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DESIGN AND FABRICATION OF COFFEE MANURING MACHINE

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Abstract: Coffee being one of the commercial crops is quite labour intensive. Throughout the year it needs to be maintained by couple of procedures like Pruning, Manuring, Coffee plucking, Coffee drying, Coffee pulping etc. Manuring process basically involves cleaning of dead leaves, sticks, and other waste materials which are fallen on the ground around the coffee plant stem. It also involves removing unwanted plants around it. So as to make the absorption process easier and plant root receive maximum manure content. Manuring is basically carried out twice in a year that is in the month of June and August. On an average it requires 8-9 men to complete the work of manuring of one acre coffee plantation in 2 days which on an average costs rupees 6500/- a year per acre. The traditional method involves removal of material (dead sticks etc.) around the coffee plant stem by using a shovel, then the labour put the manure using his hands. This machine focuses on doing cleaning and manuring work simultaneously. Thereby reducing the time to perform manuring by traditional method to almost 1/4 on an average. It is also affordable for poor farmers, easy to handle, and safer. Even the maintenance is also easy which drastically increases the profit of the farmers.

Index Terms – Dispenser, rotor, Hopper

I. INTRODUCTION

In olden days, the coffee estates were made by clearing the forests. There was no ready land available for the farmer to grow coffee. One has to convert the land suitable for growing the plant in all favourable conditions. Big trees were left while clearing the land. Hence the land pattern was left with forest trees. Because of all these unwanted trees and uneven landscape coffee production was limited to some extent in olden days. In modern days, owner cultivates the land in such a way to overcome the above mentioned problems, so that only coffee plants are grown densely in a specific pattern. And the gap between the coffee plants was made fixed (usually 3 meters). Other plants like pepper, Vanilla, Beetles, and Silver, Fruits like Orange, Litchi, and Papayas were planted and mixed farming was followed to increase the overall annual profit of the farmer. First the worker needs to bring the machine near a particular coffee lane and before starting the machine, one needs to clear all the obstacles present in the respective lane like fallen coconut tree branches, or any other trees branch manually. One should keep manure bags at the start or at the end of every coffee lane in order to fill the manure into hopper manually. Then worker will start the machine, bring it nearer to a plant, and revolve the machine around the plant, by doing this manure will be displaced to that plant. Then worker need to move the machine to next plant, then again all the above mentioned processes will be repeated in the same manner. This again is carried out to manure one complete lane. After this, all the above process will be repeated for every lane present in the coffee estate. Coffee manuring is one of the labour intensive and costly process. Due to high demand for labour, transportation problems such as transporting labourers from their houses to the working places, labour wages, labour fatigue which makes the work, a time consuming process, make the manuring process difficult. Coffee manuring focuses on reducing heavy manual work, it also focuses on reducing time. It can be operated by a single operator with basic driving skills. It can drastically reduce the time to 1/4th of the actual process time, making the work get completed at a faster rate. Coffee manuring machine also removes the problem of finding labours and waiting for them. The machine shall be user friendly, safe to use and shall increase the annual income of the planters resulting in lower maintenance cost. In order to produce an effective and long-lasting solution, the bridging idea for the design and construction of a coffee manuring machine calls for the seamless integration of cutting-edge design concepts with useful fabrication techniques. This entails designing a machine that satisfies the particular needs of coffee manuring while also taking durability, convenience of use, and environmental impact into account. During the design stage, the machine's functionality is carefully considered, and elements such as ergonomic design for user comfort and customizable settings for various soil types and topography are incorporated.

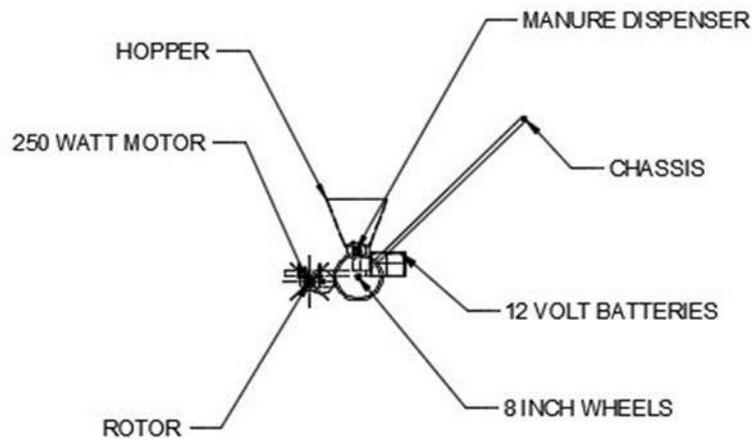


Figure 1 – Proposed Sketch

II. LITERATURE REVIEW

[1]. **Hybrid Electric Tiller for Agriculture Application** [1] by K.Sudharsan, A.Yogeshwaran, E.Vasanth, R.Prakash, S.Saravanan Published on 7 July 2022. Farming has been a necessarily portion of the human environment. Be that as it may, conventional cultivating strategies require a parcel of human exertion and are exceptionally time-consuming. Cultivate working is one of the foremost work seriously operations in farming. Manual tiling of areas is exceptionally strenuous assignment whereas tractors incur tall capital together with heavy fuel utilization costs. This low-cost versatile battery charged electric control tiller machine may be a one-stop advanced arrangement to upgrade the ordinary farming strategies of cultivating, because it diminishes the human effort, at an awfully insignificant cost utilizing motorized working component. The electric control tiller makes a difference diminish the time and fetched included in working employing a shrewd versatile plan in this manner expanding the efficiency and productivity in farming. Key points: In this project they used 250 watt motor which is attached to the wheel with the help of chain to move the machine bit faster.

[2].**Design and Fabrication of Battery Operated Weeder Machine** [2] by R.Magesh Kumar, M.Mayakkannan published on April 2020. Weed is a plant that is considered undesirable in a particular situation, it is basically “a plant in the wrong place”. Weeds are needed to be controlled because it reduces crop quality by contaminating the commodity. Weeds reduce farm productivity, they invade crops, smother pastures and in some cases can be harmful for the livestock. They aggressively compete for water, nutrients and sunlight, resulting in reduced crop yield and poor crop quality. Weed control is one of the most difficult tasks on an agricultural farm. Mechanical weed control is easily adopted by farmers once they get convinced of its advantages. Motorized agriculture weeding machine not only uproots the weeds between the crops rows but also keeps the soil surface loose, ensuring better soil aeration and water intake capacity. Weeding by motorized Weeder reduces the cost of labour and also saves time. In human operated Weeder, muscle power is required and so it cannot be operated for long time. The traditional method of hand weeding is time consuming.

[3].**Multipurpose Farm Machine** [3] by Dr. C.N.Sakahle Published on 09 Sep-2016.. India is an agriculture based country in which, 70% of people depends on the outcome of farming. But if we observe that with increase in population the farm gets distributed among the family and because of this, farmer in India held averagely only two acre farm. Also economically, farmers are very poor due to which they are unable to purchase tractors and other costly equipments hence they use traditional method of farming. Basically, many farmers in India also use bullocks, horses and he-buffalo for farming operation. This will not satisfy need of energy requirement of the farming as compared to other countries in the world.

[4].**Multipurpose Pesticides Sprayer Pump** [4] by Mr. Swapnil Thorat, Mr. Jagdish Pathare, Mr. Vinayak Kumbhar Published on 06 June -2018. The equipment is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying as well as weeding at minimum cost for the farmer so that he can afford it. The performance of the equipment will increase when it is operates on the smooth surface or less uneven surface.

[5]. **Design, Analysis and Optimization of Motorized Agriculture Weeding Tool** [5] by Deep Kishorkumar Bhatt published on 09 Sep 2021. It is used to remove the weeds (Undesired plants) found near the desired crop. It can help remove weed efficiently and without damaging the crop. The optimized design of the blade shown to fulfil all the aspects which were absent in the previous design with reduction in consumption of the power by the motor, more efficient removal of the weed and consistency in the performance reliability of the tool.

[6]. **Battery Operated Weeder & Sprayer** [6] by Sarang A. Bhongade, Aniket S. Sawarkar, Shantanu R. Kohale, Kaustubh R. Kandalkar, D. A. Shahakar Published on 03 Mar 2019. Weeder cycle is the equipment used in the agricultural field. In this equipment consist of Handle, Sprocket wheel, Rotor, Planet Gear, Chain, etc. The rotor and wheel are joined by the chain that will be attached to a frame. The weeder is operated by battery hence it become portable & handy. The device can be used in two different way are for weeding purpose & other for spraying purpose.

[7]. **Design and Fabrication of Manually Operated Weeder with Pesticides Sprayer** [7] by M.G.Jadhav, Prof.J.K.Sawale Published on 12 Dec -2016. The principles of motion of trolley which transmit its rotary motion from chain and sprocket arrangement and reciprocating piston into the cylinder for pumping the pesticides which is used to the manually operated organic fertilizers cum

pesticides sprayer. This model removes problem of back pain. As per our requirement we can separately use weeder or sprayer.

III. PROBLEM STATEMENT

Coffee manuring is one of the labour intensive and costly process. Due to high demands for labour, transportation problems such as transporting labours from their house to the working place, labour wages and labour fatigue which makes the work a time-consuming process, makes the manuring process very difficult.

IV. OBJECTIVES

The objectives of the project are:

- To design and fabrication of coffee manuring machine at low cost and to minimize labour fatigue.
- Consider factors like cost-effectiveness, environmental impact, and user-friendly operation

V. METHODOLOGY

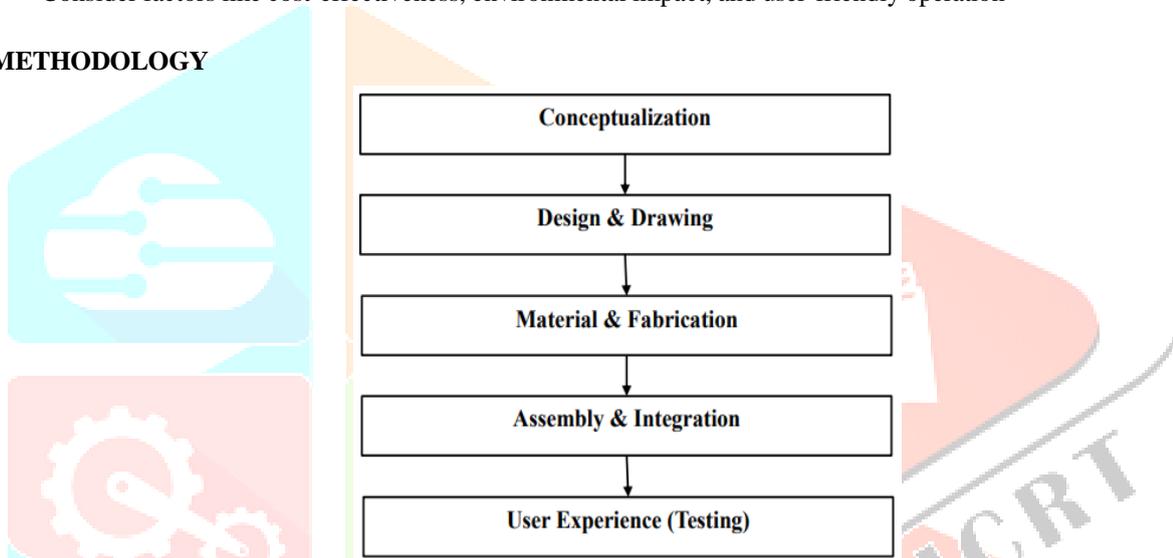


Figure 2 - Methodology

3.1 Conceptualization:

A sturdy frame for structural support, a hopper for storing coffee manure, a dispenser for discharging manure into the soil, and motors for powering the system are all essential parts in the conceptualization of a coffee manuring machine. The structure will be made to firmly hold the other components in place while withstanding the demands of field operations. The rotor will be able to be adjusted to ensure that the manure is distributed evenly around the field, and the hopper will have a large capacity to reduce the frequency of refills during operation. The rotor and any other moving parts will be driven by motors, which will take into account the torque and speed required for effective functioning. In order to guarantee operator safety and maximize performance, additional safety elements and a control system will be included. The design will be improved by testing and prototyping to guarantee dependability and efficiency in practical applications, taking into account elements like upkeep and repair ability to increase the machine's lifespan.

3.2 Design and Drawing:

A coffee manuring machine's design and drawing will require careful consideration of each part's operation and integration into the overall structure. In order to accommodate the secure positioning of the hopper and motor assemblies, the frame will be developed to offer stability and support. The size of the hopper will be chosen to maximize its ability to hold coffee manure while guaranteeing simple access for refilling. The goal of the dispenser's design is to evenly distribute the manure onto the soil. With consideration for power and wiring needs, motors will be arranged strategically to drive the rotor and other moving parts effectively. Thorough component drawings that guarantee correct alignment and clearances. Furthermore, measurements and standards for manufacturing, making it easier to build a dependable and effective coffee manuring machine.

3.3 Material and Fabrication

Reliability, usability, and affordability will be given top priority during the material selection and production stages of a coffee manuring machine. To endure the rigors of field use, the frame is usually made of robust materials such mild steel. It is possible to construct parts like the rotor and hopper to support the weight of manure. The selection of motors will be based on operational efficiency and power needs, and their housings will be made to shield them from the weather. The power transfer between the rotor and motor is accomplished by a chain and sprocket mechanism, the parts of which are cast or machined from high-strength materials to support large weights. Precision and quality control will be prioritised while integrating these components into a cohesive unit through the use of fabrication procedures such as welding, machining, and assembly.

3.4 Assembly and Integration

The machine consists of a rotor. The blades of the rotor shall be constructed from 2 mm mild steel sheet metal. The rotor blade are welded on a 20 mm shaft and the assembly is mounted to the chassis of the machine using UC204 bearing block. The chassis of the machine shall be constructed from 20 *40 mm mild steel rectangular hollow pipe. The rotor is powered by 250 WATT e bike motor. The manure shall be stored in a hopper made from 2 mm mild steel sheet metal. The rotor shall help in cleaning the ground around the plant. The motorized dispensing wheels are fitted below the hopper. The motorized wheels drop the manure from the hopper to the ground slowly. The operator has to guide the machine around the plant to carry out this process. In the first round cleaning is

done using the rotor. In the second round, the manuring is done. Once the process is done, the operator has to drive the machine to other plant.

3.5 User Experience

In order to assess the coffee manuring machine's performance and usability, extensive field testing and feedback collection will be part of the design and construction process. In order to evaluate the machine's overall dependability, manure distribution efficiency, and convenience of use, operators will be asked to test it in real-world scenarios. We'll be gathering input on things like maintenance needs, control interface usability, and ergonomics. To find opportunities for improvement, performance parameters such as machine durability and uniformity of manure dispersal will be assessed and studied. To maximize machine functionality and improve user happiness, iterative design adjustments and enhancements will be made to address any problems that arise during testing. User experience testing will ultimately guarantee that the coffee manuring machine fulfils the requirements and anticipations of operators while delivering consistent and effective results in agricultural applications.

VI. COMPONENTS AND DESCRIPTION

The major components that are involved in the fabrication of the treadmill cycle are:

4.1 CHASSIS

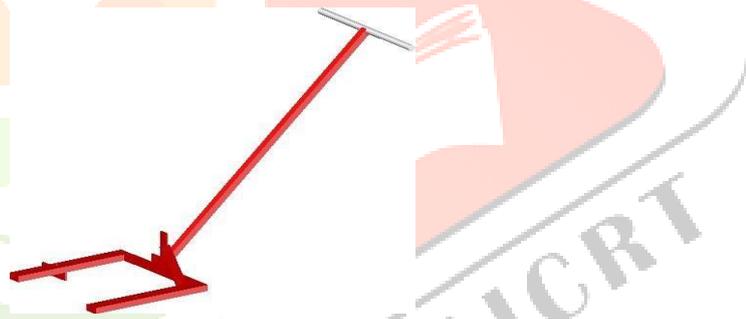


Figure 3- Chassis

The chassis of the machine is constructed from 20*40 mm mild steel pipe. The chassis holds components such as motor, rotor, batteries and manuring mechanism. The chassis helps to efficiently clean around the plants and apply manure. It also helps for efficient motion transfers between parts.

4.2 ROTOR

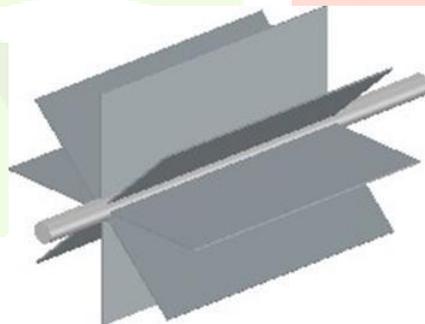


Figure 4- Rotor

The rotor is constructed from 20 mm mild steel shaft and 2 mm sheet metal. The rotor is directly coupled to the motor shaft. The rotor is rotating member that helps to remove unwanted leaves and twigs around the plant.

4.3 MANURING MECHANISM

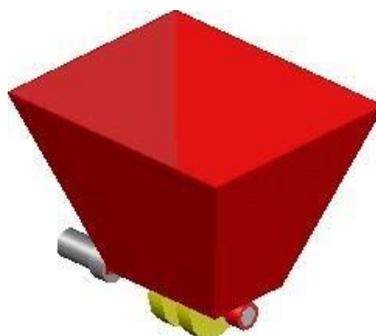


Figure 5- Manuring Mechanism

The manuring mechanism consists of hopper that is constructed from 2 mm mild sheet metal. The hopper is used to store the manure. Below the hopper, the dispensing wheels are kept to dispense the manure from the hopper to the plants. The mechanism is motor driven and can be controlled using a switch.

4.4 8 INCH WHEEL



Figure 6- 8 Inch Wheel

This wheel is used for smooth movement of the machine in the estate. It has two high quality bearing mounted inside it. It is made of plastic rim and the outer circumference is fitted with a rubber tyre for better traction.

4.5 BEARINGS (UC 204)



Figure 7-Bearings

Ball bearings are used to provide smooth, low friction motion in rotary applications. The UC 204 bearing is part of the broader category of ball bearings known for their efficiency in reducing friction between the rotating shaft and the stationary parts. These bearings feature a set of steel balls held within a circular race, allowing for smooth and controlled rotation. The spherical outer ring of UC 204 bearings simplifies the mounting process, making them particularly suitable for applications in which ease of assembly and disassembly is important. Commonly used in conveyor systems, agricultural machinery, and various industrial equipment, UC 204 bearings are known for their durability and ability to handle radial loads.

4.6 250-WATT GEARED DC MOTOR



Figure 8- 250-Watt Geared Motor

This dc engine is utilized to turn the rotor which have sharp edges on them. It employs a adapt box and combination of gears to diminish its speed, subsequently the title 'geared DC motor'. This can be done to get fundamental torque for its operation. The working voltage of this engine is 24 volts. It can be associated to circuit controller to get variable speed, which can be controlled by turn throttle. It moreover incorporates a sprocket made of combination steel. Control can be effortlessly transmitted utilizing chain drive. The 250-watt adapted DC engine speaks to a compact and proficient arrangement for different applications, mixing control with exactness. This sort of engine is commonly utilized in a bunch of gadgets and frameworks, counting mechanical autonomy, electric

bikes, and little electric vehicles. The 250-watt rating implies the control yield of the engine, showing its capability to change over electrical vitality into mechanical control. The integration of gears in this DC engine upgrades its usefulness. Adapting permits for the alteration of speed and torque, optimizing the motor's execution for particular errands. This makes the 250-watt adapted DC engine well-suited for applications requiring controlled and variable speeds, such as in computerized apparatus or apparatuses. The 250-watt adapted DC engine is frequently favored in plans where space, control utilization, and exact control are significant variables. Engineers and creators regularly select this engine to meet particular execution necessities, making it a key component in the realm of small-scale mechanization and electric portability.

4.7 12 VOLT DC MOTOR



Figure 9- 12 Volt Motor

DC engine is an electrical machine that utilizes electric control coming about in mechanical control yield. Ordinarily the engine yield may be a rotational movement of the shaft. The input may be coordinate current supply or rotating supply. But in case of DC engine coordinate current is utilized. The instrument of dc engine is like a bar wound with wire is put in between 2 magnets having North and South Post. When it is given with electric supply the wire gets to be energized coming about in rotational movement which leads to rotational yield. The all-inclusive motor can operate on coordinate current but may be a lightweight engine utilized for convenient control instruments and machines. Bigger DC engines are utilized in impetus of electric vehicles, lift and lifts, or in drives for steel rolling plants. The appearance of control hardware has made substitution of DC motors with AC engines conceivable in numerous applications can work on coordinate current but could be a lightweight engine utilized for convenient control devices and apparatuses. Bigger DC engines are utilized in impetus of electric vehicles, lift and lifts, or in drives for steel rolling plants. The coming of control gadgets has made substitution of DC engines with the widespread engine can work on coordinate current but may be a lightweight engine utilized for portable power tools and machines. Bigger DC engines are utilized in impetus of electric vehicles, lift and lifts, or in drives for steel rolling plants. The appearance of control gadgets has made substitution of DC engines with AC engines conceivable in numerous applications conceivable in numerous applications.

4.8 LEAD ACID BATTERY (12 VOLT)



Figure 10-Lead Acid Battery

A lead corrosive battery may be an auxiliary cell, meaning that it is rechargeable. It is exceptionally common in cars and trucks. It contains plates of lead and lead (IV) oxide in a sulfuric corrosive arrangement. The lead (IV) oxide oxidizes the lead plate, making an electrical current. Lead-acid batteries are the cheapest rechargeable batteries and can deliver much control. They contain poisonous lead, in spite of the fact that, and ought to be reused. They are damp cells, and the unsafe corrosive can spill out. Fixed lead corrosive batteries are batteries where the sulfuric corrosive is in a gel which remains in, indeed when the battery is turned upside down. Lead-acid batteries are a well-established and broadly utilized vitality capacity arrangement known for their unwavering quality and flexibility. Comprising lead dioxide and wipe lead drenched in a sulfuric corrosive electrolyte, these batteries effectively change over chemical vitality into electrical control. They discover broad application in different businesses, counting car, broadcast communications, and uninterruptible control supply (UPS) frameworks. One of the outstanding features of lead-acid batteries is their capacity to supply a tall surge of current, making them perfect for beginning vehicles. In car applications, these batteries are commonly utilized for controlling motors and providing electrical vitality to different vehicle components. Furthermore, lead-acid batteries play a crucial part in reinforcement control frameworks, where they act as a solid source of vitality amid control blackouts.

4.93 INCH WHEELS



Figure 11-3 Inch Wheel

The 3-inch wheels have grooves carved on their circumference. This makes a difference in apportioning the fertilizer from the container to the ground. The 3-inch wheel speaks to a compact however basic component in different mechanical frameworks, especially within the plan of carts, casters, and small-scale apparatus. The assignment 3-inch alludes to the distance across of the wheel, a basic measurement that impacts portability, load-bearing capacity, and maneuverability. These wheels are commonly made from solid materials such as elastic, polyurethane, or nylon, giving a adjust between quality and adaptability. The 3-inch wheel is regularly coordinates with swivel or inflexible casters, permitting for smooth and controlled development completely different bearings. Due to its moderately little measure, the 3-inch wheel is appropriate for applications where space imperatives are a thought, such as in furniture, dollies, or gear that requires exact maneuvering in limited zones. The wheel's measure too makes it appropriate for stack capacities commonly experienced in lightweight to modestly heavy-duty applications. Engineers and creators carefully select and coordinated 3-inch wheels based on components like stack necessities, floor surfaces, and the require for commotion decrease or stun retention.

4.10 SHAFT

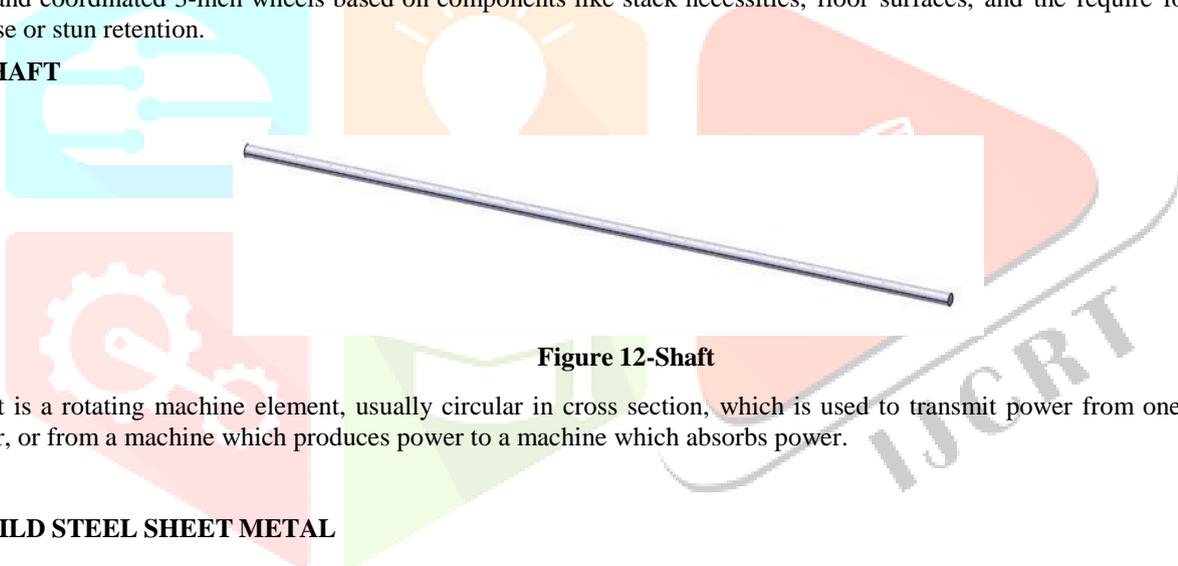


Figure 12-Shaft

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power.

4.11 MILD STEEL SHEET METAL



Figure 13-Mild Steel Sheet Metal

The mild steel sheet metal is used to construct the blades of the rotor system. Mild steel sheet metal is a widely utilized material in various industrial applications due to its versatility, durability, and ease of fabrication. Composed primarily of low-carbon steel, this type of sheet metal is known for its malleability, making it relatively simple to cut, bend, and shape into a variety of forms. It is often employed in the construction of structures, automotive components, appliances, and various other product. One of the significant advantages of mild steel sheet metal lies in its cost-effectiveness, making it a preferred choice for many applications. Welding techniques can be easily applied to join sheets, offering flexibility in creating complex structures and designs. Despite its susceptibility to corrosion in certain environments, proper coating or protective measures can mitigate this issue, ensuring the longevity and reliability of products made from mild steel sheet metal. Overall, the combination of affordability, formability, and strength makes mild steel sheet metal an integral material in the fabrication of a wide range of industrial and consumer goods. Mild

steel sheets are available in different thicknesses, commonly measured in gauges. The sheets may undergo additional processes such as galvanization or coating to enhance corrosion resistance, ensuring longevity in diverse environmental conditions.

4.1220*40 MM MILD STEEL PIPE



Figure 14-Mild Steel Pipe

The rectangular hollow pipe is used to construct the chassis of the machine. Here pipes provide a reliable and cost-effective solution for applications that demand combination of strength, versatility, and ease of fabrication. Before implementation, consideration of the intended use, environmental conditions, and adherence to local regulations is crucial to ensure optimal performance and safety.

4.131 INCH HOLLOW PIPE



Figure 15-Hollow Pipe

The 1-inch empty pipe is utilized to create the handle of the machine, ordinarily made from materials like steel or other amalgams, these empty channels offer auxiliary astuteness whereas keeping up a hollow interior. The one-inch breadth could be a standard measure, broadly utilized for plumbing, fencing, and basic systems. These channels are known for their quality, and depending on the fabric and divider thickness, they can withstand changing levels of weight and stack. The empty plan not as it were decreases generally weight but moreover permits for the section of liquids, making them appropriate for applications like conduit frameworks or the transport of fluids and gasses. Welding methods can be utilized for joining these channels, giving adaptability in plan and development. Whether utilized in private or commercial ventures, the 1inch empty pipe plays a urgent part in making strong and solid structures, displaying its significance in present day building and development hones.

4.14 Calculations

- Battery charging time

Battery charging time = battery capacity / amps supplied by charger

$$= 15\text{Ah} / 2\text{A}$$

$$= 7.5 \text{ hours}$$

- Battery capacity in parallel combination

Total battery capacity = capacity of battery 1 + capacity of battery 2

$$= 7.5\text{Ah} + 7.5\text{Ah}$$

$$= 15 \text{ Ah}$$

- Battery voltage in series combination

Total battery voltage = voltage of battery 1 + voltage of battery 2

$$= 12 + 12$$

$$= 24 \text{ volts}$$

➤ Power consumption of rotor motor $P = V * I$

$$= 24 * 9$$

$$= 216 \text{ watt hour}$$

➤ Power consumption of manuring mechanism motor $P = V * I$

$$= 12 * 3 = 36 \text{ watt hour}$$

➤ Force exerted by the motor at the end of the blades

$$\text{Torque of the motor} = 2.4 \text{ Nm} \quad \text{Radius of rotor} = 0.1 \text{ m}$$

$$\text{Torque} = \text{Force} * \text{Radius} \quad F = T / R$$

$$= 2.4 / 0.1$$

$$= 24 \text{ N} \quad \text{Power consumption of rotor motor}$$

➤ Manure dispensing rate of the machine Volume of holes in the wheel $= \pi r^2 L$

$$= 3.14 \times 1 \text{ cm}^2 \times 2 \text{ cm}^2$$

$$= 6.28 \text{ cm}^3$$

There are four holes in each wheels and there are two wheels So,

$$4 \times 2 \times 6.28 \text{ cm}^3 = 50.2 \text{ cm}^3 = v/\text{rpm} \text{ Dispensing rate} / \text{minute} = \text{rpm} \times v/\text{rpm}$$

$$= 100 \times 50.2 \text{ cm}^3$$

$$= 5020 \text{ cm}^3 / \text{min}$$

➤ Volume of the hopper

= volume of prism 1 –
volume of prism 2

$$= l_1 \times b_1 \times h_1 - l_2 \times b_2 \times h_2$$

$$= 30 \times 25 \times 30 - 10 \times 15 \times 10$$

$$= 21000 \text{ cm}^3$$

VII. 3D MODEL



Figure 16-3D Model

VIII. FABRICATED MODEL



Figure 17-Fabricated Model

IX. FUTURE SCOPE

- The blades of the machine can be altered and it can be used to clean around coconut and arecanut trees.
- The machine can be converted to a remote-operated machine.
- The machine can be equipped with a gasoline engine to avoid the dependency on electricity for charging.

X. CONCLUSION

The coffee manuring machine serves as an excellent tool for manuring, allowing for both manuring and cleaning. It offers a convenient mode of working without the need for much manual power, thus producing zero pollution and emissions. This simple yet advantageous model holds significant potential for further enhancements and modifications. It aims to offer an efficient process of manuring, ultimately helping to minimize the labor.

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