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Design of Hybrid Power Grass Cutter

Ajay Darak[1], Vinay Murgod[2]

[1]*Department of Mechanical Engineering, KLSGIT, Belagavi*
[2] *Department of Mechanical Engineering, KLSGIT, Belagavi*

Abstract - Hybrid powered grass cutter can be described as the application of solar energy to power an electric motor which in turn rotates a blade which does the mowing of a lawn. The hybrid powered lawnmower is an improvement on cordless electric lawn mower.

Key Words: *grass cutter;solar panel; cutting blades; solarcharger.*

1. INTRODUCTION

Making the process of cutting grass easier over the years, many individuals have added modification to the original design speed, efficiency and power of a mowing machine. The hybrid powered grass cutter is based on the same principle that other early inventions of grass cutter works on. The difference is the application of the energy source and the cutting operations. It uses the photovoltaic panel to generate the energy needed to power the mover[1]. It is assumed that a lawnmower using solar as the energy source will address a number of issues that the standard internal combustion engine and electric motors grass cutter do not[1]. A grass cutter with hybrid energy will be easier to use, it eliminates down time by frequent trips to the gas station for fill-ups and danger associated with gasoline spillage. The hybrid powered grass cutter will help to reduce air pollution as well as noise pollution produced by other types of grass cutter. In addition, it will help to reduce the running cost of using and maintaining a grass cutter. However, most electric grass cutters available at present are very inconvenient in that they require the use of an extension cord which invariably gets in the way of mowing the lawn. Rotary mowers are based on the use of small but powerful engine that provides enough torque to spin a very sharp horizontal blade that cuts the grass upon contact.

2. METHODOLOGY

Basically it consist of a rectangular framing section hand*le, DC gear motor, sheet metal*, solar panel battery etc. In operation the solar energy absorbed by the solar panel is been stored in the battery and the energy stored into the battery will be used for further operation. The hybrid grass cutter uses an eliminator to use AC current to run the cutter*[4]*. The operator just needs to push the machine in which *every* direction he needs then he just needs to switch on the motor as soon as the motor is switch on the cutting action gets activated and these blades are been attached to the shaft of the motor as the blade gets mesh up with the grass the grass gets cut

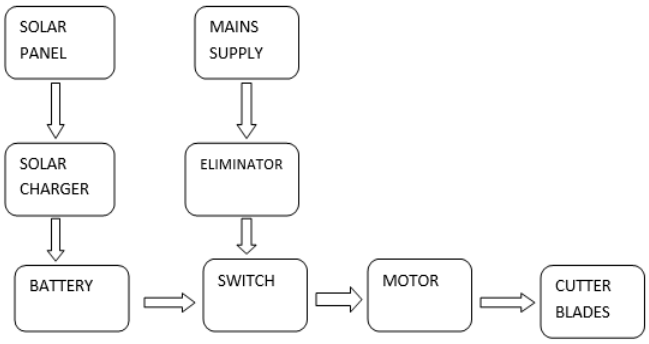

Fig -1: Flowchart of methodology

3. WORKING PRINCIPLE

Coming to the working principle of solar grass cutter, it has panel mounted on top of model in a particular arrangement such that angle of inclination is 45 degree hence it can be receive solar radiation easily. Solar panel converts solar energy into electrical energy. This electrical energy is stored in the battery. The motor is connected to the battery through connecting wires[4]. The cutting blades tap the power from DC motor and which in turn actuates the blades and hence rotating blades cut the grass. It also works on direct electric current by using eliminator it can extract electric current directly from the switch board and the motor wires are directly connected to the eliminator which then helps the blades to rotate and hence cut the grass.

4. CALCULATIONS

For the design of blade, the force require to cut the gears and force acting on the table was considered[2][3].
Generally a force of less than 10N is required to cut the grass therefore in designing the blade the force must be greater than 10N .

Blade area = length*width
= 320 * 30
= 9600 mm^2

t= thickness of blades = 0.9mm
Therefore,

Volume of blades = area * thickness
= 9600 * 0.9
= 8640 mm^2

Mass of the blade (m) = density * volume
= 7857 * 8640*10^9
= 0.066 kg

Weight of the blade, (w) = mg
= 0.066 * 9.8
= 0.64 N

Radius of the blade, (r) = 320/2
= 160 mm

Torque on cutting blade, (T) = w*r
= 0.64*160*10^{-3}

= 102.4 N-mm
= 0.1024 N-m

The speed of the rotating blade is N=800rpm

Angular velocity, (ω) = (2πN)/60
= (2*3.14*800)/60
= 83.7 rad/s
Power required, (P) = T ω
= 0.102 * 83.7
= 8.46 W
Motor size : The power required by the blades is used in selection of the motor .
Motor power = 8.46 W
= 0.00846 kW
The force produced by the blade is the centrifugal force
$F_c = m*\omega^2* r$
$= 0.066* (83.7)^2*160*0.001$
= 73.98 N

Frame Design.

A mild steel square bars are used in the construction of the frame because of it's availability, strength, workability and cheap. The frame supports the battery, electric motor, eliminator and solar panel and handle frame[2][3][5]. They transmit the load of 8kg and its length is 20" = 508mm
where P is the load on each wheel = (8*10)/4 = 20 N
Therefore, Bending moment, (M) = PL/4
= (20*508)/4
= 2.54 N-m
Yield stress = 200 N/mm^2
Allowable shear stress = (1/√3)*yield stress
= 0.577 * 200
= 115.4 N/mm^2
Efficiency of cutting:
1) Efficiency of cutting of mower = (L1/L2)*100
where, L1 is the length after cutting
L2 is the expected length of grass
Trials:
(i) Trial 1 efficiency = (85/92)*100 = 92.3%
(ii) Trial 2 efficiency = (85/89)*100 = 95.5%
(iii) Trial 3 efficiency = (85/90)*100 = 94.4%
2) Efficiency of cutting of trimmer
Trails:
(i) Trial 1 efficiency = (30/34)*100 = 88.23%
(ii) Trial 2 efficiency = (30/32)*100 = 93.75%
(iii) Trail 3 efficiency = (30/33)*100 = 90.90%

Average efficiency of the mower = 94.06%
Average efficiency of the trimmer = 91%
Overall efficiency of the grass cutter = 92.56%

5. RESULT

The hybrid powered grass cutter is and fabricated. Test was carried out with several numbers of trials and summarized as shown in table,

Table -1: Test for Mover Blades

Sample plot	Height of the grass before mowing (mm)	Height of the grass after mowing (mm)	Expected height of the grass after mowing (mm)
Trail 1	111	92	85
Trail 2	97	89	85
Trail 3	92	90	85
Trail 4	81	81	85

Table -2: Test for Trimmer Blades

Sample plot	Height of the grass before mowing (mm)	Height of the grass after mowing (mm)	Expected height of the grass after mowing (mm)
Trail 1	92	34	30
Trail 2	89	32	30
Trail 3	90	33	30
Trail 4	81	32	30

6. CONCLUSION

In the world today, all machines are designed with the aim of reducing or eliminating greenhouse gas emissions which is the major causes of climate change. This hybrid operational grass cutter will meet the challenge of environmental production and low cost of operation since there is no cost for fuelling. A hybrid operational grass cutter has been developed for the use of residences and establishments that have lawns where tractor driven mowers could not be used. The machine's capacity is adequate for its purpose. The device combines the mower and trimmer in a single set up to reduce the operational costs and efforts of using the mower and trimmer separately. Also it can be operated on both DC and AC current. The machine has proved to be a possible replacement for the gasoline powered lawn mowers.

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