

DESIGN AND FABRICATION OF AGRICULTURAL WHEEL SPRAYER

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering.

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APPROVAL

This is to certify that the project on “**Design and Fabrication of Agricultural Wheel Sprayer**”.
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DECLARATION

We, hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Minhaz Uddin Lecturer, Department of Mechanical Engineering, and Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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ABSTRACT

The concept proposed in this project is Design and Fabrication of Agricultural Wheel Sprayer. Which automatically pesticides to the field. Although now days maximum people do this with a diesel engine powered pea. After all this machine plays an important role. In case the cost is in high driven or battery driven machine, this machine provides free service. We have designed this machine according to the affordability of the poor farmer in our country, so that everyone can buy and use it easily. We have somethings with this device as such metal, by cycle and motor cycle parts. The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort. The weeding is the generally done with the help of Bulls becomes for small land farmers. Similarly, the seed sowing application is also done with the help of bulls, which in the present age is time consuming and laborious. So, to overcome these above problems a machine is developed which will be beneficial to the farmer for the spraying and weeding operation along with the seed sowing application. A multifunction device will come in handy that can be put to use in different stages of farming as per requirement. Bangladesh is an agrarian country. On an average about 60 to 70% of the Bangladesh population depends directly or indirectly on agriculture for their income or we can say basic needs (food, cloth and shelter). In this agriculture sector there is a lot of field work, such as weeding, reaping, sowing etc. Apart from these operations, spraying is also an important operation to be performed by the farmer to protect the cultivated crops from insects, pests, funguses and diseases in which various insecticides, pesticides, fungicides and nutrients are sprayed on crops. Also there is growth of unwanted herbs/weeds in the fields which affects the development of crops cultivated. Therefore, herbicides are also required to be sprayed on open fields before sowing to meet the demand for quality and quantity of crops. And this spraying is done with the help of sprayer. So, this research work aims at designing and manufacturing the sprayer which operates with minimal effort and better ease.

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CHAPTER -1 INTRODUCTION

1.1 General

A sprayer is a device used to spray chemicals or liquids depending upon the application.

In agriculture, sprayers are used to apply herbicides, fertilizers, and pesticides to crops.

Sprayers come in a different range of sizes from man-portable units to self-propelled units similar to tractors.

1.2 Objectives of Agricultural Spraying Machine

- To reduce overall cycle time for the agricultural sprayer.
- To reduce human efforts in order to reduce the fatigue load on farmers.
- Decrease the operational cost by using new mechanism.
- Work reliably under different working conditions.
- Making such a machine which can be able to perform both the operation (spraying)..
- To increase efficiency of sprayer.
- To remove backpack and foot spraying techniques.
- To save the time of the farmers.

2.1 Introduction:

Agricultural spraying machine is to overcome the problems faced by traditionally spraying done by farmers who carry knapsack-type sprayers because of its versatility, design, and cost. But it is time-consuming and requires human efforts causing problems like back pain. Hence, in order to overcome these problems, we have designed and developed a new agricultural sprayer that is more efficient than traditional sprayers and requires negligible human efforts. A multi-functional device will come in handy that can be used in different stages of farming as per farmers' requirements. This wheel-operated pesticide spray equipment consumes less time and achieves uniform nozzle pressure. A crank mechanism with a piston pump that is driven by a wheel is also used. The main aim of this project is to develop low cost mechanically operated sprayer pump. The equipment has been validated by the users and feedback has been taken and improvements have been done.

2.2 Types of Wheel Sprayer

1. Knapsack Sprayer
2. Hand Sprayer
3. Pump Sprayer
4. Compression Sprayer
5. Garden Sprayer
6. Stirrup Sprayer

Knapsack Sprayer

A knapsack is a type of sprayer that disperses liquid through a hand-held nozzle that is attached to a pressurized reservoir carried on the operators back. Knapsack sprayers can be used to apply liquids such as fertilizers, herbicides and fungicides for example and is suited to spot treating areas. A spraying apparatus consisting of a knapsack tank together with pressurizing device, line, and sprayer nozzle, used chiefly in fire control and in spraying fungicides or insecticides.



Figure 2.2.1 (Knapsack Sprayer)

Hand Sprayer

During industrial construction hand held sprayers are commonly used for numerous purposes. They are used for spraying pesticides, acids, oil, sealers, diesel, etc. It is a portable tank with a wand attached to it. The liquid is compressed in the tank and through the wand it comes out in a fine spray.



Figure2.2.2 (Hand Sprayer)

Pump sprayer

Sprayer pumps are required for all spraying applications, fluid transfers, pressure washing, water or chemical delivery and distribution settings. Ag Spray carries one of the most comprehensive inventories of sprayer pumps online. We carry hundreds of different pumps for almost every use.



Figure 2.2.3 (Hand pump sprayer)

Compression Sprayer

Widely used in agriculture, this is carried on the back. A frame or shield prevents contact between the tank and the back. It is a continuous type of sprayer with a fairly constant discharge rate. The person maintains pressure in the tank by pumping air with a lever with one hand and directs the spray lance with the other. If the sprayer is fitted with a spray control valve, continuous pumping may not be necessary.



Figure 2.2.4 (Compression Sprayer)

Garden Sprayer

Garden sprayers are used to apply liquid treatments to tomato plants, such as fungicide to treat diseases, insecticide to control pests, or a fertilizer product like fish emulsion. Both synthetic (man-made) products as well as organic materials like horticultural oils can be applied with a sprayer.



Figure 2.2.5 (Garden Sprayer)

Stirrup Pump Sprayer

A stirrup pump is a portable reciprocating water pump used to extinguish or control small fires. It is operated by hand. The operator places a foot on a stirrup-like bracket at the bottom of the pump to hold the pump steady, the bottom of the suction cylinder was placed inside a bucket of water. Stirrup Sprayers are conventional and most popular equipment's used in Municipal Corporation. View Complete Details. Fill the quantity to get latest price!



Figure 2.2.6 (stirrup pump sprayer)

2.3 Applications

- ❖ Its major use in agriculture to spray fertilizer.
- ❖ In city and urban area, it can use for spraying water on lawn.
- ❖ It may be exercise device at morning during utilize in lawn.
- ❖ Use from spray chemical Pesticide in plants in farm.
- ❖ It is use for spray painting in industry.
- ❖ It is use for spray water in garden on the plants.
- ❖ It is use for transfer water from one place to its nearer place.
- ❖ For the insecticides application to control insect pests on crops and in stores, houses, kitchen, poultry farms, barns, etc.
- ❖ For the fungicides and bactericides application to control the plant diseases.
- ❖ For the herbicide's application, to kill the weeds.
- ❖ For the harmony sprays application to increase the fruit set or to prevent the premature dropping of fruits.

2.4 Future Scope

- ✓ The gear ratio we have used can be changed of this product according to the need. More number of teeth means more fluid will be the operation.
- ✓ More number of nozzles can be used.
- ✓ The product can be sealed using the casing.
- ✓ High-capacity backpack can be used.
- ✓ A new design can be implemented to eliminate the need for pulling the machine manually.
- ✓ Stronger but light in weight materials can be used for the frame.

CHAPTER -3 METHORDOLOGY

3.1 Process in project

- Creating an idea for Design and construction of Agricultural Wheel Sprayer.
- Designing a block diagram & to know which components need to construct it.
- Collecting properly the all components and parts for the Agricultural Wheel Sprayer to construction.
- Setting all components in Drafted process. Then assemble individual parts and finally run and check.

3.2 Block Diagram:

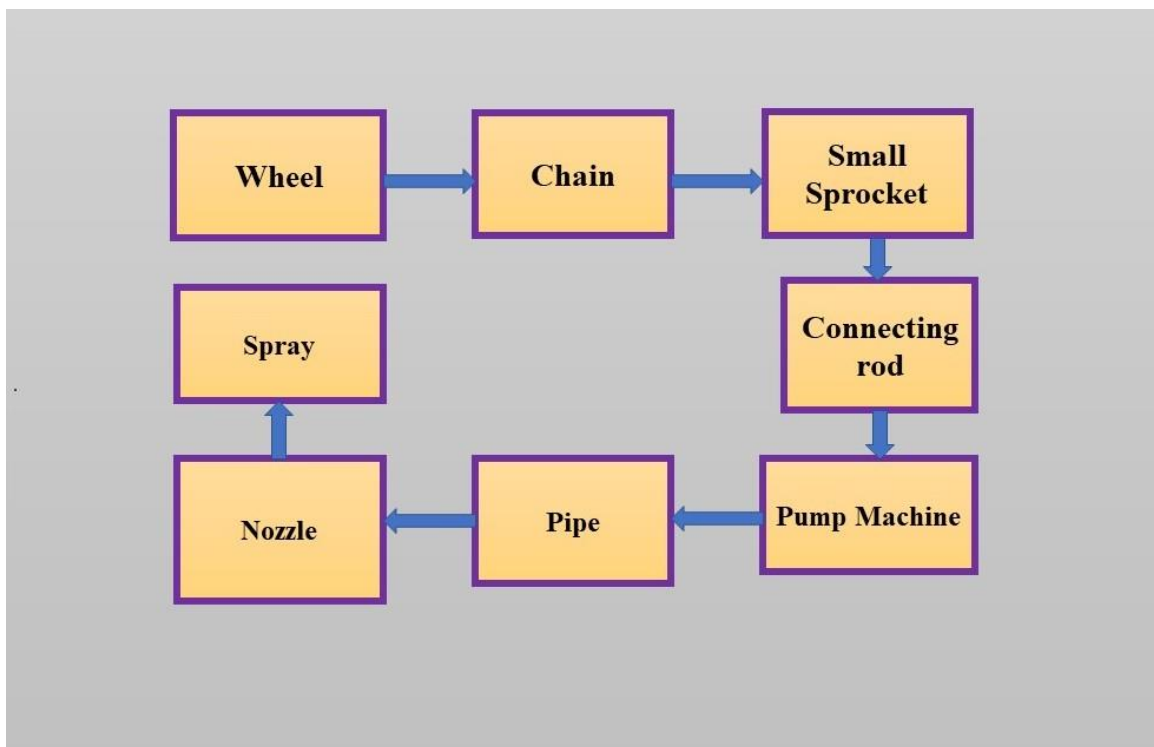


Figure 3.2.1(Block Diagram Agricultural Wheel Sprayer)

3.3 Parts Figure:

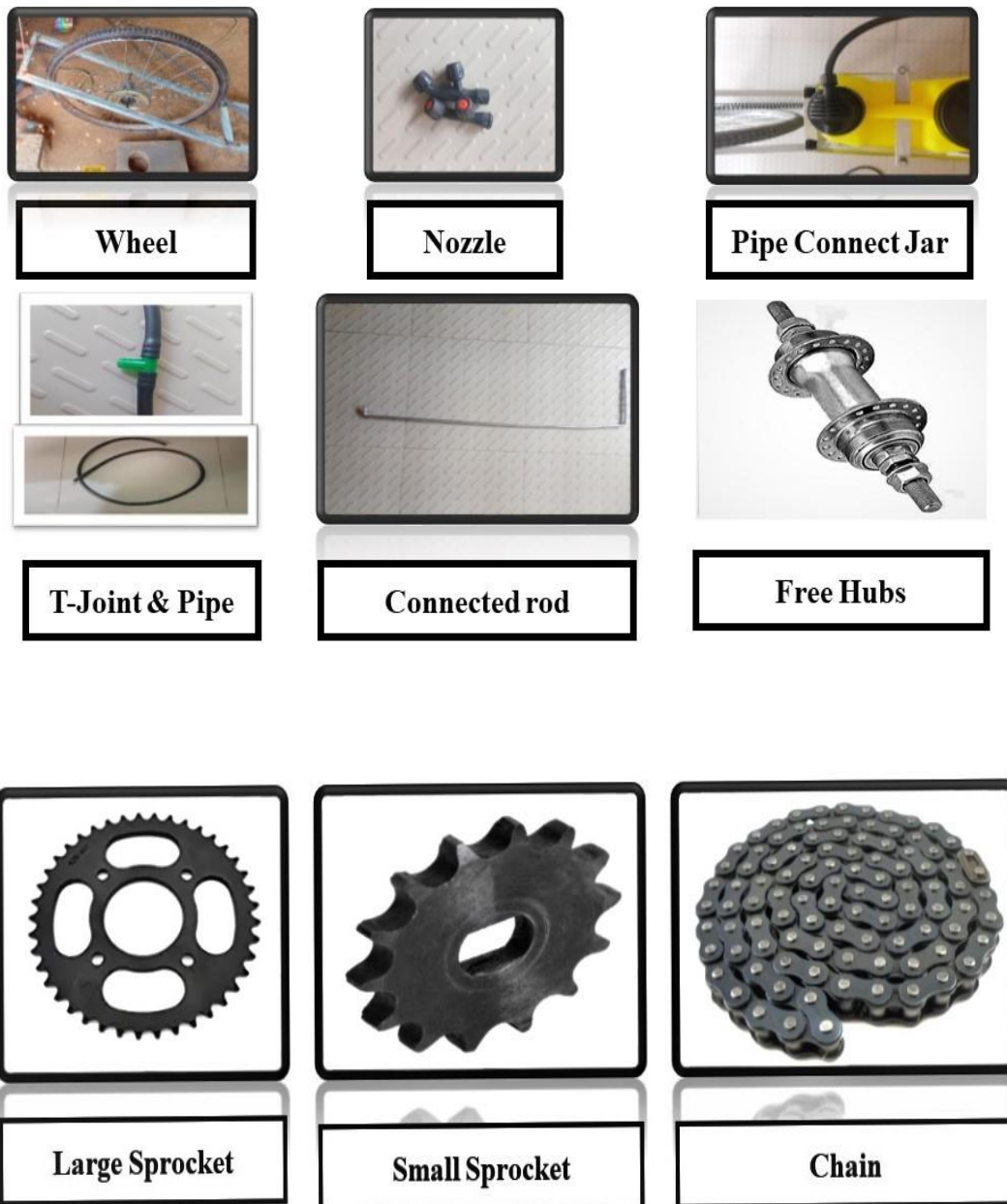


Figure 3.3.1(Individual Parts)

3.4 Working Principle

This is a rotate mechanism. Which connect in a small sprocket and the small sprocket connect chain with large sprocket in a wheel. When the wheel rotates then the small sprocket is rotated and a connected rod connect with pump jar and sprocket. As a result, pump jar is up and down automatically when the wheel is rotated. And water is automatically spray in output in upper working process.

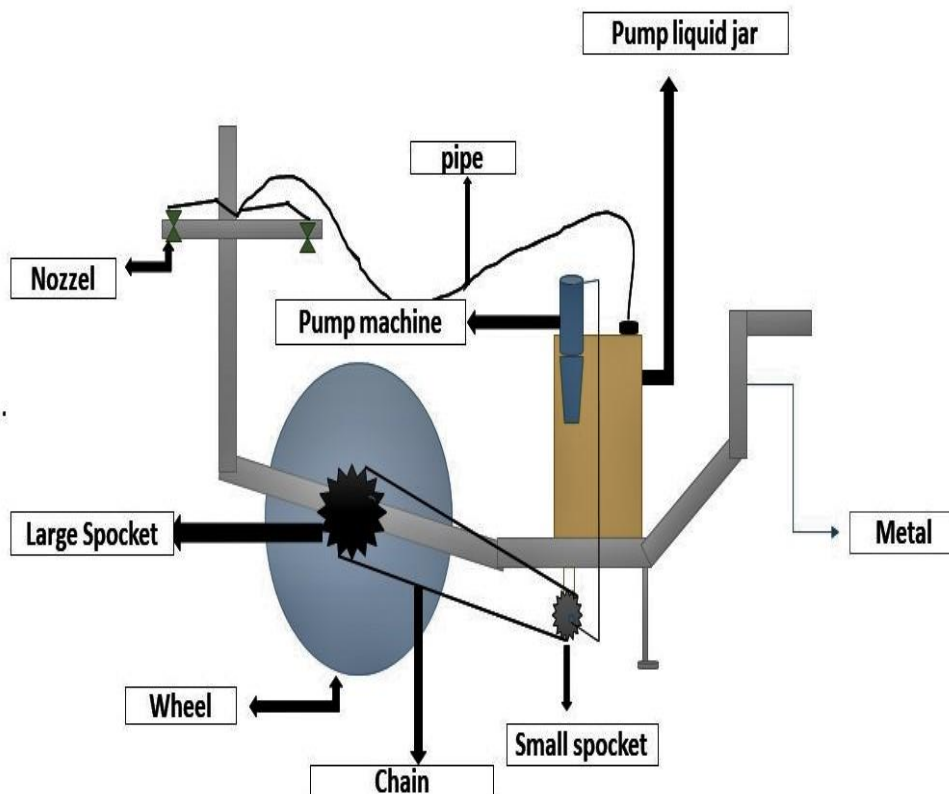


Figure 3.4.1 (Working Principal Process)

3.5 Required Instrument

Required instrument as define different necessary parts which need to construct in a project.

3.5.1 Bicycle Wheel

Bicycle wheel is a rotate system. Which connect to the large sprocket. This is the major parts of this process. Which is a running system in this Agricultural Wheel Sprayer. It's carried the entire weight of the vehicle. Wheels are simple machines for reducing the force of friction. Dragging something over rough ground is hard work, but wheels make it much easier by allowing the object to roll along. Wheels can also be used to help turn something with more force, or help something to turn faster.



Figure 3.5.1.1 (Bicycle Wheel)

3.5.2 Motorcycle Back Sprocket

The rear sprocket of a motorcycle that connects to the free hubs and is attached to the chain. When wheel turn in then the sprocket will rotate and the chain rotating the small sprocket. The sprocket has 48 teeth. A chain or belt is used to connect two sprockets, with one being the 'driver' and the other being 'driven'. Motion or force then drives them, which transmits power or changes the torque or speed of a mechanical system. A sprocket is a fairly thin wheel with teeth projecting outwards from the rim, especially a wheel that drives or is driven by a chain. When you ride a bicycle, the teeth of the sprocket mesh with the chain.



Figure 3.5.2.1 (Motorcycle Back Sprocket)

3.5.3 Motorcycle Front Sprocket

Small sprocket is set below the pump jar frame. It's connected a with free hubs, which one side has small sprocket and opposite side has large sprocket connected. And two sprocket is joint free hubs exile opposite side. Small sprocket is also connected are chain with wheel. Small sprocket and Chains help rotate when the wheel is rotated. A bigger rear sprocket/ smaller front sprocket will give you an increase in acceleration but decrease your top speed. A smaller rear sprocket/bigger front sprocket will reduce you acceleration but increase the top speed.



Figure 3.5.3.1 (Motorcycle Front Sprocket)

3.5.4 Motorcycle Chain

Chain is components which is running the agricultural wheel sprayer machine process. It rotates two sprocket and move forward the machine. The machine is impossible without this chain system. So, it's a most important components this machine. Sprockets are sturdy wheels with teeth that lock onto a chain. As the sprocket spins, the teeth grab onto the chain and move other parts that interlock with the chain. This sequential series of operations allows for simple and controlled rotational movement of larger equipment and machinery.



Figure 3.5.4.1 (Motorcycle Chain)

3.5.5 Spray Pump Jar

Pump jar is a component which contain to liquid pesticides. And it has a pumped machine one side with which the liquid is sprayed out through the pump process. This pump machine supported by a connecting rod which connect to large sprocket helped for up and & down pump jar machine. In a spray mechanism, the one-way valve between the pump and the nozzle is a sort of cup, which fits over the end of the barrel. On the upstroke, the inward pressure from the pump pulls the cup against the barrel, so air can't flow in through the nozzle.



Figure 3.5.5.1 (Spray Pump Jar)

3.5.6 Nozzle

It's a device which converts the pressure energy of fluid into kinetic energy. Spray nozzle is a precision energy that facilitates of liquid into spray. Nozzle is used for purpose to distribute a liquid over an area. A nozzle is often a pipe or tube of varying cross-sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. The two most popular types for chemical applicator are the flat spray and hollow cone nozzles.



Figure 3.5.6.1 (Multi Nozzle)

3.5.7 Connecting Rod

The main function of connecting rod is to convert rotary motion into reciprocating/liner motion. Here connecting convert rod rotary motion crank to reciprocating motion of pump and extension rod. The connecting rods transfer the rotating force of the crank pin to an oscillating force on the wrist pin. Connecting rods are split perpendicular to their centerlines at the crank pin end for assembly of the rod onto the sprocket.



Figure 3.5.7.1(Connecting Rod)

3.5.8 Frame

The main function of frame is to carry whole assembly on it so it has to be strong enough to hold it. The frame is hold made of square pipe and it is formed out of mild steel. The frame has one up down move metal which has connecting with pipe and nozzle. There have two stands under the frame which helped to stay.

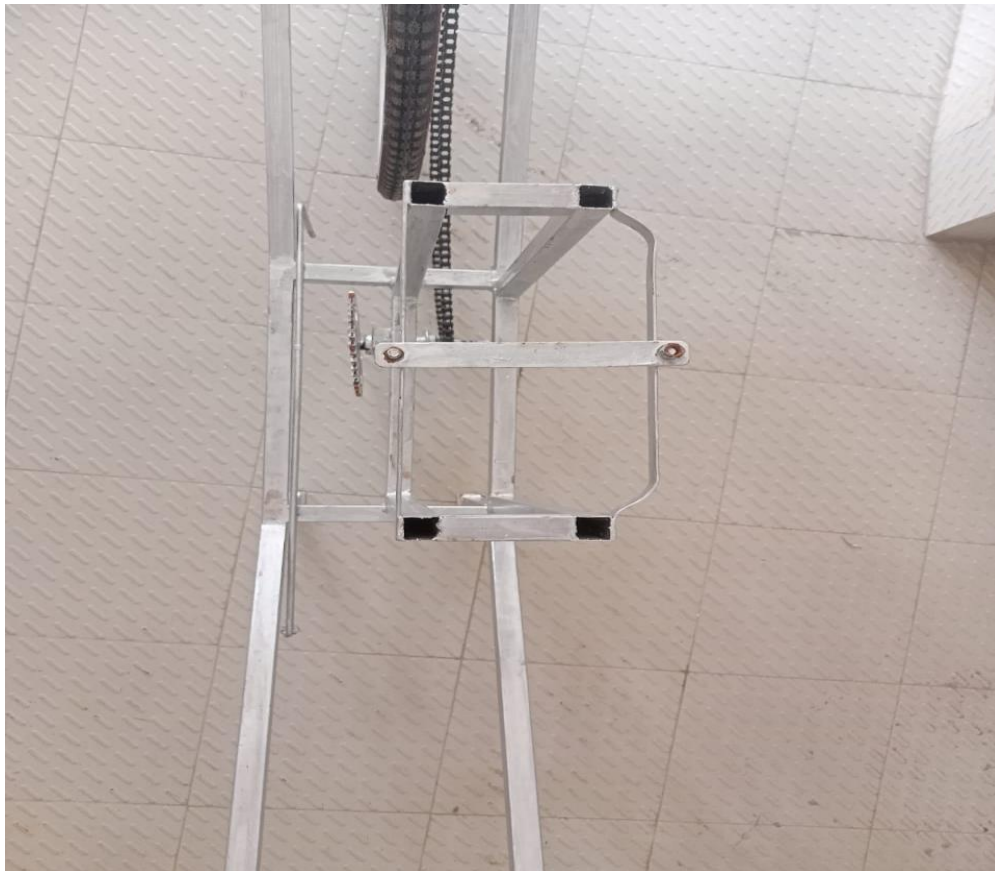


Figure 3.5.8.1 (Square pipe Frame)

3.8.9 Free Hubs

The free hub is an extension of the right-hand side of the rear wheel's hub. It contains a system that engages with the wheel when you're pedaling, to propel you forward, and which disengages when you stop pedaling so that the wheel continues to turn without the gears and pedals turning. The simplest freewheel device consists of two saw-toothed, spring-loaded discs pressing against each other with the toothed sides together, somewhat like a ratchet. Rotating in one direction, the saw teeth of the drive disc lock with the teeth of the driven disc, making it rotate at the same speed.



Figure 3.5.9.1 (Free Hubs)

3.5.10 T-Joint & Pipe

The T-shaped connector into which tubes or pipes are inserted to form a tee joint is also itself known as a tee joint. This connector may be used to direct the flow of fluid in one direction or the other, to divide it in two directions, or to combine flow from two streams into a single stream. In plumbing applications, the T-shaped connector into which tubes or pipes are inserted to form a tee joint is also itself known as a tee joint. This connector may be used to direct the flow of fluid in one direction or the other, to divide it in two directions, or to combine flow from two streams into a single stream.



Figure 3.5.10.1 (T- Joint & Pipe)

CHAPTER -4 RESULT AND DISCUSSION

4.1 Result

Finally, we were able to create our project successfully. After making the Sprayer frame, we designed a Draft working process. After then we are practically made the designed process. And that's working so well. We take an experiment for better result in a vegetable land. And there at the same result the agricultural wheel sprayer working perfectly. Below is a picture of our successfully completed entire project



Figure 4.4.1 (Complete Project Picture)

4.2 Discussion

Bangladesh Agricultural Development Institute has worked on “Agricultural fertilizer & pesticides sprayers”. In his work he emphasizes on different method of spraying devices Day by day the population of Bangladesh is increasing and to fulfil the need of food modernization of agricultural sectors are important. Due to chemical fertilizers the fertility of soil is decreasing. Hence farmers are attracted towards organic farming. By mechanization in spraying devices fertilizers and pesticides are distributed equally on the farm and reduce the quantity of waste, which results in prevention of losses and wastage of input applied to farm. It will reduce the cost of production. It will reduce the cost of production. Mechanization gives higher productivity in minimum input. Farmers are using same traditional methods for spraying fertilizers and pesticides. Equipment is also the same for ages. In Bangladesh there is a large development in industrial sectors compared to agricultural sectors. Conventionally the spraying is done by labors carrying backpack sprayer and fertilizers are sprayed manually. The efforts required are more and beneficial by farmers having small farming land. The most scientist resources work in “Design Fabrication of Agricultural sprayers, weed with cutter Chemicals are widely used for controlling disease, insects and weeds in the crops. They are able to save a crop from pest attack only when applied in time. The chemicals are costly. Therefore, equipment for uniform and effective application is essential. Dusters and sprayers are generally used for applying chemicals. Dusting, the simpler method of applying chemical, is best suited to portable machinery and it usually requires simple equipment. But it is less efficient than spraying, because of the low retention of the dust. In this work we have proposed an equipment that is wheel and pedal operated sprayer, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel and also peddling the equipment. In this equipment using reciprocating pump and there is an accumulator provided for the continuous flows of liquid to create necessary pressure for the spraying action. This wheel operated pesticide spray equipment consumes less time and avoids the pesticide from coming from front of the nozzles which will in contact of the person who sprays pesticides. Weed management is one of the tedious operations in crop production. Because of labor costs, time and fully manual weeding is unfavorable.

Hence effort is made to design and develop efficient Farm equipment to perform weeding without using electric pow. According to literature published on flow control of agricultural spraying machine by Massey university New Zealand on different spraying mechanism are studied New Zealand relies heavily on its agricultural industry. A large portion of this industry is pastoral farming, where livestock are raised to graze on pasture. This includes beef, sheep and dairy farming. An important aspect of this style of farming is maintaining pasture quality. In order to increase growth fertilizers are often applied to the pastures. This increase yields in both meat and milk production. However, the increased application of fertilizer is linked with diminishing water quality. While the effects of nitrogen leaching and the best ways to manage fertilizer use are still being investigated, it is clear that control over the application will become more and more important. The Tow and Fret is a range of fertilizers machines designed and built in New Zealand by Metal form Dannevirke. The Tow and Fret range is capable of spraying a wide range of fertilizers including both soluble and non-soluble fertilizers. The Tow and Fret is unique in its ability to spray fertilizers slurries consisting of mixture ratios of up to three-part fine particle fertilizer to one-part water. This is achieved by the use of a recirculating system. Currently there is next to no control on the flow rate of the machines and the application rate is determined by the speed the operator maintains. The purpose of this thesis is to design and build a flow control system for the Tow and Fret product range and investigate the effect of the changing flow rate on the spray characteristics. The ability to spray such a wide range of fluids with drastically different properties presents many challenges.

CHAPTER -5

CONCLUSION

5.1 Conclusion

- 1) The suggested model has removed the problem of back pain, since there is no need to carry the tank on the backbone and solder.
- 2) More no. of nozzle which cover maximum area of spray in minimum time at maximum rate.
- 3) Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
- 4) Imported hollow cone nozzle should be used in the field for the better performance.
- 5) Muscular problem is removed and there is no need to operate lever.
- 6) This alone pump can use for multiple crops.
- 7) After having a trial, we have found that one finds it easy to operate push type machine.
- 8) The pump can deliver the liquid at sufficient pressure where output of the nozzle in 1min is 0.3 and spray width 0.4m from calculation so that it reaches all the foliage and spreads entirely over the spray surface.
- 9) It is little heavy but efficiently working in rough conditions of farm. It is economical therefore affordable for all kind of farmers.
- 10) It requires comparatively less time for spraying so we can get more fields spraying per day. It is cost effective than the existing spraying pumps available in the market as no direct fuel cost or cost for maintenance is needed for this.
- 11) It is upgraded design of manually operated sprayer and weedier which will be helpful for small land farmers.
- 12) It consumes less time and saves money as compared with conventional spraying and weeding.
- 13) This machine does not require any fuel or power so maintenance is less.

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