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Design & Fabrication of Sugar Cutting Machine

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***Abstract*--- India is an agricultural country, In which 70% people are farmers. As, the population of India is growing, the demand of food is also increasing. Therefore, we should try to bring more land under cultivation. Under these circumstances, we are in need of fast cutting process instead of traditional cutting methods. In past, agri-related activities were taken care by means of manual force. But now a days in most parts of our country there is scarity of labours; hence labours are not available when required. So the labour cost is increased as for cutting of sugarcanes only skilled labours are required. To minimize the labour cost and to get work done in minimum, time at cheap cost we have designed "SUGARCANE CUTTER'. It is simple in construction. It does not need skilled labour.**

I. INTRODUCTION

In primitive India, agri-related activities were taken care of by manual means. But in most of the parts of our country, there is a scarcity of labours and hence labours are not available when required. This gives an opportunity to develop some new method. So, mechanization of agriculture equipment becomes necessary.INDIA is the country of farmers and near about 70% of it's Population depends on agriculture. The History of Indian farmers tells us today how they have achieved the comfortable position. He acquired the skill of raising crops which provided food whenever he found good fertile land, he settled down and took to agriculture and also followed other pursuits of its which made him richer and more comfortable.

As the population Increased food was not sufficient and surplus population of more on the other areas not so productive. As a result of demand of food is increased, man is trying to bring and more land under cultivation, under these circumstances we are in need of fast cutting procedure instead of manual crop cutting.So we have to adopt mechanical means for the purpose of cutting crops. This alternative is not only fast but also very cheaper than the conventional manual crop, cutting. This alternative is not only fast but also very cheaper than the conventional manual crop, cutting.

Manual Sugarcane Cutting By Sickle

Generally manual sugar cane cutting involves slicing and tearing action that results in plant structure failure due to compression, tension or shear. This manual sugar cane cutting practice is followed by majority of farmers because of socio- economical and agro-technological reasons. Different types of sickles are used in different part of country.

II. REVIEW

Mechanical sugar cane harvesting machines were first developed by farmers in Australia. In early 1970s the Australian concept of harvester served as inspiration for the production of the first successful machines in Brazil. This research explored the design of these machines in Brazil and in Australia. Task analysis of machine operation, questionnaires and interviews with harvesting teams were undertaken at five sites considering both countries. It was observed that maintenance staffs made several modifications to the machines to improve reliability, operation, productivity, maintenance and safety. It is believed design in use should be taken into account during the design process. A small work towards analyzing sugarcane harvester machine aspects for economical harvesting which will help to minimize the working fatigue and to reduce labor cost. Sugarcane is the major economic crops in India. It is used as a raw material in sugar manufacturing. Recently India is the second-biggest sugar producer country after Brazil. The Indian agriculture depends heavily on human labor which results in low productivity per hector of per labor, so it wastes a lot of time on working process. Indian agriculture has facing challenges like shortage of agricultural labor, not only in peak working as but also in normal time.This is mainly for increased nonfarm job opportunities having higher wage, migration of labor force to cities and low status of agricultural labors in the society. Human labor shortage tends to be a serious problem in rapid agricultural industrial development. Sugarcane leaf-removing tools could help speed up sugarcane harvest and reduce contamination. Harvesting is a process of cutting and gathering of mature crop from the field. Harvester is a machine is used for harvesting. Different types of

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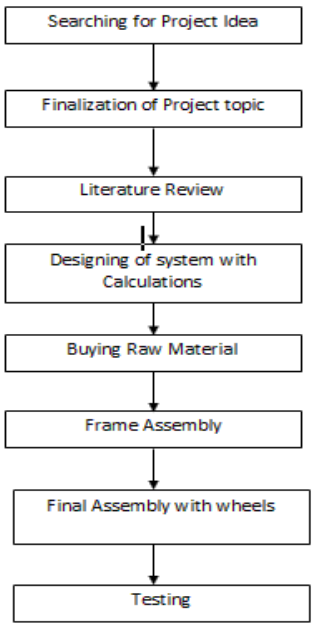
harvesting machines are available in the market namely paddy harvester, Tea harvester, Potato harvester, Wheat harvester and sugarcane harvester, as mentioned above all are available in small scale except sugarcane harvesting machine. Sugarcane harvesting is an agricultural machinery use to harvest and process sugarcane. Today's world there is a heavy demand for sugar and its byproducts. The major states growing sugarcane are Maharashtra, Uttar Pradesh and Karnataka. Now India is the leading producer of sugarcane in the world.

III. METHODOLOGY



To completely provide a design of the machine, the following stages of the design were incorporated to have a proper design methodology

1. Design Conceptualization: Based on needs of the farmers and the market survey conducted. Different iterations of the design of machine were prepared.
2. Calculation and outline validation: planning stage is imperative stage as quality, weariness, factor of safety, every single specialized point was taken while doing the computations and configuration. • Prototype making and testing:
3. After finishing the calculations, a three-dimensional assembly was made virtually on the software within the genuine conditions which gave a perspective of the real world and its quality that allows doing testing of any sort conceivable.
4. Testing: After assembling the model, testing was done to check the feasibility of the model. This is also done using the virtual simulations.

IV. DESIGN CALCULATION

1 Design as per Sugar Cane Cutting Machine

1.1 Design of Pulley (On centrifugal stress consideration)

Designing the pulley on the basis of centrifugal stress consideration.

Let, D = Diameter of driven pulley.

N1 = Speed of P.T.O. shaft.

1) We know centrifugal stress

Assume, tensile stress $\sigma = 0.7 \times 106$ N/m2

Density of CI, $\sigma = 7250$ Kg/m3

$0.7 \times 106 = 7250 \times v2$

$v = 9.83$ m/s

Velocity of Pulley v = 9.83 = (from machine design by Khurmi and Gupta)

d = 0.1173 m

d = 117.3 mm

For power ranges 0.7 - 3.5 kW

Width of belt (b) = 13 mm

Thickness of belt (t) = 8 mm

(Type of belt - A - A - 525 mm long)

2) Width of smaller pulley

The width of smaller pulley or face of pulley (b)

b = 1.25 x k (k=17, from machine design by Khurmi and Gupta)

= 1.25 x 17

= 21.25

b = 25 mms

1.2 Design of Driven Pulley Shaft

Let d = diameter of shaft

N2 = speed of pulley

Power transmitted = 1.119 KW

RPM of pulley = 1600 (from machine design by Khurmi and Gupta)

We known that torque acting on the pulley shaft

T =

≅ 6.67 Nm

Assuming 25 % overload

T pulley = 1.25 x 6.67

= 8.35 Nm ≅ 10Nm

Also the axial load on the pulley

ft =

= 100 Nm

and bending moment, M = ft x Dp /2

= 100 x 0.2 /2

= 10 Nm

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Now we also the equivalent twisting moment

Te =

Te =

Te = 14.14 Nm ≅ 15 Nm

This twisting moment is equal to

Te =

d = 13.65 mm ≅ 14 mm

Take, d = 19mm (std. Diameter)

Assuming fluctuating load condition, take diameter of shaft = 25 mm and the shaft is made in step having bearing size 20 mm.

1.3 Design of Key

From data book for the range of shaft dia. 22 to 33 key cross section are as follows :

i.e. width b = 8 mm

Height h = 7 mm

1.4 Cutting Force and Power

We know that the force required to cut is given by

F = Area x Shear stress

Where A = area of sugarcane

& A = π /4 d2

and d = dia. of sugarcan = 30 mm

and considering the shear stress of a sugarcane is 2 N/mm2

Force f = A x fS

= π /4 d2x fS

= π /4 (30)2x 2

= 1413.71 N

This force f is required to cut one sugarcane by one cutter. But our machine has two cutters and at a time 2- stems are cut

Forced required to cut 2 stems

F = 2 x f

= 2 x 1413.71

= 2827 .42 N

Therefore power required for cutting

P = force x velocity

1.119 x 103 = 2827.42 x V

V = 0.3957 m/s

= 23.7460 m/min

≅ 25 m/min

Since the velocity of the machine calculated is high. And there are many difficulties in moving the machine in the field, such as the weight of the machine itself and the field condition (including human condition).

Therefore, considering V = 15 m/min = 0.25 m/sec.

2. For this, selection of material based on mechanical properties such as

Mechanical properties of Mild Steel(0.07%C, 2.00%Mn, 0.045%S, 0.045%P,1% Si, 19.5%Cr, 10.5%Ni)

Tensile Strength : 540-750 N/mm^2

Yield strength : 230 N/mm^2

%Elongation : 45% Min

V. FUTURE SCOPE

In present machine there are still modifications to get better results, better efficiency and easy operation. Hence we suggest following some modifications.

1) Gear Box :-In place of direct pulley transmission. If gearbox is used then different types of speed range are available on the cutter. Gearbox prevents the entry of dirt and dust particles in the gear.Also gearbox absorbs the damping and makes the operation noiseless and hence the life of gear increases.

2) Automotive :-By giving the same engine power to the wheels by the use of suitable arrangement the machine can made automotive. Due to this operator does not require to push the machine and hence he can operate machine easily.

3) Clutch :-Clutch is used to connect the engine shaft to gear shaft. Thus while starting the machine clutch is disengaged by operating clutch lever this reduces the load on engine at the time of starting. Also it is very essential to stop the machine at required position. Hence by disengaging the clutch machine and cutter stops at required position without stopping the engine. If this is not done at required time, these create problems and there are chances of accident, so clutch is very essential in machine.

4) Steering Arrangement :-By using front wheel castor and giving some steering to it. It is very easy for operator to turn the machine without lifting, the machine thus it can save the energy and time of operation.

5) Gripping and collecting Unit :-While harvesting the major problem arises is that falling of sugarcane on and in front of machine. This creats problem in operation of machine.So there must be auxillary gripping and collecting unit and that is proposed.

VI. PUBLICATION PRINCIPLES

1. Harvesting time will be lower.
2. Efficient work is done by using this machine.
3. Low number of labors are required for whole operation.
4. Cost of harvesting is very less as compared with manual harvesting

VII. CONCLUSION

A conclusion section is not required. Although a conclusion may review the main points of the paper, do

not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank.” Instead, write “F. A. Author thanks.” **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page**.

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