

FABRICATION OF PORTABLE ELECTRIC TILLING MACHINE

¹E.Venkateswara Rao, ²A.Srinivasa Rao

^{1,2} Assistant Professor, Department of Mechanical Engineering, Sir C. R. Reddy College of Engineering,
Eluru, A.P

ABSTRACT: In Indian Agriculture, generally tractors or cultivator machines are commonly used for ploughing. Before this method farmers uses the traditional method, this is time consuming and hardworking and costly. So, we introducing a new machine, named the portable electric tilling machine. The conventional agriculture methods of farming, as it reduces the human effort, at a very low cost using motorized tilling mechanism. The electric power tiller helps to reduce the time and cost involved in tilling using a new portable design there by increasing the productivity and efficiency in agriculture. The machine is use of a wheel with welded angles to provide maximum gripping on soil. The wheel design is developed, to provide a firmgrip on soil strong enough to drag the cultivator forks while tilling process. The machine is driven by an electric motor which uses a sprocket chain arrangement to drive the pulling wheel.

INTRODUCTION: In India currently farmers are unhappy for keeping more money on ploughing operations, raise in petrol price day by day. To solve this problem, we made an electric power tiller machine which is power by battery to electric motor. The battery is eco-friendly and easily recharge. The power tiller is mainly used in farming operation for preparing a seedbed on upper level of land. The portable power tiller is not only the large soil mixing capacity compared to the other machine but also good weed cutting capability. In a market various power tiller machine is available and it is operated on internal- combustion engine. It running on engine the petrol or diesel is needed it is big problem, because this tiller machinecreates a pollution in environment and it is dangerous for human health. To solve this problem, we make this portable electric power tiller machine. This is cost-effective and pollution free. In this portable electric power tiller, we added some more useful accessories, which are wheel attachment and cutter attachment is used to cut the grown crop in soil and grass in gardening. Agriculture is the backbone of Indian economy as it provides direct employment to about 69% of the working people. Being the largest source of employment and income for millions of people, it also provides a vast market for our industrial products. The country has made a three- fold increase in food grain production from a level of about 55 million tons in 1970- 71 to 1930 kg/hectare in 2010-11 primarily on the back of increasing penetration of irrigation facilities, hybrid seeds and farm mechanization. The growing shortage of agricultural labor and rising wage rates are not the only reasons for the accelerated mechanization of farm operations. Factors such as timesaving, efficient input application, transportation of farm inputs and produce, and reducing drudgery also stimulate demand for farm machines. The development and mass production of multi-utility mechanized devices to suit the requirements of farmers important for the growth of mechanization in India. Power tiller is a prime mover in which direction of travel and its control for field operation is performed by the operator walking behind it. It is also known as hand or walking type tractor (BIS,2002). Power tiller is walking tractor mostly used for rotary cultivation in puddle soil and can be replace the animal power more effectively and help in increasing

demand for human labor. The power tiller is a multipurpose hand tractor designed primarily for rotary tilling and other operations on small farms. Small tractors are suitable for agricultural conditions and farming requirements in most areas. As the small tractors have the advantage in size, lightweight and good maneuverability. Small tractors are suitable to the level of mechanical knowledge and management in rural areas. The structure of small tractors is simple, and this makes the operation, maintenance and repair easy called garden tractors.



Fig 1: Portable Electric Tilling Machine

To enable good soil grip, the machine uses a wheel with welded angles. The wheel design was created to offer a tight grip on the soil that would allow the cultivator prongs to be dragged during the tilling process. The machine is turned on and off using a switch on the handle. The machine is powered by an electric motor that drives the pulling wheel using a sprocket chain configuration. The motor is powered by a battery and has enough force to draw the forks through the soil. The three cultivator forks allow for precise and easy tilling, which is ideal for farming. The machine's direction can be easily controlled while in use because of its portable, lightweight construction. For carrying the machine, it can also be simply carried around in vehicles or by hand. As a result, the electric power tiller offers a smart, fuel-free mechanism for farm and garden tilling. Rotary tillers are a type of cultivator. They are popular with home gardeners who want large vegetable gardens. The garden may be tilled a few times before planting each crop. Rotary tillers may be rented from tool rental centers for single-use applications, such as when planting grass. A small rotary hoe for domestic gardens was known by the trademark Rototiller and another, made by the Howard Group, who produced a range of rotary tillers, was known as the Rotavator.

OBJECTIVES

- To obtain seed bed, suitable for different type of crops.
- To add more humus and fertility to soil by covering the vegetation.
- To destroy and prevent weeds.
- To aerate the soil for proper growth of crops.
- To increase water absorbing capacity of the soil.
- To destroy the insects, pests and their breeding places and
- To reduce the soil erosion.

WORKING PRINCIPLE OF POWER TILLER

DESCRIPTION The operation of a power tiller involves walking behind the machine. The machine consists of electric motor, battery, chain sprocket, wheel angles, bearing, electrical & wiring, mounts and joints, supporting frames, screw and fitting, bicycle wheel, the machine is driven by electric motor which uses a sprocket chain arrangement to drive the pulling wheel. A battery is used to power motor with a forks through soil. The cultivator forks allow for easy and narrow tilling exactly as needed for farming. The machine is light in weight and portable. Due to easy construction of machine the maintenance is very low. A motorized tiller is operated by walking behind the machine. The machine consists of electric motor, battery, chain sprocket, wheel angles, bearing, electrical & wiring, mounts and joints, supporting frames, screw and fitting, bicycle wheel, the machine is powered by an electric motor that drives the pulling wheel using a sprocket chain configuration. The motor that drives the forks into the soil is powered by a battery. The cultivator forks enable for precise and easy tilling, as required by farming. The machine is light in weight and portable. Due to easy construction of machine the maintenance is very low. The portable battery charged electric power tiller machine. the conventional agriculture methods of farming, as it reduces the human effort, at a very low cost using motorized tilling mechanism. The electric power tiller helps to reduce the time and cost involved in tilling using a new portable design thereby increasing the productivity and efficiency in agriculture. The machine is use of a wheel with welded angles to provide maximum gripping on soil. The wheel design is developed, to provide a firm grip on soil strong enough to drag the cultivator forks while tilling process. The machine is driven by an electric motor which uses a sprocket chain arrangement to drive the pulling wheel. In For making farmers life comfortable during tilling work, Earlier farmers were using Traditional farming method which is time consuming, hardworking and costly, hence we introduce new technology. Normally, the machines are used for the agricultural use in India which is of higher stage. All machines were used in farm are high price and not reasonable to farmers, hence to overcome this trouble we were make this model. This working model of power tiller is Reducing man power & rescuing the risk. This machine reduces the cost, improve the soil properties. A portable electric tilling machine is a cultivating tool that is used to till or cultivate soil for planting purposes. It is designed to be lightweight and easy to maneuver, making it a convenient option for farmers of all levels. The machine is powered by electrically and comes with a battery that can be rechargeable from a power outlet. This eliminates the need for gas or oil, making it an eco-friendly and cost- effective option. The machine has a set of or tines that break up and loosen the soil, making it easier to plant.

METHODOLOGY

The following is the methodology used to fabricate our portable tilling machine.



Determination of the forces at wheel and thriller

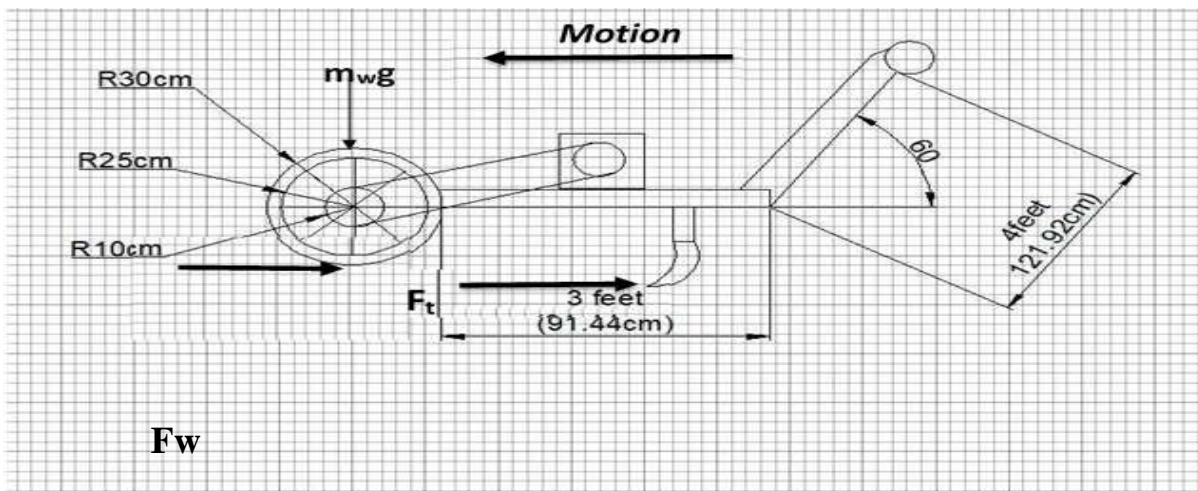


Fig 2: Line Diagram of Prototype

Forces opposed by soil

I. At the wheel

-These forces not allow slipping condition

$$F_r = \mu N$$

Since soil surfaces are rough. Consider μ 0.8,1) Then,

$$F_r = 0.8 \times N \times 0.9$$

.....where 0.9 is safety factor

$$F_r = 0.7 \times N \quad (N) \quad (1)$$

II. At tillers

-Assume the ploughing process as the chip removal Then,

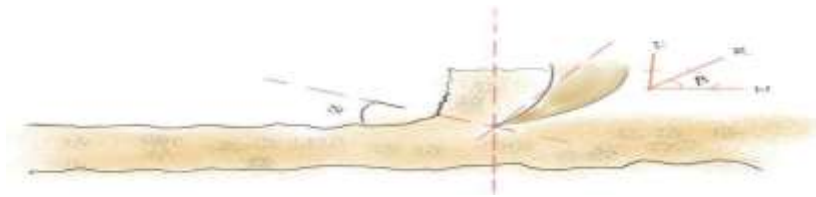


Fig 4: Ploughing Angle

$$F = F_c \sin \alpha + F_t \cos \alpha \quad (N)$$

$$N = F_c \cos \alpha - F_t \sin \alpha \quad (N)$$

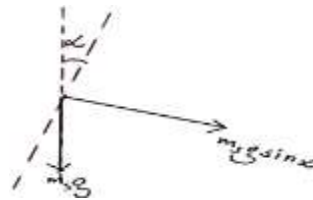


Fig 5: Line diagram of Ploughing

At tillers the coefficient of friction is maximum then, $\tan \beta = 1$

Then Angle = 45° , therefore

$$F_s = N$$

From above figure,

$$N = mgs \sin \alpha$$

In experience the intermolecular forces also influence, Therefore

$$F_s = N + \delta F \quad \dots \dots \dots (2)$$

Since number of cultivator folks = 2

$$F_s = (N + \delta F) \times 2$$

The total frictional force over the machine

$$F_R = 2 \times F_s + F_f \quad \dots \dots \dots (1) \& (2)$$

$$F_f = (0.7) Nw + 2(mgs \sin \alpha + \delta F) \quad \dots \dots \dots (4)$$

Torque required to overcome the ploughing process

$$T_r = (1.2) \times F_R \times R \quad \text{where } f_{os} = 1.2$$

Required power

$$P = \frac{(T_r \times 2\pi \times N)}{60} \quad \dots \dots \dots (5)$$

DESIGNING OF PORTABLE ELECTRIC TILLING MACHINE USING AUTO CAD SOFTWARE:

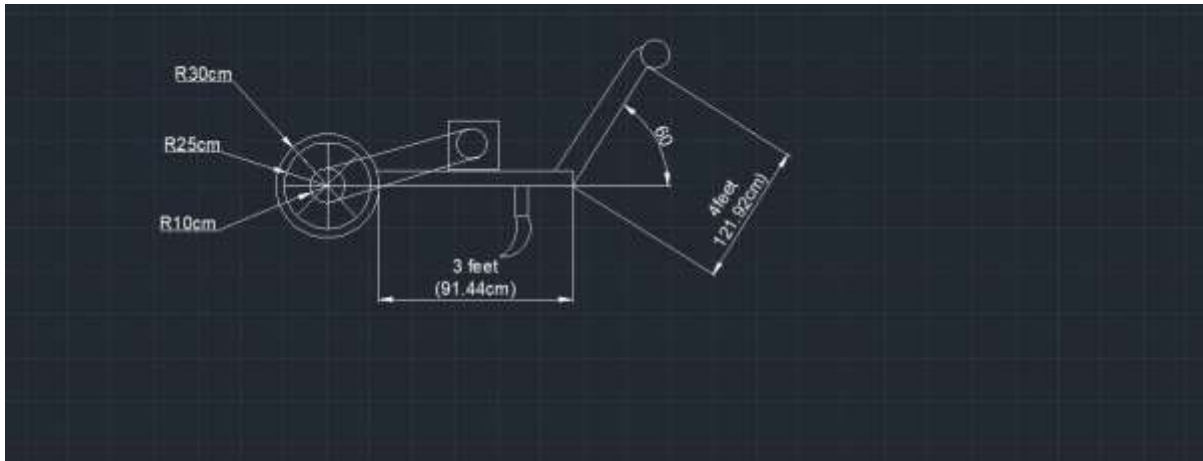


Fig 6: Side View

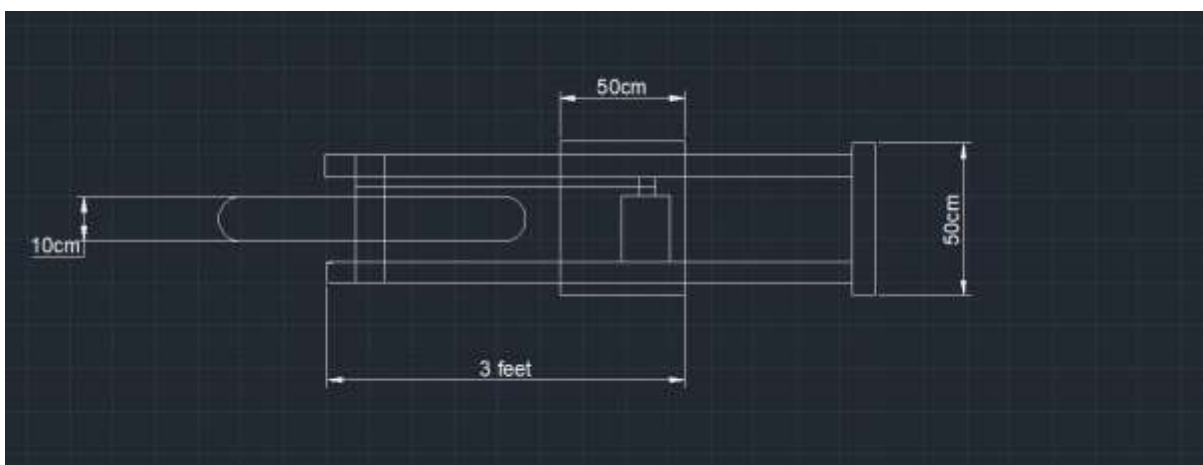


Fig 7: Top View

FABRICATION OF PORTABLE ELECTRIC TILLING MACHINE

Chassis Welding:

Chassis welding is one of the most important works to be done perfectly. As the total machine is stranded upon the chassis itself. We have used aluminum steel rectangular bars for designing chassis for the tiller machine. And more over it should be capable of supporting the respective weights of the battery and motor. It should withstand the load conditions under any circumstances throughout the process of working. At first, we had taken the rectangular aluminum bars and then cut them into respective lengths. Thereafter they need to weld at an angle of 60 degrees. Sufficient space to be left for the insertion of the wheel in between the aluminum bars. The handle of the chassis must be in a height at which the person who is controlling the machine can easily handle the tiller machine with their hands. Welding must be done in a proper way so that there are no cracks and breaks. Thus, cracks and breaks in or on the welding joint leads to the wear of joint at the welding spots for a respective time. Thus, welding must be done carefully, and perfectly. Were been done the welding very carefully, so that no complications should occur on or in run time of the tiler machine. There are various welding options but we choose gas welding as the gas welding does the job with great strength and rigid support which enhances the perfect shape to the tiller machine. Rigidity and durability are particularly important because the

chassis plays the role of supporting the weight of the body. Gas shielded arc welding in the form of lap fillet joints is mainly used in manufacturing chassis parts, and fatigue strength is the most important property requirement for welded joints. It is known that the fatigue strength of welded joints cannot be increased by using higher strength steel sheets because the fatigue properties of joints are governed by stress concentration on the weld bead. Therefore, improving the fatigue strength of welded joints is the most critical issue for welding chassis parts when using high tensile steel materials. Moreover, corrosion resistance (rust resistance) is also important from the viewpoint of durability because chassis parts are exposed to an environment where rust easily occurs due to water is splashed from the road surface during travel. Although chassis parts are painted to guarantee corrosion resistance, the fact that the paint ability of gas shielded arc welds is reduced by slag adhering to the weld bead surface, and as a result, the corrosion resistance of the chassis parts is reduced, is viewed as a problem.



Fig8: Welding of Wheel Angles to Wheel:

Wheel grippers are most important for getting a grip in a work area. Therefore, grippers which have high rigidity and strength must be used to withstand the load of ploughing in the fields. Grippers are of different types in society. But here we are using aluminum grippers as they have good rigid strength ability to withstand under load conditions. We had taken the same aluminum rectangular bars, the same which we took for the making the chassis. And then we cut them diagonally to get L shaped bars. Thus, after getting L shaped bars, we marked every 5 cm and then cut the L shaped aluminum bars. Then we obtained L shaped grippers of having dimensions of 5 cm with L angle of 90 degrees.

After the grippers are ready, the next step is to weld the grippers to the wheel. But normal welding is not giving good results as we prioritize strength and rigidity. Thus, we went to the gas welding in order to achieve required strength and rigidity. We are taking 12 L angled grippers for great gripping. For welding on wheel, we had marked the distance between each gripper by giving space of 30 degrees. As the wheel is of 360 degrees and spacing 30 degrees led to use of 12 grippers. This grippers after being gas welded with in same distance between them provides great gripping on or in fields.



Fig9: Wheel Assembly to Chassis:

We determine the desired placement of the wheels on the frame and mark the location where the wheel hubs will be attached. Use a measuring tape and a marker to ensure the placement is accurate. We use a drill with a bit that matches the size of the bolts you will be using to attach the wheel hubs. Drill holes through the frame at the marked locations for the wheel hubs. We Insert the bolts through the wheel hub and then through the holes in the frame. Secure the bolts on the opposite side of the frame with nuts. Make sure the wheel hubs are aligned properly and the bolts are tightened securely.

Slide the axle through the wheel hubs and attach it to the frame using bolts and nuts. The axle should be perpendicular to the frame and the wheels should be level and aligned. We Test the wheel assembly to ensure that the wheels spin freely and do not wobble or rub against the frame. If any adjustments are needed, make them before continuing with the rest of the assembly process.



Fig10: Chain Connection to Motor Sprocket to Wheel Sprocket:

We determine the length of chain needed by measuring the distance between the motor sprocket and the chain sprocket. Add a few extra links to the chain to allow for tension adjustment. We are attaching the motor sprocket to the motor shaft using the appropriate fasteners. Make sure the sprocket is centered on the shaft and securely fastened. We mount the chain sprocket onto the shaft or axle to which it will be attached.

Secure the sprocket in place using the appropriate fasteners. We thread the chain over the motor sprocket and around the chain sprocket. Make sure the chain is properly tensioned by adjusting the position of the chain sprocket or the tensioner, if present. Connect the two ends of the chain using a chain link or a master link, depending on the type of chain you are using. Make sure the link is properly installed and secure. Test the chain connection by turning on the motor and observing the movement of the chain. Make any necessary adjustments to the tension or alignment of the chain to ensure smooth operation.



Fig11: Attachment of Tiller Blades to Chassis:

We had to determine the location on the frame where the rod will be welded to hold the ploughing blades. Use a marker or paint to mark the area. Then cut the rod to the desired length and grind the surface of the frame where the rod will be welded. This will remove any rust, paint, or debris that could interfere with the welding process. Set up the welding equipment according to the manufacturer's instructions. This will include connecting the welding machine to a power source, attaching the ground clamp, and installing the appropriate welding electrode. Position the rod onto the marked area of the frame, making sure it is aligned and level. Use the welding electrode to create a strong weld by heating the metal until it melts and fuses together. Continue welding until the entire length of the rod is securely attached to the frame. Determine the desired placement of the ploughing blades on the frame and mark the location where the blade mount will be attached. Use a measuring tape and a marker to ensure the placement is accurate. Attach the blade mount to the frame using bolts and nuts. The blade mount should be positioned in the location you have marked for the ploughing blades. Insert the ploughing blades into the blade mount. The blades should slide into the mount and be securely fastened using bolts and nuts. Adjust the angle of the ploughing blades as necessary to ensure proper ploughing depth and angle. The angle can be adjusted by loosening the bolts holding the blade in place and rotating the blade to the desired angle. Test the ploughing blades by turning on the motor and observing the movement of the blades. Make any necessary adjustments to the angle or depth of the blades to ensure smooth operation.



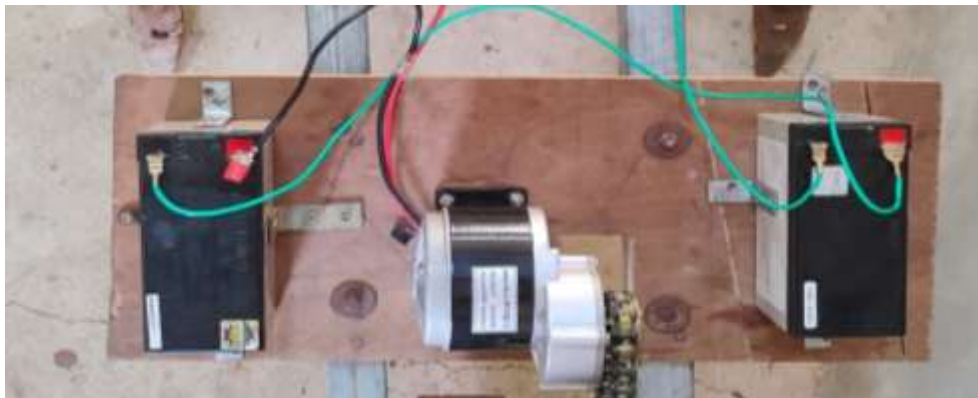
Fig12: Wiring Connections for Motor and Battery:

Here we are using two batteries. So, positive terminal from battery A is connected to negative terminal of battery B. After connecting both batteries to each other. Now the negative terminal of battery A is connected to one terminal of the Electric Motor. And the positive terminal from Battery B is connected to a switch. Thus, switch is used to turn on and off the motor to use. From the switch the wire is connected to another side of the motor which leads to working of motor. The wiring should be done very carefully as there are weak points such as terminal connections which may get detached due to the movement while using on irregular fields. The electrical wiring is done through of PVP housing wires which works good without interrupting the power output from battery to motor.

A lot depends on the type of motor and battery, but in general one of 3 things will happen:

1. The voltage is inadequate to allow the motor to begin turning. Current flows, but the motor remains stationary.
2. The voltage is adequate to make the motor turn. The exact speed is determined by the voltage applied and ratings of the motor.
3. The voltage exceeds the ratings of the motor, which begins turning before burning out and possibly bursting into flames. (Done that)

These scenarios apply to simple DC motors, but there are many types of DC motors, some of which require specialized drivers to work properly.



CONCLUSION

The Portable tiller is most suited for usage in hilly locations, moist conditions, and on small farms because it can do both primary and secondary tillage operations. The Portable tiller, with the correct set of tools and attachments, can handle most of the field operations in intensive cultivation. The Portable tiller's small weight makes it ideal for working in both wet and dry situations. Depending on the type of work, external attachments can be added to the tiller. As a result, the tiller can be utilized for a variety of tasks.

- As the prototype is run through the battery, so no fuel needed which reduces the cost of the fuel and pollution free.
- Cost Effective when compared to tractor.
- As it is simple in design, can be carried or transported simply from one place to another.

FUTURE SCOPE

- Various processes along with ploughing done such as seeding and spraying of pesticides by adding more attachments.
- By modifying the prototype, which is able to change different rotary tools for different purpose of operations.
- By making further modification using large power generated solar panel.
- By increasing the capacity of the motor and battery for long life and effective use.

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