using locally available spare parts. This harvester might be the solution to the problems faced by a small scale farmer regarding labour implementation and cost. After testing this machine in farm it is found that the cost of harvesting using this harvester is considerably much less as compare to manual harvesting.*

Key word: productivity, Crop cutting, harvester, reaper, scissoring action, Fabrication etc.

1.INTRODUCTION

Recently ruler has seen a shortage of skilled labour available for agriculture. Because of this shortage the farmers have transitioned to using harvesters. These harvesters are available for purchase but they are not affordable because of their high costs, however, agriculture groups make these available for rent on an hourly basis. But the small holding farm owners i.e. generally having land less than 2 Acers generally do not require the full-featured combine harvesters. Due to financial or transportation reasons these combine harvesters are not available in all parts of rural area. Thus, there is a need for a smaller and efficient combine harvester which would be considerably cheaper and also more accessible. The mission is to create a portable, low cost mini harvester and user-friendly. These problems gave us the basic idea about what was required in the current situation. The idea was to create a machine which will reduce the labour required to harvest crops and which is cheap. This machine has the capability and the economic value for fulfilling the needs of farmers having small land holdings which is less than 2 acres. This machine is cost effective and also easy to maintain and repair for farmers.

fig.1 manually crop cutting

Today, India ranks second among other countries across the world in farm output. Agriculture and allied sectors like fisheries and forestry accounted for 13.7% of the GDP in 2013, about 50% of the workforce. The economic contribution of agriculture to India's GDP is decreasing steadily with the country's broad-based economic growth. According to WHO (world health organisation), Slow agricultural growth is a interest for policymakers as 2/3 of India's people depend on rural employment for a living.

Agriculture is the backbone of Indian economy. In India agriculture has facing serious challenges like scarcity of agricultural labour in peak working seasons of farming but also in normal time of working.

1.1 Problem Statement

- Currently in India former used conventional method for the crop cutting i.e. the conventional method for crop cutting is as manually cutting using labour
- but this method is lengthy and time consuming
- Harvesters are available for purchase but because of their high costs, they are not affordable.
- But the small scale farmers who have land area of less than 2 acres generally do not require the full-featured combine harvesters.
- Also, these combine harvesters are not available in all parts of rural Area due to financial or transportation reasons.

1.2 Design Objective

- The Design of the prototype of motorized cutter for a harvesting crop using low cost criteria.
- create a machine which is reduce the labour required and cheap to harvest crops
- Fabricate the prototype of motorized cutter for machine

2.DESIGN AND ANALYSIS

2.1. Spur Gear Design:

Design power (Pd): Pd = PR * KL .... K= 1.80 =0.80*180=1.5hp=1120watt

Tooth load, $F_t = (Pd/v_p)$, $V_p = \pi D_p.N_p /60 = 2.86 m/s$

Calculate actual value, $F_t = 523.23/2 = 261.66$ N

PCD of pinion $D_p = m * T_p = 2*19 = 38mm$

$D_g = m*T_g = 2*68=136mm$

$V_p = 1.4328*m = 2.86m/s$,

Dynamic load, F_d =

$F_d = Ft + (2V_p*C_e*b + F_t) / 2Vp+\sqrt{C_e*b+ F_t}$

C = 485.184 (20^0 full depth)

$F_d = 3760.22$ N $F_d > F_b$ ....Hence design is safe.

2.2. Design of Shaft:

$T_d = 6*P1*K_L / 2\pi N$.....$K_L=2$,

$T_d = 6*3*2/2*\pi*24 = 24.60$ N-mm.

Resultant bending moment to the point B , C, and D are as follows ;

Resultant BM at B=

$\sqrt{(M_B^2) + (M_B^2)} = 53.38$ N, BM at C = $\sqrt{(M_C^2) + (M_C^2)} = 97.94$ N

Resultant BM at D = $\sqrt{(M_D^2) + (M_D^2)} = 68.40$ N.

Equivalent twisting moment,

$T_e = \sqrt{(K_m * M)^2 + (K_t * T)^2}$

Now calculating the shaft diameter

$T_e = (\pi/l)*\zeta*d^3 : 66.90*10^3$; d= 20.09mm

Selecting standard diameter, d = 25 mm

2.3 Design Of Antifriction Bearing:

There are two antifriction bearings C_1 and C_2 used in the experimental setup. The maximum reaction developed at bearing C_2 i.e. = 667.33 N is considered for designing the bearing.

1. Equivalent load coming on bearing, Fe, N

Fe = (X F_r+ Y F_a) K_s K_o K_p K_r, F_r= 667.33 N, F_a= 0,

N_e = F_a/F_r, e = 0

Selecting self-aligning ball bearing = 1, Y = 2.3

K_p = 1 (no preloaded bearing), Kr = 1(outer race fixed inner race rotating)

K_s = 2 (moderate shock load)

,Fe = (X Fr+ Y F_a) Ks $K_o$$K_p$ K_r

= (1x 667.33 + 0) x 1 x 1 x 1 x 2= 1334.66 N

Bearing Life, L (revolutions in Millions= $(C/Fe)^n$ K_{ret} ,K_{ret} = 1 (reliability = 90 %), C = (500) (1/3) x Fe, C = 10818.148 N.

Dimension d = 25 mm, D = 52 mm, B = 15 mm.

2.4 Bevel gear drive

T3 = Input bevel gear teeth

T4 = output bevel gear teeth

N4 = N3 = Input rpm to bevel gear

N3 T3 = N4 T4

232.84 × 10 = N4 × 16

N4 = 150.52

Final rpm at cutter is 150.52 rpm

5. Belt drive design for motor

N1 = 2000 rpm

N2 = 833.33 rpm

Speed ratio (Sr) = 2.4

Service factor for engine = 1.2

Design Power (Pd) = 2.2 x 1.2

Belt Section – A/Ax Small pulley diameter, d = 2.5”

Large pulley diameter, D = 6”

Centre distance, C = 2D = 12” Belt Length

, L = 2C + 1.57 (D + d) + L = 38.85”

Minimum length of belt = 38.85”

Thus we used length of the belt as 51”

Power Rating, P = 1.54KW

Arc of contact factor, Fc = 1710

Pitch length correction factor, Fd = 0.80

Number of belt required = 2

Hence 2 belts are required. Belt drive design for collecting mechanism Smaller

Diameter of collecting pulley, dc = 2”

Larger diameter of collecting pulley, Dc = 3”

Centre distance, C = 2Dc = 6”

Belt Length, L = 2C + 1.57 (Dc + dc) +

Belt length, L = 15.93”

Length of belt used to drive collecting mechanism is 16”

2.6. Design of Handle

A square steel pipe used as a handle which is folded to a length of 2.74 m and 0.76 m orientation toward the machine frame at an angle of 45 degree which is welded for the operator’s Convenience. The handle is subjected to both axial and bending forces due to the inclined position.

3.Literature Review:

G.Maruthi Prasad Yadav[1], provide information that Today,Agriculture especially in India need to concentrate in some aspects such as how to increase the productivity and profit, how to reduce the cost and how to solve the problem comes from workers. It comprises three criterions such as "easy to fabricate, low cost and light weight". With this Ultraportable Crop Cutter. The objectives are to fabricate and test the performance of the prototype of a motorized crop cutter for harvesting the crop.

Laukik P. Raut[2], this paper Stated that this machine targets the small scale farmers who have land area less than 2 acres. They conclude that the harvesting cost using crop cutting machine is considerably less as compare to manual harvesting. The harvesters available in market are suitable for large farms,so this can be the best machine for the farmers with small land.

Victor and Vern's,[3]designed and developed a power operated rotary weedier for wet paddy land. The complex nature of the machine makes its maintenance and operation difficult for the presant farmers

Yuming Guo's [4] this paper stated that the relation between the stalk strength and the cutting force that is required for cutting the crop. The paper was helpful in guiding on the calculations front. This paper briefly describes the strength of soybean and compares it with the various crops. This relationship helps in giving a rough idea about the cutting speed required to cut the crop.

5 N. S. Srivastava[5] this paper is in the interests of the farmers and the problems they face while maintaining and harvesting the agriculture field. This paper was an study of the farming conditions of the farmers and their basic problems.

Indian Government Analysis[6] was the survey done by Indian Government in the fiscal year of 2012-13. This survey was intended to analyse and collect the data related to the problems and difficulties faced by the Indian farmers

4. Proposed solution:

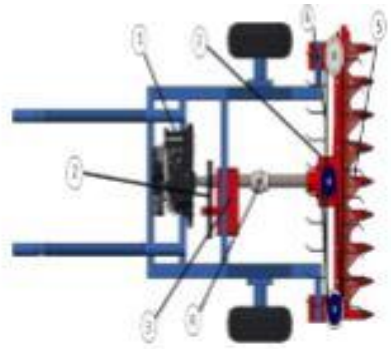
This is the theoretical and systematic analysis of the methods applied to a study or to the theoretical analysis of the principles and method associated with branch of study. This study is to design and fabricate the machinery which can reduce dependency on workers which give much effect to our country in increasing the profits for the farmers. To design and fabricate this machine, there are many criterion are selected such as easy to manufacture, low cost in long term, and can harvest high and with much easy to use

The fabrication of any machine demands sufficient and proper planning while selection of systematic process. Normally, the fabrication is carried out after the design process. Once the required dimension obtained then the only work remains and that is to convert the calculated dimensions into actual fabricated model. It is the common that any new concept which is being evolved it needs to be verified to check its performed physical dimensions.

1. Studying the present mechanisms.
2. To identifying the potential problem.
3. Problem definition.
4. Literature review.
5. Design of crop cutter.
7. Calculation.
8. Fabrication

5.Working Principle of the Multi crop cutter

It is a walk behind type of harvester which is powered by the 1.5HP, 2000 rpm electric motor. With the help of V- belt, drive power is transmitted to gearbox. As the required rpm at cutter is as low as 200 rpm, a bevel gearbox and a spur gearbox is used. Direction of the drive can be changed by 90° with the help of bevel gears. Rotary motion of shaft converted into reciprocating motion of cutter blade with the help of One end of this output shaft is connected to slider crank mechanism. Scissoring action is created when reciprocating cutter blade slides over fixed blade which is responsible for cutting the crops. Collecting mechanism consist of flat belt with collecting plates are bolted on it. Collecting belt simply carry cut crops sideways.



1. Electric Motor 2. Belt Drive 3. Spur gearbox 4. Coupling 5. Cutter assembly 6.Collecting belt 7. Bevel gearbox

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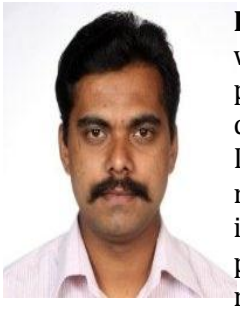

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