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"Design and Development of Agriculture Multi-Crop Cutter"

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Abstract: ***Crop cutting machine is mechanical device. It can be use for cutting the dry cut branch of grain break or covering of trunk of tree. In the crop cutting machine required less human effort and it very reasonable for middle class farmer it is not complicated structure and it easily operated by unskilled person. It can reduce labour cost due to the only one person can handle. Crop cutter machine does not required high life support. This machine targets the small-scale farmers who have land area of smaller than 2or3 acres. This mechanism is compact and can cut up to two rows of wheat, millet, jowar crops. It has cutting blades which cut the crop in a scissoring type of movement. It runs on petrol engine, this power from engine, is provided through shaft, pulley and belt drive system to the cutting blades. This compact crop cutter is manufactured using locally available spare parts and thus, it is easily maintainable. This crop cutter might be the solution to the problems faced by a small-scale farmer regarding cost and worker implementation.***

Keywords: Crop cutter, maize, jower, millet, harvesting

I. INTRODUCTION

In the country like India where the main source of income is agriculture. It require to concentrate in some aspects like how to increase productivity and profit, how to reduce cost and how to solve and facility the problems of workers. To overcome this a new physical operated cutter is fabricated for cutting of crop during harvesting and named as Crop Cutter. It possesses four criterion ease in manufacturing, ease in control. Low cost and light weight. There are some procedures involved in assembly of this device such as fabricating prototypes. Material and component selection, etc.

To design and manufacturing of multi crop cutter which is help to the Indian former which is in leader side and small farm. It will reduce cost of crop cutting field. It will help to growth economical standard in Indian former. Crop Cutting is last stage in farming which takes maximum time of farmer among all farming Process. In India harvesting is generally done manually. This machine consist of simple Mechanism make to run by a petrol engine which will be economical to farmer and will take less time for harvesting operation.

Fig No 1: Front view of Cutter (harvester)

A. Design And Material Selection

Some relevant factors were considered in the design and development of the crusher; such factors are cost of maintenance, power requirement and ease of replacement of various components and labor requirement. The machine is easy to maintain. The rectangular shaft impacts strong impact force on the crushing chamber to achieve crushing into desired granular size, materials fed into it. So, following are the components required to be designed,

1) Frame.
2) Shaft.
3) Chamber.
4) Blades.
5) Flywheel and Pulley.

B. Design Of Agriculture Crop Cutter

The data that obtained from the discussion and research is used to finalize the specifications of grain machine; this included general size and performance. On the basis of detail collected from farmers, manufacturer and analyst the following objectives being set;

1) Designing a compact machine.
2) Decrease the cost of machine.
3) Decrease the labour requirement for harvesting.
4) Decrease the efforts required for harvesting.
5) Using proper collecting mechanism to increase the efficiency of harvesting.

So considering these points connected to harvesting an try is made to design and fabricate such equipment which will able to perform the operations more effective and also will results in low cost. The machine carry out two operations namely 'Harvesting and collecting'. There are two cutter blades; one is movable and another is stationery.

II. WORKING PRINCIPLE

The petrol engine is used as prime movers that transmit power to a smaller pulley. Smaller pulley transmits power to larger pulley though v-belt. Larger pulley transmits shaft. Then scotch yoke mechanism used to transmit rotary motion of disc to reciprocating motion of movable blades. Blades are slides over each other in definite way to cut crops and additional attachments is that he dome of metallic sheet that divide the cut crop into besides of crop cutter. When cutter move forward the crop fall on the dome of sheet that collected of crop cutter.

A. Machine Component

1) Petrol Engine

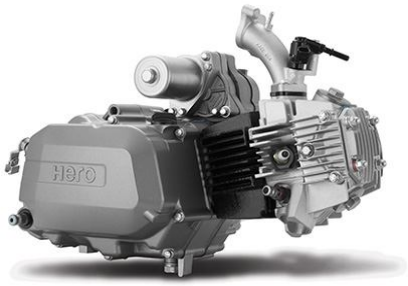

Fig No 2: Petrol Engine

The engine converts Heat Energy into Kinetic Energy in the form of Reciprocating movement.The expansion of heated gases and their pressure act on the engine pistons. The gases push the pistons downwards which results in reciprocating move of pistons. The engine is the petrol . When it has start it required petrol means start of the engine. Stop the petrol chock because we have required whole the work with the help of petrol through the work running on petrol so that when engine start Engine.

2) Scotch Yoke Mechanism

The Scotch Yoke (also known as slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion, or vice versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part.

3) Sprocket chain

Fig No 3: Sprocket chain

Sprockets are used primarily in chain driven systems to transfer power or rotation to other shafts.The name 'Sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it is distinguished from a gear in that sprockets are never meshed together direct, and different from a pulley in that sprockets have teeth and pulleys are smooth except for timing pulleys used with toothed belts. Sprockets are used in bicycles, motorcycles tracked vehicles, and other machinery either to gears are unsuitable or to impart linear motion to track, tape etc.

4) Cutter Blade

Fig No 4: Cutter Blade

A rotary blade cutter is used for quick cuts, a tangential knife for details and a creasing tool for setting fold lines. Cutter is made up of high speed steel it has high hardness and stiffness it have great capacity to cut the crop. Cutting systems are used to work with corrugated cardboard, composites, rubber, cork and filter materials. The thickness of cutter is 4 mm. The angle between two teeth is 45' Cutters used for harvesting, or reaping, grain crops or cutting succulent forage chiefly for feeding livestock, either freshly cut. Cutting heads include circular saw blades , brush knives, grass blades, etc.

III. METHODOLOGY

The design of multipurpose agriculture cutter can be increase for cutting paddy, weeds, and lawn grass etc. by using petrol engine the in present days the Concept and Technology employing this conventional energy becomes very popular for all types of development activities. Multipurpose agriculture cutter which can be used for finishing work as well as for cutting crops, thick grass. Its have been carefully designed for user comfort by condering ergonomics aesthetics. Methodology is the systematic, Theoretical analysis of the methods applied to a study or to the theoretical research of the method and principles associated with branch of study.

1) Studying the present mechanism.
2) Field Survey
3) To identifying the potential problem.
4) Problem definition.
5) Literature review.
6) Design of crop cutter.
7) Calculation.
8) Analysis using FEM Method.
9) Fabrication.

III. DESIGN CALCULATION

Diameter of driver pulley D1= 100mm
Dia of driven pulley D2= 150 mm.
Speed of driver pulley (N1) = speed of Engine shaft=3300RPM
speed of driven pulley (N 2):
(N2/N1)= (D1/D2)
N2= (D1/D2)×N1
N2=(100/300)×4500
N2 =1500RPM
Now.
It is given that dia of disc= 150 mm.
Therefore Speed of cutter calculated by following formula.
We know that when disc rotated by I rev. it will produce 2 Strokes
Speed of cutter =Speed of driven pulley (disc)
Surface feed per minute(sfm)
Speed of cutter=(sfm)×12(dia×π)
Speed= (sfm×3.82)/D
Sfm= 58.900.52feet/min
Cutting speed =0.66rpm

A. Selection Of Belt

V-belts are also selected from the manufacturer's catalogue. Following is the procedure for selection of a flat belt:

1) Design of shaft

Hourse power=Torque×Rpm/5.252
Hourse power calculation
HP=CC/15
100/15
HP=6.66
6.66=Torque×Rpm/5.252
T=7.77N/mm
We know that
Torque= Force X Distance
7.77=Force X (150×10^3)/2
Force=103.6
Taking Moment at point B=0
ForceX600-Ra X 450 =0
103.6 X 600 – Ra X 450 = 0
Ra=138.13
Ra+Rb=103.6N
Rb= -34.53N
Bending Moment Calculation:
Bending Moment at point B=0
Bending Moment at point A is given by,
=F x 150-Rb x550
=103.6x 150-(-34.53 x550)
=345331.5N-m
Torsional moment
$(P_1/P_2)= e^{\mu\Theta}$
$P_2=P_1/ e^{\mu\Theta}$

P2=103.6/2.125
P2= 48.75N
The toque supplied is to The shaft is given by
Mt= (P1-P2) x R
=(103.6-48.75)x 75
= 4113.75 N-mm
Bending moment Mb=34531.5N-mm
shaft dia (τmax) = $16/(\pi d^3)$ x$(M_b^2 + M_t^2)^{1/2}$ ----------(1)
τmax=0.5 syt/FS
=0.5 x 400/3
=66.67N/mm²
From equation 1
$66.67=16/(\pi d^3)$ x$(34531.5)^2 + (4113.75)^2$
$d^3 =16/(\pi 66.67)$ x$(34531.5)^2$
d^3=2656.53
d=154.62 mm
from standard diameter of steel diameter d=12mm

2) force and energy calculation for cutter
The shape of cutter is equilateral triangle and having length of side is 25 mm and total no. of teeth are 32
The shear stress of wheat stalk -=3.86Mpa
Suppose external dia of cropp =3 mm internal dia of crop =2mm-
Area of single crop: $(\pi/4)$ x (D^2-d^2)
a=3.92699mm^2
Total Area =no. of teeth X Area
A =32 X a
A =125.44 mm^2
force required to cut the crop (wheat) =shear stress X Area
=3.86 x 125.44
F=484.198

IV. RESULTS

A. Comparison of Harvesting Cost by Traditional Method and Our Harvester

1) Harvesting done by MANUAL process
Amount paid to the labor for one day = Rs. 300 per labour
Total number of labour required in general to harvest the 1 acre farm in a day = 6
Total amount paid to the labour = 6 x 300
= Rs. 1800 per acre in one day
Therefore, total expenditure in one day is = Rs. 1800

2) Harvesting done by Machine
Quantity of diesel require for 0.25 to 0.3 acre = 1 litre
Quantity of diesel require for 1 to 1.2 acre = 4 litre
Cost of Petrol per litre = Rs100.95
Total cost of Petrol for 1 acre farm for a day = 3 x Rs100.95 = Rs. 302.85
Amount paid to the labour = Rs. 300 per day
Total expenditure = Total cost of Petrol + Amount paid to the labour + Maintenance
= 302.85 + 300 + 60
= Rs. 660.85
Amount saved by using the harvester = 1800 – 660.85 = Rs. 1139.15 per day per acre.

Parameter	Harvesting done by manual process	Harvesting done by machine
Time required to harvest the 1 acre farm	6 day	1 day
Labour Cost spend to harvesting	Rs 1800	Rs 300
Total cost spending	Rs 1800	Rs. 660.85

V. FUTURE SCOPE

"The crop cutter machine" provides wide range for future advancements. Some of these are as follows:

1) By just changing the teeth size we can use the crop cutter as lawn mover. We can make the crop cutter to work under the different crops as per the loads (Just we have to change the power and blade size).

2) By providing the curved collectors at sides of crop cutter to collect the cutting crops and also the bunch of crops is get tying together by using automation. And throw at backside of cutter.

3) In case to use the machine in case of sugarcane application we can provide more power at prime mover one spring in parallel, let us say 4 parallel springs can be used to increase the capacity.

VI. CONCLUSIONS

The unite reaper and colleting machine is built to be compact and efficient to cut the crops. The machine was trial on a field to check its cutting capability and efficiency. The test results were successful as the machine performed perfectly. It can be concluded that the machine is almost compact and easy to handle. This machine is able to run of field effortlessly and the attempt of farmers are reduced. The cost of harvesting using this machine is substantially less as compare to manual harvesting. The cutter(harvester)s available in market are suitable for large farms, so this can be the best machine for the farmers with small land. The success of this machine depends on how the farmers collect this machine as their ally. There are some changes that need to be done on the machine and a final product is to be taken out for sell.

VII. ACKNOWLEDGMENT

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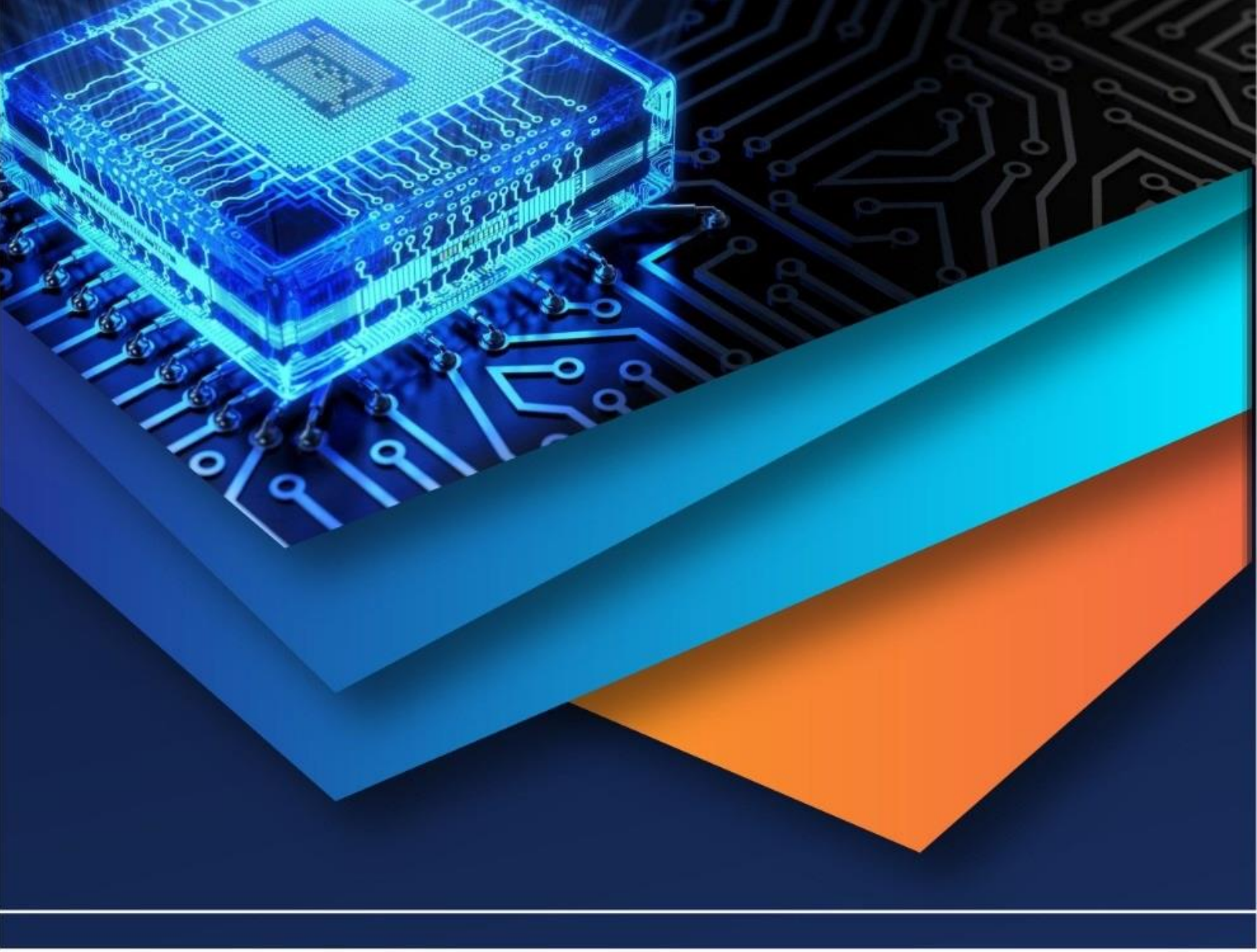

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