DESIGN AND FABRICATION OF AUTOMATIC MECHANICAL CUTTER USING FOUR BAR MECHANISM

A PROJECT REPORT

Submitted by

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In partial fulfillment for the award of the degree

Of
BACHELOR OF ENGINEERING
IN
MECHANICAL ENGINEERING

VELAMMAL
ENGINEERING COLLEGE
The Wheel of Knowledge rolls on!

VELAMMAL ENGINEERING COLLEGE, CHENNAI-66

(An Autonomous Institution, Affiliated to Anna University, Chennai)

JUNE 2022

VELAMMAL ENGINEERING COLLEGE, CHENNAI-66

BONAFIDE CERTIFICATE

Certified that this project report **"AUTOMATIC MECHANICAL CUTTER USING FOUR BAR MECHANISM"** is the bonafide work of **"PRADEEP S**, **PRASANNA KUMAR R**, **SASHTI SUBANKAR D, SATHISH S"** of sixth semester B.E, Mechanical Engineering, who have carried out the Design and Fabrication Project under my supervision.

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Submitted for UNIVERSITY VIVA VOCE EXAMINATION held on........................

INTERNAL EXAMINER   EXTERNAL EXAMINER

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ABSTRACT

Agriculture is one of the oldest professions but the development and use of machinery has made the job title of farmer a rarity. Instead of every person having to work to provide food for themselves, smaller portion of our population today works in agriculture, the smaller portion provides considerably more food than the other can eat. The basic technology of agricultural machines has changed little in the last century with the coming of the Industrial Revolution and the development of more complicated machines. In this work design and fabricate the automatic mechanical cutter by using crank and slotted lever mechanism, for cutting agricultural products like sugarcane for cultivation. The present work to fabricate a machine which is simple in construction than the existing machines. The equipment make the use of crank and slotted lever mechanism with one slider to couple with an electric motor using pulley and belt drive.

Chapter 1
INTRODUCTION

The working principle behind the operation of simple mechanical cutting machine is four bar chain mechanism particularly crank and slotted lever mechanism. The crank wheel is rotated by the motor through the pulley belt assembly. The rotating motion the crank wheel is converted into oscillating motion by the coupling link by using the slider. The oscillating motion at the other end of the coupling link is converted into reciprocating motion to the blade by using guide hole. Therefore the rotating motion of the crank wheel is converted into reciprocating motion to the blade through the coupling link.

Agriculture is the only means of living for almost two thirds of the workers in India. The agriculture sector of India has occupied 43% of India's geographical area, and is contributing 16.1% of India's GDP. Agriculture still contributes significantly to India's GDP despite decline of its share in India's GDP. There are number of crops grown by farmers. These include different food crops, commercial crops, oil seeds etc. Sugarcane is one of the important commercial crops grown in India.

In India agriculture is facing serious challenges like scarcity of agricultural labor, not only in peak working seasons 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 Approximately 80% of the world's sugar is produced from sugarcane in tropical and subtropical climates, with the remaining 20% derived from sugar beet, which is grown mostly in the temperate

zones of the northern hemisphere. 70 countries produce sugar from sugarcane, 40 from sugar beet and 10 from both. In agricultural harvesting we require maximum man power, ample money and also it is more time consuming process. In cutting process we face various problems and these are not easily solved. The design of this machine is very simple also easy to implement. In this manner we are designing the Sugarcane Cutting Machine to reduce effort and time. In sugar cane farms we are using this machine for cutting purpose. This is user friendly cutting machine; anyone can handle this machine in any working condition. Skilled persons aren't required for operating this machine.

Chapter 2
PROBLEM STATEMENT

2.1 Justification

In manual harvesting to cut one acre of sugarcane 15-16 labors are required they take 3 days to cut one acre. By using this machine problem of the labor crises can be reduced. Comparing with manual harvesting only 18% of labors are required, it makes the process faster hence reduces most of the harvesting time and labor required to operate the machine is also less. This machine is helpful for both small and big farmers. (Ratod et al. 2013). To overcome these problems this project work aims to develop low cost sugarcane harvesting machine which is more efficient and having simple mechanism for cutting the sugarcane at a faster rate. (Siddaling and Ravaikiran 2015) The purpose of developing this machine is to reduce cost and time required for sugarcane harvesting. Sugarcane harvesting machine which is economical, more efficient and cuts the sugarcane at faster rate and it will be helpful for small scale farmers, unskilled labors can also operate without difficulty. By using this harvesting machine, we can also solve the problem of labor shortage.

Chapter 3
Physical Properties of Sugarcane Crops

Blackburn described the sugarcane as a tall tropical grass with a single un-branched stem of average height in the range of 3 to 4m with a stem diameter ranges from 3 to 5cm depending on the species. Moore and Misstated that the sugarcane is a large tropical grass that produces multiple stems or culms each of which consist of a series of nodes separated by internodes. After germination, the terminal vegetative bud of each shoot lays down a series of nodes, each with a dormant bud and one or more rows of root primordial and a growth ring. The internodes consist of sucrose storing parenchyma cells and vascular tissue. The stalk of sugarcane is the major storage area for photosynthate (sucrose) within the sugarcane plant, rather than fruit or seed structures. Stalk is also known as "millable cane". The top of the stalk is relatively low in sucrose and therefore is of little value to the mill. The stalk consists of segments called joints. Each joint is made up of a node and an inter node. The node is the place where the leaf attaches to the stalk.

Chapter 4
LITERATURE REVIEW

Kiatiwait et al. (1992) developed a selph-propelled walking type sugarcane harvester-windrower in Thailand. The machine is a one row single-axle walking-behind-type. It works on the principle of impact cutting by knife blades. As the machine moves forward along the row, the cluster of cane stalks is guided from the divider by a two sets of lugged chains and a spring loaded guide frame. At the narrowest point of guided path, the canes are cut by blades of the base cutter, revolving at peripheral speed approximately 42 m/s. A pair of solid rubber-gage tractor wheels mounted in the front part of the machine prevents the base cutter blade from striking the ground and control the height of cut. The machine type is4GZ-9 whole stalk harvester, mounted on 11-14.7 kW hand tractor. Its productivity is 0.1-0.15 ha/h, and it is adapted to row spacing ≥1.0 m. shifting a lock-pin along the shaft to make adjustment for various spacing along the adjacent rows. Viator and Wang (2321-3051) studies that the green harvesting method can also have negative effects on cane yield in certain environments because the trash layer can lower the soil temperature, which can slow down early plant growth and increase the risk of frost damage in young plants during freeze or near- freeze events summarizes the weaknesses of green cane harvesting practices. Sandhu et al. (4337-4343) showed that green cane harvesting method could reduce Lesser Cornstalk Borer damage to sugarcane because the trash blanket can inhibit the egg deposition and increase the larval mortality.

Chapter 5

MATERIALS AND METHODS

If a number of bodies are assembled in such a way that the motion of one causes constrained and predictable motion to the others, it is known as a mechanism. A mechanism is a simplified model, usually in the form of a line diagram, which is used to reproduce the motion occurring in a machine. The purpose of this reproduction is to enable the nature of the machine. The purpose of this reproduction is to enable the nature of the motion to be investigated without the encumbrance of the various solid bodies which form the machine elements.

The various parts of the mechanism are called links or elements. Where two links are in contact and a relative motion is possible, then they are known as a pair. An arbitrary set of a links which form a closed chain that is capable of relative motion, and that can be made into a rigid structure by the addition of a single link, is known as a kinematics chain. To form a mechanism from a kinematics chain one of the links must be fixed. However as any of the links can be fixed, it follows that there are as many mechanism as there are links in the chain.

The technique obtaining different mechanism by fixing the various links in turn is known as inversion. Experimental procedure: A crank is an arm attached at right angles to a rotating shaft by which reciprocating motion is imparted to or received from the shaft. It is used to convert circular motion into reciprocating motion, or vice-versa. The arm may be a bent portion of the shaft, or a separate arm or disk attached to it. Attached to the end of the crank by a pivot is a rod, usually called a connecting rod. The end of the rod attached to the crank moves in a circular motion, while the other end is usually constrained to move in a linear sliding motion. Crank

wheel is the rotating member. It is made up of stainless steel. It is attached at one end of a shaft and on the other end of the shaft is fitted with a pulley which is coupled with an electric motor.

The crank wheel transmits the power from the motor to the coupling link. The photograph of the crank wheel is shown. The outer circumference of the crank wheel is provided with teeth which may be used for the proper engagement of a chain drive. But we did not go for chain drive. The crank wheel has a pin to engage the coupling link with it. This pin slides over the coupling link and make it oscillates when the crank wheel rotates.

Chapter 6
MECHANISM USED

6.1 FOUR BAR MECHANISM

DEFINITION

A four-bar linkage, also called a four-bar, is the simplest movable closed chain linkage. They perform a wide variety of motions with a few simple parts. Then is paper involves the design, synthesis and fabrication of one such mechanism (four bar mechanism). In this paper four Leg Kinematic movement works on Chebyshev's parallel motion which deals the relation between the links.
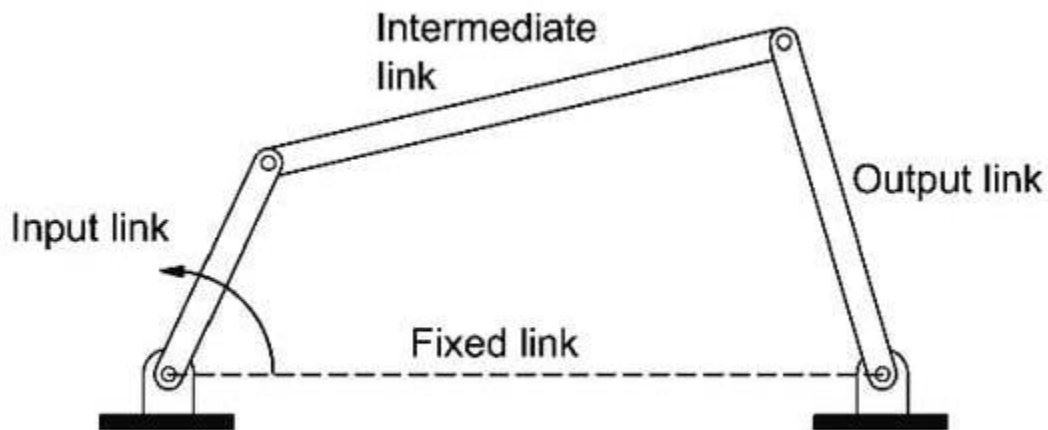

6.2 CRANK MECHANISM

DEFINITION

This machine is basically works on the principle of Single Slider Crank Mechanism which is the heart of this machine and it converts rotary motion into a reciprocating machine to crush the Cans/Plastic bottles. In this, link 1 is fixed and link 2 which is a crank is rotating about fixed link 1 and converts this rotary motion into

the reciprocating motion of slider (corresponds to the link 4) by means of connecting rod which corresponds to the link 3. This is the inversion of single slider crank which is obtained by fixing link.
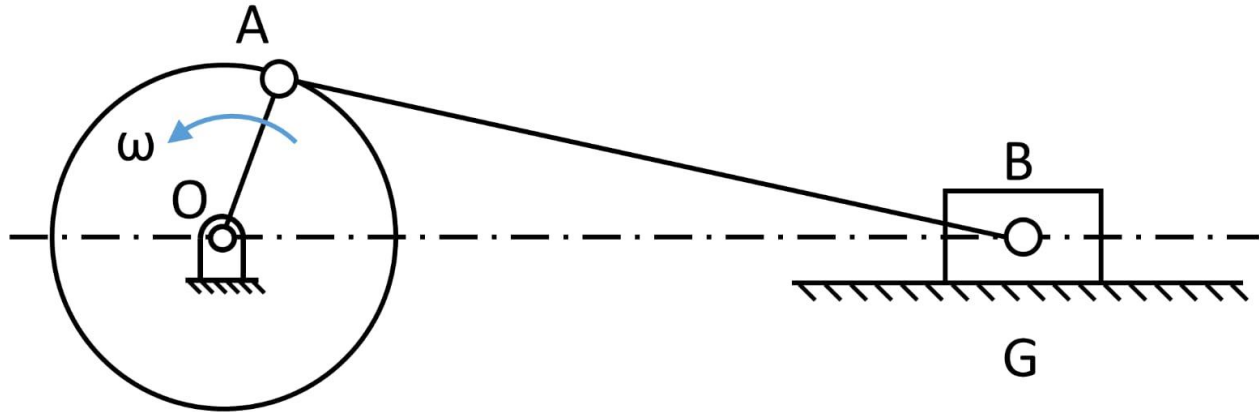
6.3 LINKAGE MECHANISM

DEFINITION

A linkage is a mechanism formed by connecting two or more levers together. Linkages canbe designed to change the direction of a force or make two or more objects move at the same time. Many different fasteners are used to connect linkages together yet allow them to move freely such as pins, end-threaded bolts with nuts, and loosely fitted rivets.

A linkage is an assembly of bodies connected to manage forces and movement. The movement of a body, or link, is studied using geometry so the link is considered to be rigid. The connections between links are modeled as providing ideal movement, pure rotation or sliding for example, and are called joints. The speed ratio and mechanical advantage are defined so they yield the same number in an ideal

linkage. A kinematic chain, in which one link is fixed or stationary, is called a mechanism, and a linkage designed to be stationary is called a structure.

6.4 SLIDER MECHANISM

DEFINITION

Common to most reciprocating engines is a linkage known as a crank-slider mechanism. Diagrammed in Figure.5, this mechanism is one of several capable of producing the straight-line, backward-and-forward motion known as reciprocating. Fundamentally, the crank-slider converts rotational motion into linear motion, or vice versa.

The position of the piston with respect to the crank center line problem for the control is given by

$$x = (S/2) \cos + L\cos \varnothing \ [\text{ft} \mid \text{m}] \ \text{............. (1)}$$

where,

$yA = (S/2) \sin = L \sin\varnothing$ can be used to eliminate $\varnothing$ to obtain

$X/L = (S/2L) \cos + [1-(S/2L)\text{si n }] \ ½$

Chapter 7

MATERIALS AND COSTS

S.No	Equipments	Quantity	Cost Rs./unit
1	DC Motor (12V/7Amps)	1	2500
2	Cutter	1	1000
3	Steel rods	-	380
4	Circular Disc	2	200
5	Connecting Rod	1	500
6	Crank Shaft	2	200
7	Plummer Block	2	600
8	Welding	-	850
9	Miscellaneous	-	800
	Total Cost		7030

Chapter 8
COMPONENETS USED

8.1 STEEL FRAME

Steel buildings are more flexible than RCC building but they display lateral deflection than RCC building. A Bracing is a system that is provided to minimize the lateral deflection of structure. A Braced Frame is a structural system which is designed primarily to resist wind and earthquake forces.

Braced frames are classified as concentric braced frames (CBF) or eccentric braced frames (EBF). Concentric braced frames are frames in which the center line of the member that meet at a joint, intersect at a point to form a vertical truss system which resists lateral forces.

8.2 SINGLE PHASE MOTOR

Electric motor is an electrical machine that is used to convert electrical energy into mechanical energy, for smaller loads as in household applications. Although traditionally used in fixed-speed service, induction motors are increasingly being used with variable-frequency drives in variable-speed service.

Electric motor is an electrical machine that is used to convert electrical energy into mechanical energy, for smaller loads as in household applications. Although traditionally used in fixed-speed service, induction motors are increasingly being used with variable-frequency drives in variable-speed service.

8.3 FLY WHEEL

Flywheel is used to reduce speed of shaft and to control the rotation motion. Most modern gearboxes are used to increase torque while reducing the speed of a prime mover output shaft. This means that the output shaft of a flywheel rotates at a slower rate than the input shaft, and this reduction in speed produces a mechanical advantage, increasing torque. Some of the simplest gearboxes merely change the physical rotational direction of power transmission. A flywheel designed using a worm and worm-wheel is considerably smaller than one made from plain spur gear, and has its drive axes at 90° to each other. With a single start worm, for each 360° turn of the worm, the worm-gear advances only one tooth of the gear.

8.4 CONNECTING ROD

The connection rods are used to connect the fly wheel and the reciprocating arrangement, one end of the connecting rod or shaft connected to the flywheel another end was connected to the reciprocating chamber, when the flywheel rotates it act as a slider crank mechanism for the movement of upside down.

Connecting Rod
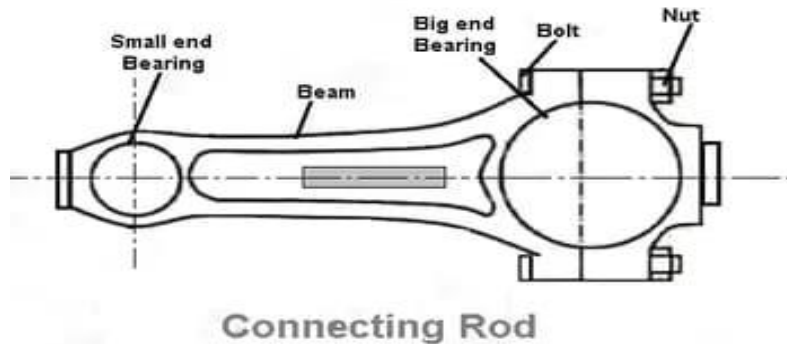
8.5 SUPPORTING FRAME

The whole arrangement was done on the supporting frame, it was made up of the rods by attaching them up into a table or a frame, and it is very easy to done a machining a process on that frame.

8.6 SUPPORTING PLATE

It is the thick plate made of steel, where it was mounted on the supporting frame as a flat surface area on that we pointed a blade setting and motor setting arrangement.

8.7 WOOD CUTTER

This is the cutter for the purpose of using this cutter for cutting the wood materials and agriculture wastages and other plant materials

Chapter 9
METHODOLOGY

- A thorough literature review to understand the basic concept of the topic like seismic evaluation of building structures, Response Spectrum analysis, and linear Time History analysis by referring books, technical papers or research papers.
- Data collection.
- Seismic behaviour of steel frames with various bracings bracing configuration.
- Modeling the steel frame with various bracing configuration by computer software ETABS2013.
- Carry out Equivalent Static analysis, Response Spectrum analysis and linear Time History analysis on the models.
- Interpretation of results & conclusion.
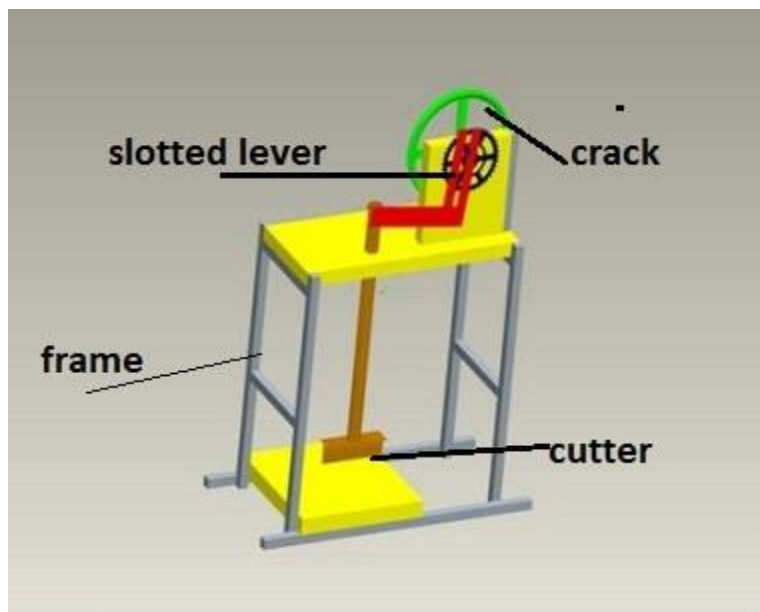
Chapter 10

Working Principle

When this electric motor is run by current if the power will be transmitted into the flywheel by the way of conveyor belt. The flywheels are used to reduce the motor speed. in that flywheel is connected to the crank by using actuating rod, the crank will be rotated and the connecting rod is move up & down in that way we cutting buds from the cane by using u-shaped cutting blade. Also we using the wood roller for cutting agriculture materials.

ADVANTAGES & LIMITATION

- ➢ Simple in construction.
- ➢ Initial cost is low.
- ➢ Less man power.
- ➢ Easy to maintain.
- ➢ Save large amount of sugarcane bud from waste by plant in form.
- ➢ We get more sugarcane compare than normal sugarcane plant method.
- ➢ Easy to operate.
- ➢ Saved sugarcane are used to white sugar production and juice.

APPLICATIONS

- ➢ Used to cut sugarcane and kappa of required size for cultivation.
- ➢ With less modification in this machine.

CHAPTER 11

IMAGE OF WORING MODEL

TOP VIEW

FRONT VIEW

SIDE VIEW

Chapter 11

FUTURE SCOPE

Man is always trying to develop more and more modified techniques with increasing the apathetically look and economic consideration. Hence there is always more and more scope towards whatever he might have created of course after having the experience of the present manufacturing things. Being engineers and having the ability to think and plan but, due to some time constraints and also due to lack of fund, we only have thought and put in the report the following future modifications.

By using the cutter blade with high strength and the increase in power used, the cutter can be used for many applications in agriculture sector like tree cutting, shrubs cutting, cane cutting, maize cutting etc.

Chapter 12

RESULT AND DISCUSSION

The Four-Bar Chain:The four bar chain is the most fundamental of the plane kinematic chain. It is a much preferred mechanical device for the mechanization and control of motion due to its simplicity and versatility. Basically, it consists of four rigid links which are connected in the form of quadrilateral by four-pin joints. When one of the links is fixed, it is known as a linkage or mechanism. Link that rotate complete revolution is called the crank, the link opposite to the fixed link is called the coupler, and the fourth link is called the lever or rocker if it oscillates or another crank, if it rotates. Grashof's Law For A Four-Bar Mechanism: Groshof's law states that a four bar chain mechanism has at least one revolving link if the sum of the lengths of the largest and the shortest links is less than the sum of lengths of the other two links.

Chapter 13
CONCLUSION

The sugarcane machine is very useful to small scale farmer to planting sugarcane bud .and also time is saved by this process as compared to the traditional system of sugarcane bud plant. Extra sugarcane waste in small form that can be saved by using sugar cane bud cutting machine that can be used as a white sugar production and juice. Also the wood cutter is very useful for the farmers and it reduces the human.

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