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Fabrication and Testing of Battery Powered Weeder

Er. Mathan. M[1], Santhosh. D[2], Santhosh. S[3], Sri Vishnu. L. R[4], Surya Prakash. R[5]
Assistant Professor[1], Student[2, 3, 4, 5]
Sri Shakthi Institue of Engineering and Technology, Coimbatore, Tamil Nadu, India

Abstract:
A weeder is a machine used in agricultural fields to remove the weeds, which are unnecessary crops that hinder the growth of crops. The weeder which is operated with the gasoline engine is called a power weeder. The power weeder has the problem of pollution and excess vibration. To overcome these issues the power weeder is to be converted to an electrically operated system. So here the existing gasoline engine is replaced with a motor for drive and batteries for power source. The DC motor of power 2hp and 1500W is replaced for the 5.5hp existing gasoline engine according to the engine and motor power equilancy. Drive output from the motor is given as input to the gearbox through a belt and pulley setup of ratio 3:7. The gearbox has a 2forward and 1reverse gear arrangement. The battery source is given to the motor for drive. A lead-acid battery setup with 4numbers each of 12v capacity is used. The operating life of the battery is around 200-300 recharge cycles.

Key words: weeder machine, DC motor, Gearbox, Drive, Belt and pulley.

I. INTRODUCTION

Agriculture is the backbone of India, and weed removal being one of the primary process in the field, there is a necessity for weed to be removed in all the fields to increase the quality of crops and to decrease the effect of weeds on crops. A weed may be defined as any plant or vegetation that interferes with the objectives of farming or forestry, such as growing crops, grazing animals or cultivating forest plantations. A weed may also be defined as any plant growing where it is not wanted. For example, a plant may be valuable or useful in a garden, or on a farm or plantation – but if the same plant is growing where it reduces the value of agricultural produce or spoils aesthetic or environmental values, then it is considered a weed. However, some plants are weeds regardless of where they grow.

II. MATERIALS AND METHODS

The materials which are suitable for the fabrication of eederis taken into account and other materials which are required for the propulsion of the machine is selected.

A) MATERIAL SPECIFICATION

S. No.	Title	Specification	Quantity No's
1	Brushless DC motor	2-hp, 1.5 kw,48v, 3000 rpm	1
2	Battery	12v, 50ah	4
3	Charger	48v, 15amps, constant current type	1
4	Belt	V-belt, b-type	1
5	Pulley	standard type, 3,7 inch, 1 way	2
6	Frame	Mild steel	1 unit
7	Blades	Mild steel, j-type tine, 12 blades, split into 3 blades on each set, 4 sets	1 unit
8	Gearbox	1-unit, with 2-forward nd 1-reverse gear. Spur gear	1 unit
9	Connecting rod	Mild steel, split connection to rotavator and wheels.	1

a) Main frame

The main frame is the skeletal structure of the machine. It acts as the chassis for the system. All the loads applied are distributed over the frame. Components and attachments are affixed to the main frame for support and balance. The main frame is strong and rigid to withstand vibrations and tilts produced during the operation. The main frame is manufactured by arc welding process.

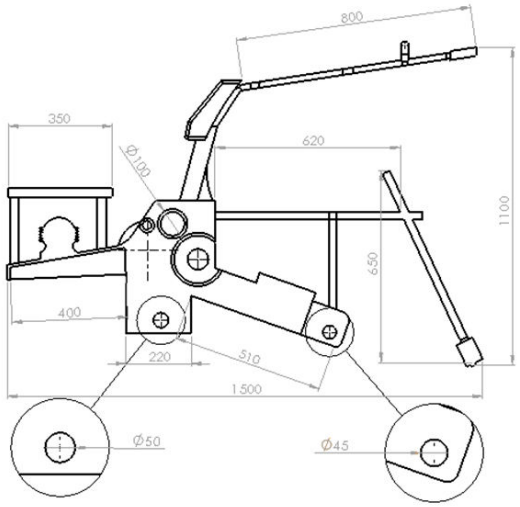

Figure.2.2 Main Frame (Side View)

b) Blade

Soil preparation can be time consuming. However, with the right tools and equipment you can increase the efficiency of your business. A rotavator is a useful piece of machinery when it comes to soil preparation..These versatile pieces of farming equipment is a motorised machine which uses rotating blades to turn soil. In their essence rotavators are earth turning equipment which perform a similar function to cultivators and tillers. While all rotavators perform a similar function, different models offer different capabilities. Rotavator use in Agriculture allows farmers to prepare the soil without using large amounts of labour. It is vital to ensure that the soil is properly prepared. The blades are the equipment which eradicates the unwanted weed out of the soil. The blades are arranged in series with a number of 4 blades attached on a

shaft. The blades cumulated are altogether called as rotavator. The blades are also called tines. The tine used in the machine are J-type tine. Angle of the blade is about 45degree. Blades are arranged in a 3-tine on a blade split into 4 halves. And a total of 12 tines are placed. It is placed behind the wheels and beneath the drive shaft of the main frame. The rotavator rotates at a constant speed of 375 rpm. The blade has an average run time of 50 hours on Indian soil before its efficiency is lost.

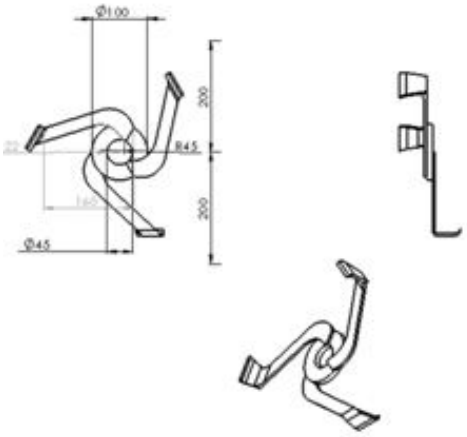

Figure.2.4. Blade Views

c) Drive shaft

The drive shaft connects the wheels with the gearbox. Drive shaft is made of mild steel. There are 2 connecting rods. One is placed in contact with the gearbox, and coupled to the wheels. The other shaft is placed in connection with the gearbox which is connected to the rotavator shaft. The gearbox when given drive, splits the drive into 2 paths. One is to drive the wheels and the other is to drive the rotavator.

d) Brushless DC motor

The motor provides the drive necessary for the displacement of the machine. Motor is mounted on the front of the machine which is placed on the mainframe. The motor used is a "Brushless DC motor", along with a controller for precise motion and speed control. The rated speed of the motor is 3000rpm at no load condition, and has a rated capacity of 1.5kw, with a rated current of 30-45 amps.

e) Traction wheel

The wheel is the rotatory part of the machine, on which the machine balances most of its weight. The wheels are with bigger stud for a better grip in the agricultural field. The tyre dimension for the weeder is constant, it is 4.00-8 in which 4.00 represents the diameter and 8 represents the width of the tyre. The wheels are coupled to the gearbox through the connecting rod. The wheel has a bigger button specially for agricultural purpose for better movement through the soil. The button height is about 5-7 cm.

f) Lead acid battery

The battery used is lead acid battery. It provides the necessary power to drive the motor, and the battery acts as the power source for the machine. Lead acid batteries are more affordable and has a better efficiency of about 80-85%. Amount of heat generated is also less and the capacities of the batteries available are also wide. The battery is of constant 12V. The amps rating selected is 50AH. A total of 4 batteries are used for power supply. Batteries are mounted on the tray, which is placed on the mainframe with the help of welding. The batteries are connected in series to build a voltage of 48V that is suitable to drive the motor with more power and torque.

g) Gearbox

The gearbox is required to provide the drive at a desired speed. The gearbox here is used to give drive to both the wheels and rotavator. The gear is of spur type. It is given with 2-forward and 1-reverse gear. Gear 1 is used to convey high torque and gear 2 is used to increase the speed. The gearbox is positioned in between the wheels and below the handle. Gearbox holds two connecting rods.

h) Cut-off converter

Cutoff converter is a device coupled with the controller of the motor. When both accelerator and brake are actuated at the same time, the current from the battery to the motor is cutoff in order to prevent the overload on the motor. It acts as a circuit breaker and relieves the motor from excess loading.

i) Secondary wheel

The secondary wheel supports the weeder from the back and aids the user to turn in the desired direction. It is rotatable in multi direction which makes the turning process an easy one. The wheel is basically a composition and nylon and other mixtures. It usually has a longer life and withstands hard soil conditions. It is the leveler of the weeder to adjust the depth of the blade. It has slots on the bar and a pin to lock at the desired position which holds the height of the blade steady.

B) Design calculation

Weight of the actual weeder with engine
= 120 kg
Weight of the engine and its accesseries removed= 30-35 kg
Total self weight after the removal of engine = 90 kg
Weight of a battery (4 x 18) = 72 kg
Weight of the motor = 5.5 kg
Weight of controller = 1.75 kg
Additional weight assumed to be added = 5 kg
Total weight assumed to be carried = 200-250 kg
Calculation of motor rating
weight to be pulled = 250 kg
Max speed required = 1.5-3 kmph
Horsepower (hp) = weight x(velocity/234)/3
= 250x(0.8/234)/3
= 1.6 hp
Torque = 5252 x Hp/speed(rpm)
= 5252 x 2/1000
= 10.5 N-m

Calculation of battery backup required
power of the moto(p) = 1500 W
Estimated battery backup time = 1.5 hours
Total output voltage of the battery= 12 V x 4 nos
= 48 V
Calculation of required storage = (p x time)/ V
= (1500x1.5)/48
= 47 AH

C) Test results

The machine is tested for capacity, endurance and efficiency. The machine is tested in the field in the presence of weeds. The RNAM test procedure was used as guidelines and procedure for the test. According to the test procedure conducted, the details were obtained. The test was done on a previously ploughed land which has an average moisture content of 15%-20%. The efficiency of the machine is found to be 80% by using the formula,
W1-w2 /w1 * 100
W1-number of weeds before weeding

W2-number of weeds after weeding
Travelling speed = 0.5- 0.7 m/s
Actual operating time = 1.5-2 hours per acre
Comfortable depth of cut = 5-10 centimeters
Effective width covered in-between 2 rows
= 2feet
Fuel consumption = 1.75-2 hours per charge.
A charge takes a maximum of 1-2 hours at partial drain condition.
On completely draining the batteries it will take about 3-4 hours.
Fuel consumption = Batteries drain when it runs for more than an hour and a half continuously.
The parameters such as modes; low, medium, high is varied.
The gear 1 and 2 is shifted to check the ease of operation.
The rpm is varied by the difference in acceleration which is controlled by the accelerator.
The field is divided into 5 plots with a 10m x 20m setup, for different operations.
The graph for various depths of operation and their respective time taken are represented in fig.2.5

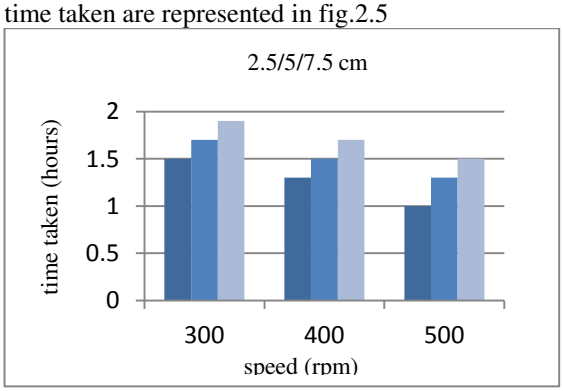

Figure.2.5 Plot For Various Depths Of Cut

III. RESULTS AND DISCUSSION

The fabricated product is represented in Fig.3.1

Figure.3.1. Fabricated Product

a) Specifications of weeder

Total length = 1500 mm
Total width = 500 mm
Total height = 1100mm
Number of blades = 12
Number of gears = 2 forward-1 reverse
Weeding distance = 420 mm
Depth of weeding = 150- 200 mm
Drive used = pulley belt drive
Rotavator speed = 375 rpm

As of the standards of the weeders available in the markets. The overall specification of the electrical power weeder is discussed in the previous chapter. The total weight is about 200kg which can be easily used and moved on the field by a normal person.

b) Economic analysis

The product manufactured is suitable for weeding of row crops which has a row width of 2 feet. The cost involved in the operation is the unit current consumed during charging. While other costs included are stable and has a longer life. The cost of operation is also reduced by reducing the labour requirements. Usage of the electrical weeder is completely non-polluting and eco-friendly. The operating cost as of comparison with electricity is very less. 1litre of petrol or diesel costs around 70-75 Rs.Where as unit current is around 2.50-6Rs, based on the locality. The charging process on completely draining takes upto 6 hours. And the total operating cost is about 35-40Rs. Which runs for 2 hours and covers 3/4th of an acre. While on the other hand, the gasoline engine covers less than an acre for a litre of fuel.

IV. CONCLUSION

Comparing the process between electrical power weeder and normal weeding machine , after testing in the field for about five times, based on the tests the efficiency is calculated to be 80% which is almost equal to the normal existing weeder, which is much efficient while a single person operates the machine. Deeper working depth and a slow travel speed can achieve a good weed control. Weed removing machine add the modernization and advancements in the agricultural field. This machine will make the farmer independent and not rely on the labourers for removing weed. As the test is done in different soil conditions and with different weeds, it is simple and more effective for the regular usage when compared to normal weeding machine, with the help of electric power weeder zero emission is ensured, which is the primary motive to develop this machine.

V. REFERENCES

[1].Akshayshinde, AkshayPatil, SohamTirodkar, Mandar Jagtap (2017) " Solar Powered &Arduino Controlled Agribot IJSTE - International Journal of Science Technology & Engineering ,Volume 4, Issue 5 ISSN (online): 2349-784X.

[2]. Newton Roy Gingerich (1998) "Electric Powered Small Tractor" United States Patent, Patent Number: 5,743,347

[3].Stephen Heckeroth (2009) "Electric Tractor" United states Patent , Patent Number: US 7828,099 B2

[4]. Tharoon T (2017) "Design and fabrication of rotary tiller blade" IRJET volume:04 Issue:1 e-ISSN:2395-0056 ,p-ISSN: 2395-0072.

[5].Weerachai Arjharn (2001) "Preliminary Study on the Applicability of an Electric Tractor" Journal of JSAM 63(3) 130-137, 2001.