Design and Manufacturing a Vehicle with Sprayer and Grass Cutter for Lawn Application

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Abstract: *The Project aims on the design, development and the fabrication of the vehicle which can pump and spray water and pesticide and also cut grass with height adjustment. These whole systems of the vehicle work with the battery power, the vehicle is controlled by switch. Water pump is used to spray the water and pesticide. A lawn mower is a machine that is used to cut grass in a lawn.Grass cutters are available in market having some limit to cut grass at some height. This model we made is totally made up of the mild steel.The setup is powered by a 12V/1.35A rechargeable battery which drives the DC motor up to a rotational speed of 19,300 RPM. As a result, the generated torque will be transferred to the cutting head mechanism for efficient grass cutting and the power is also utilized for spraying mechanism.*

Keywords: *Grass cutter, agricultural sprayer, pesticide sprinkler, battery power, pump*

I. Introduction

Now-a-days employing electric energy in agriculture field became a big issue due to electricity cut off for longer time in rural area. Electric energy plays an important role in agriculture Sector. Many agricultural equipment's are working on direct electric supply or fuel. For ex. Water sprinkler, Grass cutter, pesticide Sprayer.Different mechanical setups are required for each work. Which leads higher cost investment for farming.

The robots fight to take over most of the tasks and we must recognize that often they win without too much effort. But cost of robot is too expensive for farmers. It also requires higherResearch in the field led to the creation of semiautomatic machine which can be used for lawn grass cutting crop cutting as well as it can also work as a water sprinkler and pesticide sprayer. It can cut the grass with given height, can work with stored electrical energy even if there is electricity cut off issues, work with zero pollution all these with single human intervention.Machine is environment friendly because the only resource they need is electricity which is stored in their batteries.

Maintaining a grass lawn also means its fertilization which takes place naturally.To overcome all above agricultural problems and for development in agriculture sector we are trying to design machine which can having multipurpose function for agricultural work.That machine is operated with stored electrical energy and use as a grass cutter, water sprinkler and pesticide sprayer. We are also taking care of cost reduction

Grass Cutter Mechanism

The disclosure is of a cutter mechanism for lawn mowers or for agricultural machines serving solely or partially for mowing which can be drawn by any motor vehicle to which they can be adapted, or can be self-propelled, which is characterized in that the elements intended to cut are solid or hollow wires or bands which can be of any form, profile and constitution, which wires or bands are mounted on fast-rotating supports, and in that the operative lengths of the assembly of wires or bands mounted on one and the same rotating support can be modified, preferably simultaneously by one single adjustment or even if necessary by two or at the very maximum by three adjustments, and in that the assembly of wires or bands mounted on one and the same rotating support can be locked again in the desired position, preferably without adjustment or by one single adjustment, if necessary by two or at the very maximum by three adjustments.

Fig -1: Grass Cutter Blade

II. Design of Frame Structure
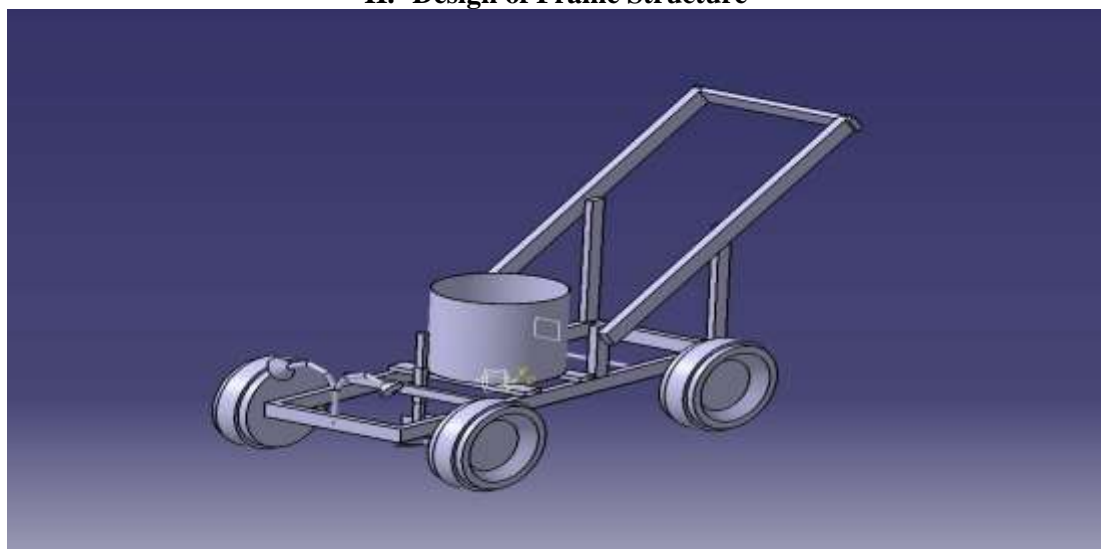
Fig 2: Isometric view of chassis

III. Methodology

➢ Energy VS demand" is one the major thread for our country. Finding solutions, to meet the "Energy demand" is the great challenge for Social Scientist, Engineers, Entrepreneurs and Industrialist of our Country. According to them, Applications of electrical energy is the only alternate solution for demand.

➢ Now-a-days the Concept and Technology employing electrical energy over a fuel becomes very popular for all kinds of development activities.

➢ One of the major area, which finds number applications are in Agriculture Sectors. Electric energy plays an important role for irrigation purpose for pumping the well water in remote villages with electricity.

➢ This Technology can be extended for spraying pesticides, Fungicides and Fertilizers etc. Using electric Sprayers. This project deals how a 'Power Sprayer' which is already in use and works with fossil fuel can be converted into electric fuel for sprayer's works.

IV. Design and Material Selection

Cast Iron is an alloy of iron and carbon containing more than of carbon. In addition to carbon, cast iron contains other elements like silicon, manganese, sulphur and phosphorus.Let's say we're trying to decide how to make a rucksack frame. We need to choose a material that is stiff, light, strong and cheap – we will therefore need to find information about the Young's modulus, density, strength and cost for lots of different materials. There is a basic difference between steels and cast iron. Steels usually contain less than 1% carbon while cast iron normally contains 2 to 4% carbon. Typical composition of ordinary cast iron is as follows:

Typical Properties of Cast Iron

Chemical Composition

Element	Content
Carbon, C	0.14 - 0.20 %
Iron, Fe	98.81 - 99.26 % (as remainder)
Manganese, Mn	0.60 - 0.90 %
Phosphorous, P	≤ 0.040 %
Sulfur, S	≤ 0.050 %

Physical Properties

Physical Properties	Metric	Imperial
Density	7.87 g/cc	0.284 lb/in^3

V. Calculation

Design is to handle 40 Kg, so with clearance we assume mass as 52 Kg.

Density of water ,ρ=997 $Kg/m3$

But,

$$mass = volume * density$$

$$volume = \frac{mass}{density} = \frac{m}{\rho}$$

$$volume = \frac{52}{997} = 0.052156 \ m^3$$

As per design considerations we assume diameter of crucible (bar),

d =400mm = 0.4m

Hence, to find height of crucible (H) $volume \ of \ crucible \ (cylinder) = \pi r^2 H$

0.052156= $\pi * 0.2^2 * H$

H=0.415 m=415 mm

To find thickness of crucible,

$t = \frac{P*d}{2\ \sigma_{tc}} = \frac{0.2*400}{2*17.5} = 2.285 \ mm$

Since the thickness of cast iron casting should not be less than 6 mm. Therefore we shall take thickness of crucible, $t=6mm$

Frame Design and Pipe Thickness:

Frame length is assume to be 900 mm and width is 500 mm. For the framework on which vessel is mounted exerts down force of nearly 3000 N on frame which cause frame to bend and hence we find out the thickness of the square pipe.
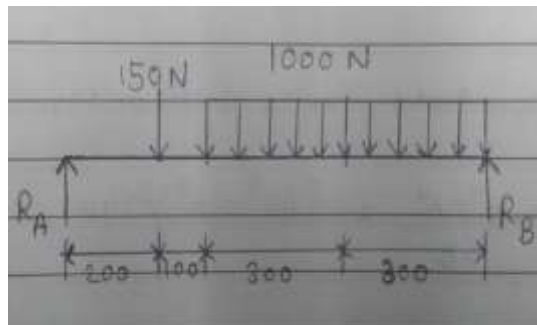
Considering vertical loads only

Taking moment about point 'A'

$R_A*900=150*700 +(1000*600) \frac{3}{2}$

$R_A=1116.67\ N$

Summation 'Y' is equal to zero,

$\Sigma Y = o$,

$RA+RB=150 + 1000*600$

$1116.67 + R_B = 600.15*10^3$

$R_B = 599.033 * 10^3 N$

Load on front wheels, $R_{A1}=R_{A2}=\frac{R_A}{2}=\frac{1116.67}{2}= 558.335\ N$

Load on rear wheels, $R_{B1}=R_{B2}=\frac{R_B}{2}=\frac{599.033 * 10^3}{2}= 299.5165\ *10^3 N$

Bending moment at point C, $=R_{A1}*200=\mathbf{111.667 * 10^3 N.mm}$

Bending moment at point D,

$=R_{A1}*300-150*100=558.35*300-15000=\mathbf{152.5 * 10^3 N.mm}$

.is the bending moment at point 'D' is maximum, hence

Maximum bending moment,

ie... M= $\mathbf{152.5*10^3 N.mm}$

section modulus for square pipe or tube,

$Z=\frac{b^4-h^4}{6b}=(2.56*10^6-h^4)/240$

Now, $\sigma_b = \frac{m}{z}$ .....where (σ=60 N/mm2)

$60 =\frac{(152.5*10^3 *240)}{(2.56*106 -h4)}$

h=37.36 mm

wall thickness of square pipe, $t = \frac{b-h}{2}= \frac{(40-37.36)}{2}$

t=1.32 mm

But standard value for square pipe thickness is 1.3mm

VI. List of Parts

SR. NO	PART NAME	SPECIFICATION
1	Mild steel (Square Pipe)	Length = 6 meters Cross-section = 10*10 mm
2	Trolley Wheel	Load Capacity = 200 – 300 kg
3	Grass Cutting Tool	No. Of Tooth = 3
4	Agricultural Sprayer Nozzle	Pressure= 3-6 bar
5	Flexible PVC pipe	Length= 2 meter
6	Heavy Duty Battery Sprayer Pump 12V	12 V Battery operated
7	Exide Lead Acid Battery	Voltage 12 V, Capacity 10 amp
8	water tank	Capacity 20 ltr

VII.   Actual Design Model of Vehicle

VIII.   Future Scope

- While coming to the importance there is a vast demand for technology in future.
- With the reliable energy source and technology, the farmers are able to increase the yield.
- The technology is used to increase the wide varieties of hybrid seed from the single crop.
- Precise application of use reduce the waste and increases the yield.
- Networking and marketing the new products.
- It is useful in modern transportation.
- Increase the awareness of IT in Agro-Industry of India.
- Furthermore, the technology is can preserve the products.

IX.   Conclusion

- Modern machines can control the efforts of farmers.
- They reduce the time.
- Used supply water to the crops.
- While Machines are useful in sowing the seeds.
- They are used in the transportation.
- Irrigational technology.
- Application of synthetic fertilizers.
- Chemical pest control.
- They increase the price and demand of the products.
- Better marketing and exposure to the price.

References

[1].   Planters and their Components - J R Murray, J N Tullberg and B B Basnet, School of Agronomy and Horticulture, University of Queensland, Australia.
[2].   Hand Book of Agriculture, Indian Council for Agricultural Research, New Delhi.
[3].   CHHIDDA SINGH, 2016, Modern Techniques of Raising Field Crops, Oxford & IBH Publ. Co., New Delhi
[4].   GOPAL CHANDRA DE, 2013, Fundamentals of Agronomy, Oxford & IBH Publ. Co., New Delhi
[5].   RATHORE, P.S., 2010, Techniques and Management of Field Crop Production, Agrobios (India), Jodhpur.
[6].   Krushi Darshan - Narrowcast Bengaluru