"Design and Fabrication of Single Axle, Self-Propelled Multi Attachment Agricultural Machine"

Achyut S Raut[1] Akshay T Agalave[2] Sanket S Kelaskar[3] Rahul B Mane[4] Ravindra R Sutar[5]
[1]Faculty [2,3,4,5]Student
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]Rajendra Mane College of Engineering & Technology, Ambav (Devrukh) Ratnagiri, Maharashtra, India-415804

Abstract— Design and manufacturing of multifunctional agricultural machine by using worm and worm wheel gearbox mainly used for inter agricultural purpose. As worm wheel gear box is utilized for producing less speed and more torque, hence introduced in machine further speed reduction is carried out by chain drive. It is nothing but two wheeled tractor popularly known as power tiller. The conventional power tiller is having many drawbacks. As like fails to delivered high torque and fails to absorb shocks during agricultural operation. The project relates with to develop more torque and design different attachments to it. Plough implement is firstly introduced to power tiller via this project. As per the name multifunctional, machine utilized for pump set, material handling, pesticide spraying etc.

Key words: Engine, Chain drive, Worm gear box, Accessories, Wheel, Handel

I. INTRODUCTION

Agriculture includes cultivation of crops as tending of livestock for the purpose of production of food and fiber for humans. Mankind began to cultivate food crops about 10,000 years ago. Prior to that time, hunter-gatherers secured their food as they travelled in the nearby environment. When they observed some of the grains left behind at their campsites sprouting and growing to harvest, they began to cultivate these grains. From these humble beginnings agriculture began. Slash and burn, an early type of crop culture, remains today a truly sustainable agriculture, one that is independent of fossil fuel energy. Two-wheel tractor or walking tractor are generic terms understood in the India and in parts of Europe to represent a single-axle tractor, which is a tractor with one axle, self-powered and self-propelled, which can pull and power various farm implements such as a trailer, cultivator or harrow, a plough, or various seeders and harvesters. The operator usually walks behind it or rides the implement being towed. Similar terms are mistakenly applied to the rotary tiller or power tiller although these may be wheeled or self-propelled. A two-wheeled tractor specializes in pulling any of numerous types of implements, whereas rotary tillers specialize in soil tillage with their dedicated digging tools. The power tillers are less costly and it engages less labor per unit of land than bullock farms and is particularly useful in the intensive cultivation of crops. It is felt that various financial institutions and borrowers are taking interest in promoting power tillers especially considering the fact that the majority of farmers are small with land holding below 2 hectare who can hardly afford costlier tractors.

II. LITERATURE REVIEW

Subrata Kr. Mandal al. (2011) this paper presented there is scope for these power tillers to be used as seedbed preparation and inter culture operation in wide spaced row crops like cotton and sugarcane. In order to assess the performance of lightweight power tiller, one such model was evaluated at Central Mechanical Engineering Research Institute, Durgapur under various soil conditions. The model was extensively used for seedbed preparation, inter culture operation etc. This paper was presented the results of the study. The field capacity found to be 0.1 ha/day (10 hrs.). The fuel consumption was 1 lit/hr.

Mohammad Muneer Uz Zaman (2015) this paper was helps to design a machine which would uproot the weed s and unwanted crops from the field completely. Similarly, grass cutter can also be utilized for cutting off the crops as it has nylon rope tightened at the end of it which expands outwards and rotate at a high speed as the power is given. Basically, we have merged two different machines one is a rotary tiller and the other one is grass cutter. Merging two machines to work together as a single unit gives out the output as we have expected. According to this paper, to nearby fields we came to conclusion that the tilling process which is traditionally done by use of animals or Employing labor according the size of the field is very time consuming and the cost of tilling the field traditionally is quite high. So, our machine fulfills the promise of helping out our farmers with the help of technology.

Bernardo D Radeo et al (1993) In this paper a mounting the rotor assembly at the rear end of the power tiller and attaching a glass fiber float underneath the chassis solved the problems such as steering difficulty, machine weight imbalance and uncontrollable pudding depth encountered in the front-mounted rotor assembly. Result showed that bolt on attachment showed great potential even in extreme soil conditions. The performance of the designed rotor assembly in the Mount Pinatubo affected areas 25 cm ash deposit's, was compared with the imported puddles, harrow and improved floating tiller.The rotor assembly efficient mixed pure soil and ash in wet and moist-plowed conditions better than the conventional harrow.

Masood Ur Rahman et al (2015) In this paper the study was conducted on a self-propelled locally made rotary hoe to overcome a problem of frequent transmission failure. The machine is used for mechanical weed control and hoeing. It was observed that the worm gear used in its transmission often failed due to surface wear of gear teeth. Worm gears made from three different copper alloys were tested against soil resistance in sandy loam soil bin. The gear compositions were determined using atomic absorption. The gears under test exhibited significant difference in

surface wear among each other. As compared to gear bronze commercial gun metal and gun metal showed surface wear of 245% and 109% respectively. The highest surface wear was observed in commercial gun metal whereas lowest surface wear was observed in gear bronze. It was concluded that gear bronze may be the best material composition for use in the worm gear of the rotary hoe transmission box as compared to the other two alloys tested.

Sirisak Chertkiattipol (2008) In this paper study was the performance of rotary power tiller .Rotary tiller is advantages over the conventional implement due to initially to the main effect of the direct application to soil Engaging tool rotating around a horizontal transverse axis.Achieves both plowing and harrowing in a pass of Machine on the field. The reduction in traction demanded of tractor driving wheels due to the ability of the soil working blades to provide some forward thrust. There are the three types of rotary blades i.e. Japanese C- shaped blade, European L-shaped blade and European C- shaped blade. This types of rotary tiller attached behind two- wheel tractor and this arrangement of rotary blades on rotor shaft and soil-cutting pattern of rotor tiller.

Zenon Pirowski et al (2009) In this paper, among other things, there were formulated requirements for shares of rotating and field ploughs in terms of casting material and construction of cast itself. Austempered ductile iron (ADI) was selected as casting material for testing shares of casts. This paper was suggested to replace beaten and welded elements of agriculture machines used to cut through soil by austempered ductile cast-iron. Such material and technological conversion should enable a longer life of these elements without an increase of production costs, and as a result it should increase competitiveness of the produced elements.

Jeevarathinam.A et al. This paper was described the design modification and development of rotavator blade through the (CAD) interrogation method by modifying the design and also by modifying the material properties. Rotary tiller or rotavator is one of the tilling machines most suitable for seedbed preparation. In a Rotary tillage machine, Blades are the critical parts which are engaged with soil to prepare the land and to mix the fertilizer. These blades interact with soil in a different way than normal plows which are subjected to impact that creates cyclic forces which result in fatigue failure of the blade. This actually decreases the service life of a blade. Therefore, it is necessary to design and develop a suitable blade.

III. PROPOSED METHODOLOGY

The agricultural machine is being designed which consists of the construction of chassis, gear box design, engine selection, wheels etc. On chassis there is a space for mounting of engine, worm and worm wheel gear box. The engine output is coupled with input of worm gear box. On the output shaft of worm gear box, chain wheel is mounted. The drive of the chain is given to the axle shaft on which wheels are mounted. The gear box mounted on chassis is removable with the help of nuts and bolts. At back side there is an arrangement for attaching the various accessories which perform the various functions in intercultural farming. There is an arrangement of pump set for the installation in place of gear box. The main function of this machine is to perform the various operations required in the intercultural farming. It starts working when the engine is started. The initial speed of the engine is around 2600 RPM. Engine is coupled with worm gear box which having the speed reduction ratio around 30:1. Greater speed is reduced at the o/p of the gear box. The final drive to wheels is given through chain drive system. Further speed reduction is possible by varying the diameters of chain wheels. For the working of rotor, first the chain is disengaged from wheel shaft and it is engaged with shaft of rotor and it starts rotating. This machine also involves the pump attachment. When the pump brings in working, the gear box is displaced from its place and pump is placed, which is directly coupled with engine. The 3d model of agriculture machine is as shown in fig 1.

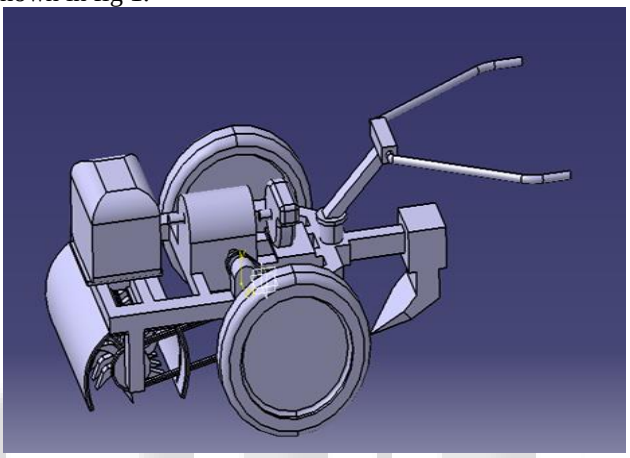

Fig. 1:

IV. DESIGN CALCULATION

Part name	Material/ Specification	Dimensions	Induced stresses(N/mm^2)	Allowable shear stress (N/mm^2)
Worm Gear box	Single start worm, Speed reduction ratio 30:1, Efficiency 60 % Power 2.94 kw	D1=80mm D2=240 mm	-	-
Pedestal bearing	Cast iron and stainless steel	ID1=25 mm ID2=30 mm	-	-
Star Coupling	Cast iron		-	-
Axle Shaft Shaft	Mild Steel	D1=25mm D2=30mm	57.05 37.86	95 95

Chain	Iso Chain No.168 No. of links=54	Z1=16 Z2=32 Pitch =25.4mm	-	-
Engine	Hp=4 Power =2.94kw Rpm=1800 Torque=15.59N.m	-	-	-

Table 1:

V. RESULTS

1) Diesel engine runs 2 hr. continuously, for 1 liter without any load.
2) Diesel engine runs 1.5 hr. continuously, for 1 liter with attachment.
3) Plough's cutting edge deeply inserts into soil up to 6 inch.
4) 1 feet furrow is obtain with attachment
5) One fourth acre farm field is worked in 1 hr.

Parameters	Hard soil field	Soft soil field	Average
Average time of operation, hr/acre	8	7	7.5
Effective field capacity, acre/hr	0.125	0.1428	0.1339
Working speed m/s	0.65	0.60	0.625
Fuel consumption L/acre	5.33	4.66	4.99
Fuel consumption L/hr	0.66	0.70	0.68

Table 2:

VI. CONCLUSION

After manufacturing the performance of multifunctional agricultural machine was evaluated in order to find maximum field efficiency along with other parameter. The agricultural machine was designed and developed with an aim to Working of machine at different speed and soil conditions, machine is able to sustain and faces frequently changing conditions. This machine is affordable to farmers and is capable of performing multifunction like ploughing, rotary tiller, pump set and material handling. The average effective field capacity was 0.1339 acre/hr. The average fuel consumption was 0.68 L/h. The average working speed was 0.625 m/s. The average time of operation was 7.5 hr/acre. It will solve the problem of unavailability of labour to save more than Rs 3500 per month of farmer.

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