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Fabrication and Analysis of Lawn Mower

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ABSTRACT: In our project we fabricate the grass cutting machine for the use of agricultural field, to cut the crops in the field. This is a new innovative concept mainly used in agricultural field. It is simple in construction and its working is easy. The components that are used are motor, gear arrangement, cam, chain and sprocket, lead screw, wheel, control unit. Below the gear arrangement cutting blade is fixed. When the motor starts running by the use of power supply, the shaft also rotates and that rotates the gear arrangement which is coupled with the motor. As the gear arrangement rotates the cam arrangement, it operates the sickle bar which tends to cut the plants or crops. The sickle bar has one is fixed cutter and another one is movable cutter which is placed on it. The whole set up is placed on a movable base which has a wheel arrangement.

KEYWORDS: Grass Cutting Machine, Components, Power Supply, Sickle Bar.

I. INTRODUCTION

A grass cutter is a machine that uses revolving blades, to cut a garden land spaces, at an even length. Grass cutters employing a blade that rotates about a vertical axis are known as cutters, while those employing a blade assembly that about a horizontal axis are known as cylinder or reel cutters. Many different designs have been made, each suited to a particular purpose. The smallest types, pushed by a human, are suitable for small residential lawns and gardens, while larger, self-contained, ride-on mowers are suitable for large lawns, and the largest, multi-gang mowers pulled behind a tractor, are designed for large expanses of grass such as golf courses and municipal parks.

II. LITERATURE REVIEW

The first lawn mower (grass cutter) was invented by Edwin Budding in 1827 in Stroud, Gloucestershire. Budding's mower was designed primarily to cut the lawn on sports grounds and expensive gardens, as a superior alternative to the scythe, and was patented in 1830. It took ten more years and further innovations to create a machine that could be worked by animals, and sixty years before a steam-powered lawn mower was built. In an agreement between John Ferrabee and Edwin Budding dated May 18, 1830, Ferrabee paid the costs of development, obtained letters of patent and acquired rights to manufacture, sell and license other manufacturers in the production of lawn mowers. Thomas Green produced the first chain-driven mower in 1859. Manufacture of lawn mowers began in the 1860s. By 1862, Farrabee's company was making eight models in various roller sizes. He manufactured over 5000 machines until production ceased in 1863. In 1870, Elwood McGuire of Richmond, Indiana designed a human-pushed lawn mower, which was very lightweight and a commercial success. John Burr patented an improved rotary-blade lawn mower in 1899, with the wheel placement altered for better performance. Amariah Hills went on to found the Archimedeian Lawn Mower Co. in 1871. Around 1900, one of the best known English machines was the Ransomes' Automaton, available in chain- or gear-driven models. JP Engineering of Leicester, founded after World War I, produced a range of very popular chain driven mowers. About this time, an operator could ride behind animals that pulled the large machines.

These were the first riding mowers. The rise in popularity of lawn sports helped prompt the spread of the invention. Lawn mowers became a more efficient alternative to the scythe and domesticated grazing animals. James Sumner of Lancashire patented the first steam-powered lawn mower in 1893. His machine burned petrol and/or kerosene as fuel.

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After numerous advances, the machines were sold by the Stott Fertilizer and Insecticide Company of Manchester and later, the Sumner's took over sales. The company they controlled was called the Leyland Steam Motor Company. Numerous manufacturers entered the field with gasoline-driven mowers after the turn of the century. The first grass boxes were flat trays but took their present shape in the 1860s. The roller-drive lawn mower has changed very little since around 1930. Gang mowers, those with multiple sets of blades, were built in the United States in 1919 by a Mister Worthington. His company was taken over by the Jacobsen Corporation, but his name is still cast on the frames of their gang units.

III.DESIGN AND DRAWING

The grass cutter is consists of the following components to full fill the requirements of complete operation of the machine.

- Motor
- Belt and pulley
- Blades
- Wheel
- Control unit
- Cam

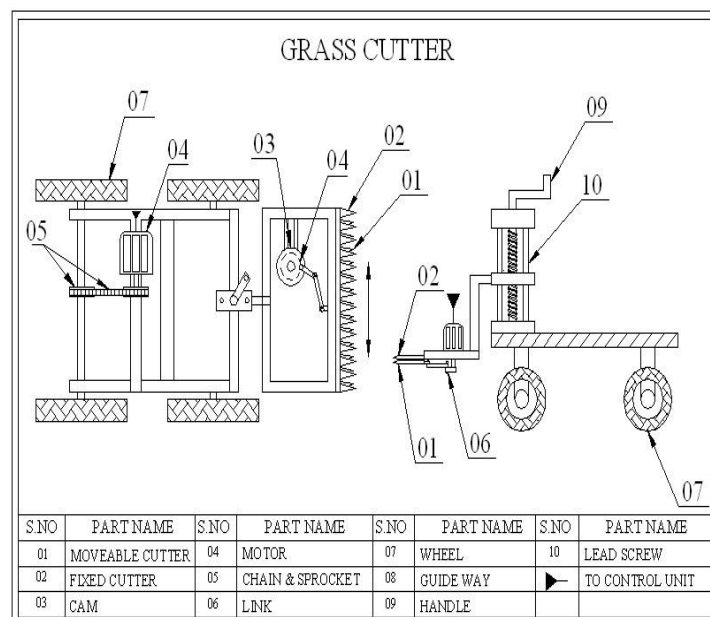


Fig. 1 Grass cutter

IV. WORKING PRINCIPLE

In our project we are using the grass cutter for cutting the grass in the field. It consists of simple manner and the using components are motor, cam, chain and sprocket, lead screw, wheel, cutter. Arrangement with this project using two cutter one movable cutter another one fixed cutter the movable cutter is connecting to the cam link and cam is rotating help of motor. Here the motor is working using with the help of electric power supply; When the motor to start running the shaft is rotate and it's rotating the cam arrangement is rotating with attach of cutting blade and the cutting process is carrying out by this machine. The grass cutter vehicle is moving help of motor. The motor is connecting with the chain and sprocket arranges meant the pulley is coupled with wheel shaft. The cutter is moving help of lead screw setup.

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V. CALCULATION

Square DC motor specification:

Speed $N = 30$ RPM

Voltage $V = 12$ Volt

Current $I = 0.3$ A (loading condition)

Current $I = 0.06$ A (No Load Condition)

Power $P = V \times I = 12 \times 0.3 = 3.6$ WATT

$P = 0.0048$ HP

Motor Efficiency = 36%

Electrical power of the motor is defined by the following formula:

$$P_{in} = I * V$$

Where,

P_{in} – input power, measured in watts (W)

I – current, measured in amperes (A)

V – applied voltage, measured in volts (V)

Motors supposed to do some work and two important values define how powerful the motor is. It is motor speed and torque – the turning force of the motor. Output mechanical power of the motor could be calculated by using the following formula

$$P_{out} = T * \omega$$

Where,

P_{out} – output power, measured in watts (W)

τ – Torque, measured in Newton meters (Nm)

ω – Angular speed, measured in radians per second (rad/s).

Calculate angular speed if you know rotational speed of the motor in rpm:

$$\omega = N * 2\pi / 60$$

Where,

ω – Angular speed, measured in radians per second (rad/s);

Rpm – rotational speed in revolutions per minute;

π – Mathematical constant pi (3.14).

60 – Number of seconds in a minute.

Efficiency of the motor is calculated as mechanical output power divided by electrical input power:

$$E = P_{out} / P_{in}$$

Therefore

$$P_{out} = P_{in} * E$$

After substitution we get

$$T * \omega = I * V * E$$

$$T * N * 2\pi / 60 = I * V * E$$

Connect the motor to the load. Using the motor from generator kit is the best way to do it. Why do you need to connect the motor to the load? Well, if there is no load – there is no torque. Measure current, voltage and rpm. Now you can calculate the torque for this load at this speed assuming that you know efficiency of the motor.

Motor torque changes with the speed. At no load you have maximum speed and zero torque. Load adds mechanical resistance. The motor starts to consume more current to overcome this resistance and the speed decreases. If you increase the load at some point motor stops (this is called stall). When it occurs the torque is at maximum and it is called stall torque. While it is hard to measure stall torque without special tools you can find this value by plotting speed-torque graph. You need to take at least two measurements with different loads to find the stall torque.

TORQUE OF THE MOTOR:

And the formula for calculating torque will be

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$$T = (I * V * E * 60) / (N * 2\pi)$$

$$= (0.3 \times 12 \times 0.36 \times 60) / (30 \times 2\pi)$$

$$\text{Torque} = 0.412 \text{ Nm}$$

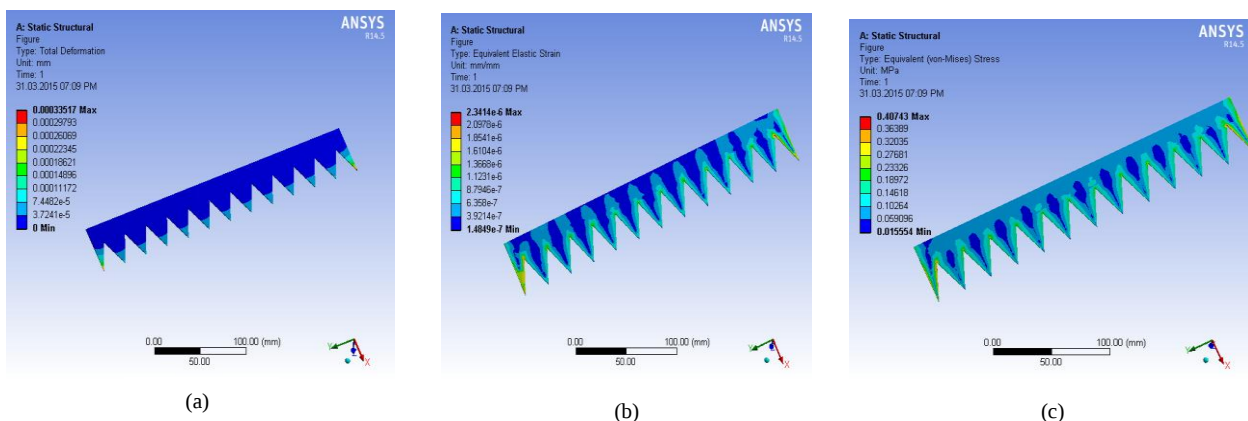
Torque (T) = 4.2kgcm

VI. GRASS CUTTER BLADE ANALYSIS IN ANSYS

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. Steady loading and response conditions are assumed; that is, the loads and the structure's response are assumed to vary slowly with respect to time. The types of loading that can be applied in a static analysis include,

- Externally applied forces and pressures
- Steady-state inertial forces (such as gravity or acceleration)
- Imposed (nonzero) displacements
- Temperatures (for thermal strain)

VII. RESULTS FOR GRASS CUTTER BLADE IN STRUCTURAL ANALYSIS



	MIN	MAX
Total deformation (mm)	0	3.3517e-4
Equivalent Elastic Strain (mm/mm)	1.485e-7	2.414e-6
Equivalent stress (MPa)	0.0155	0.407

Fig. 2 Results (a) Total deformation (b) (d) (c) Equivalent stress (d) Result tabulation

VIII. CONCLUSION

This project is made with pre planning, that it provides flexibility in operation. Easiest operation is obtained by the control unit in the “LAWN MOVER”. The comparative gain that can be accomplished is the utilization of motor in control unit. This innovation has made the more desirable. This project “GRASS CUTTER” is designed with the hope that it is very much economical and help full to many agricultural areas. This project helped us to know the periodic steps in completing a project work. Thus we have completed the project successfully.

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