

DESIGN AND FABRICATION OF SPRAYING FLUID BY WHEEL PUMP

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Abstract: India is set to be an agricultural based country and approximately 75% of the peoples are dependent on farming directly or indirectly, 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, fungi and diseases for which various insecticides, pesticides, fungicides and nutrients are sprayed on crops for protection. In today's world, we use many different spraying technologies involving use of energy like electrical energy, solar energy, and chemical energy of fuels. This fact makes us know that how large amount of energy is getting used at such place where mechanical energy can be used instead of direct energy sources. Farmers are facing enormous problem while spraying the pesticide like tank capacity is very small, high cost and spraying time taken more. In order to reduce these problems many different type of sprayers has been introduced in the market, but these devices do not meet the above problems or demands of the farmers. To solve these difficulties develop a new equipment that is mechanically operated wheel driven sprayer, it is a portable device and does not need any fuel to operate, which is easy to move and spray the pesticide by moving the wheel. This wheel operated pesticide spray equipment consumes less time and achieves uniform nozzle pressure; we used crank mechanism with piston pump, which is driven by the wheel. This paper aims at developing a low cost mechanically operated sprayer pump for Indian middle scale farmers, Study the literature review, user study and market study. Based on literature and market study Develop QFD and PDS char, and generate the many concepts. A final concept has been select for further development and detailing. A full scale working model has been fabricated for design validation.

IndexTerms - Eccentric flywheel, Bicycle wheel, plastic fiber, water quality spray nozzle.

I. INTRODUCTION

Farming is the backbone of Indian economy. 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 for which various insecticides, pesticides, fungicides and nutrients are sprayed on crops for protection. Farming has undergone a great evolution in last 50 years. Out of the various reasons involved in this evolution is control of various diseases on crops. In the modern agriculture, the usage of pesticides is still increasing moreover the 90% of these pesticides are being applied in the form of spraying which will maintain an environment friendly approach. The argument for using existing conventional equipment is that farmers will face economic difficulties in case of chemical and electrical powered pumps as well as they will face health issues in case of hand operated pumps. One way to overcome this problem is to use the equipment developed for application of the pesticides through the use of mechanical power. In selecting a pump for furnishing a supply of pesticides for farm use, or for spraying insecticides, herbicides or fungicides, we must be sure it is designed for the job to be done. The unit should have sufficient capacity to supply the needed amount of water and spray material in the allowable time.

II.COMPONENTS AND DESCRIPTION

- Piston pump
- Rear wheel roller
- Roller shaft
- Frame
- Roller block
- Front wheel roller
- Slider
- Driven sprocket
- Drive sprocket
- Chain
- Handle
- Nozzle
- Hopper
- Sowing mechanism

a. Chain sprockets:

The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth as shown in figure 1. The chain is made of steel which is used to transmit power from gear sprocket to pinion sprocket, and it has a no slip.

**Fig. 1 Chain sprockets:****b. Crank**

The function of crank is to transfer motion from prime mover to the connecting rod for further operation. Here the circular disc having eccentricity at which rotary motion of crank is converted into reciprocating/linear motion of connecting rod.

c. Nozzle

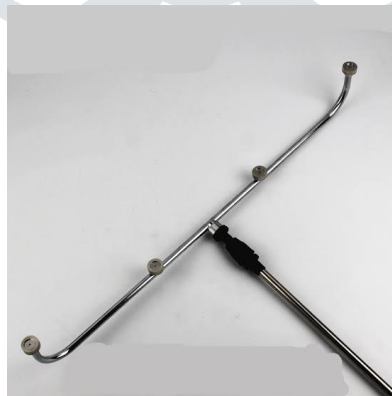
It is a device which converts the pressure energy of fluid into kinetic energy, spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzle is used for purpose to distribute a liquid over an area.

d. Wheel:

Wheel is used to carry the whole assembly and move machine from one place to another by rotary motion of it. A bicycle wheel is a wheel, most commonly a wire wheel, designed for a bicycle. Bicycle wheel is designed to fit into the frame and fork via drop outs, and hold bicycle tire as shown in figure 2.

**Fig .2 wheels****e. Pump**

It consists of piston and cylinder arrangement, it has a lever to operate the motion of piston in reciprocating direction as shown in figure 3. The pump generates the pressure of Bar and discharge of 2 plum.

**Fig .3Pump****f. Frame**

The main function of frame is to carry whole assembly on it so it has to be strong enough to hold it as shown in figure 4. The frame is made of square pipe and it is formed out of mild steel.

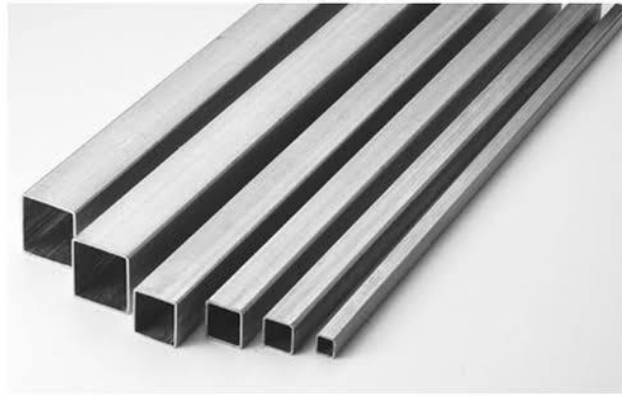


Fig .4Frame

g.Tank

We want our tank to carry as much fluid as it can be along with its self weight as less as possible. We have taken a tank which is almost 16 liter capacity as shown in figure 5. A material for tank used is plastic fiber

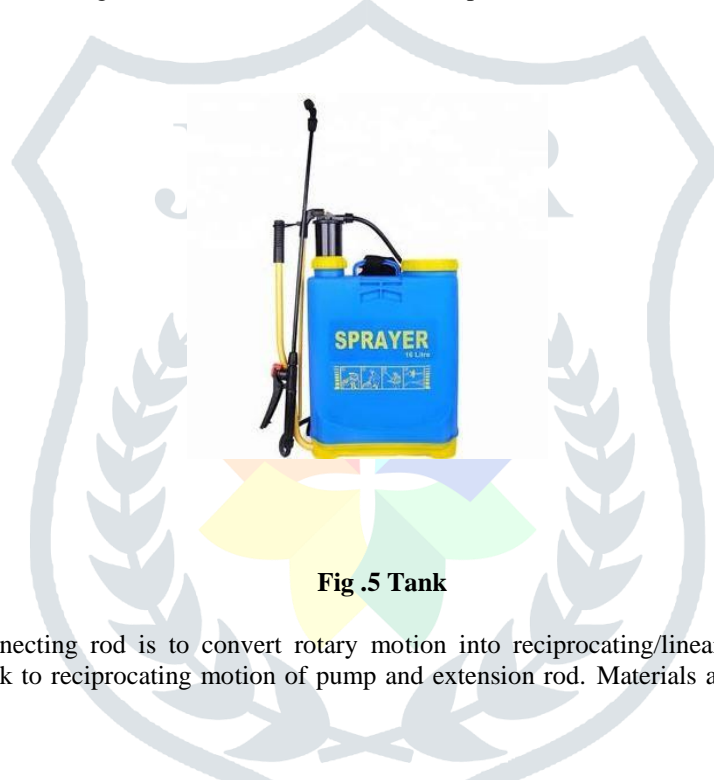


Fig .5 Tank

h.Connecting Rod

The main function of connecting rod is to convert rotary motion into reciprocating/linear motion. Here connecting rod converts rotary motion of crank to reciprocating motion of pump and extension rod. Materials as shown in figure 6. It also has very low cost.



Fig .6 Connecting Rod

i.Eccentric flywheel

Eccentric fly wheel it is converted rotary motion to reciprocating motion an eccentric is a circular disk m (eccentric sheave) solidly fixed to a rotating axle with its center offset from that of the axle (hence the word "eccentric", out of the center) as shown in figure 7.



Fig. 7 Eccentric flywheel

III. LITERATURE REVIEW

R.D. Dhete has worked on “Agricultural fertilizer & pesticides sprayers”. In his work he emphasizes on different method of spraying devices. Day by day the population of India 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 India there is a large development in industrial sectors compared to agricultural sectors. Conventionally the spraying is done by labours carrying backpack sprayer and fertilizers are sprayed manually. The efforts required are more and beneficial by farmers having small farming land.

Pavan B. Wayzode, Sagar R. Umale, Rajat R. Nikam, Amol D. Khadke, Hemant carried out their 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 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 be in contact of the person who sprays pesticides.

According to literature published on flow control of agricultural spraying machine by Massey University New Zealand on different spraying mechanisms 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 fertilisers are often applied to the pastures. This increase yields in both meat and milk production. However, the increased application of fertiliser is linked with diminishing water quality. While the effects of nitrogen leaching and the best ways to manage fertiliser use are still being investigated, it is clear that control over the application will become more and more important. The Tow and Fert is a range of fertiliser machines designed and built in New Zealand by Metal Form Dannevirke. The Tow and Fert range is capable of spraying a wide range of fertilisers including soluble and non-soluble fertilisers. The Tow and Fert is unique in its ability to spray fertiliser slurries consisting of mixture ratios of up to three-part fine particle fertiliser to one-part water. This is achieved by the use of a recirculating system. Currently.

Sudduth K.A., Borgelt S.C., Hou J., (1995) Performance of a chemical injection sprayer system - Performance of a chemical injection sprayer system, found the time delay of concentrated pesticides through injection sprayers to be significant, and proposed injection at the individual nozzles as a possible solution to shorten delays. Development of a direct nozzle injection system that overcame the concentration variation problems reported by previous researchers. Simulation are used to compare chemical application accuracies for various designs of injection sprayers. They found that reducing the diameter of the fluid lines near the end of the spray booms improved overall application accuracy.

Way T.R., Von Bargen K., Grisso R.D., Bashford L.L., (1992) Simulation of chemical application accuracy for injection sprayers. An autonomous mobile robot for use in pest control and disease prevention applications in commercial greenhouses. They develop the robot platforms ability to successfully navigate itself down rows of a greenhouse, while the pesticide spraying system efficiently covers the plants evenly with spray in the set dosages. The main application of robots in the commercial sector has been concerned with the substitution of manual human labour by robots or mechanized systems to make the work more time efficient, accurate, uniform and less costly.

Philip J. Sammons, Tomonari Furukawa, Andrew Bulgin, (2005) Autonomous Pesticide Spraying Robot for use in a Greenhouse. The University of Nairobi develop the system like centrifugal pump is the most common non-positive displacement pump. The output from this type of pump is influenced by pressure. This pump is ideal for delivering large volumes of liquid at low pressures. A key component of the centrifugal pump is the throttling valve. A manual throttling valve on the main output line is essential for the accurate operation of the centrifugal pump. The use of herbicides has replaced much of the mechanical tillage done formerly. Chemical application is done with attachments to tillage machines and seeders or with single-purpose chemical application.

IV. WORKING PRINCIPLE

When we push the sprayer trolley, work made by the wheels gets transmitted first to the cam and then to follower link, due to which the piston reciprocate and starts building pressure. Power is getting transferred to the piston, at the same time a coulter comes into action and its flaps starting their function. As the time passes, a strong pressure gets developed inside the cylinder as accumulator helps it in doing the process. As the pressure gets developed, nozzles start acting and they initiate spraying. During this time, a connecting link from coulter also moves its flaps rapidly and soil is taken to the roots of plants. Fig 8,9 and 10 shows the final working model. The main aim of this paper is to analysis of circularity and taper angle in abrasive water jet machining for Inconel825. The following conclusions are made.

- The optimum input setting for minimum circularity and minimum taper angle was arrived using grey relational analysis.
- The optimum machining parameters obtained has water pressure 3800 bar, standoff distance 2mm, abrasive flow rate 400 mg/min.
- The minimum circularity is obtained as 0.977 mm for the experimental run 2.
- The minimum taper angle calculated as 1.3748° for the experimental run 15.
- The future study is based on the SEM for topography analysis.

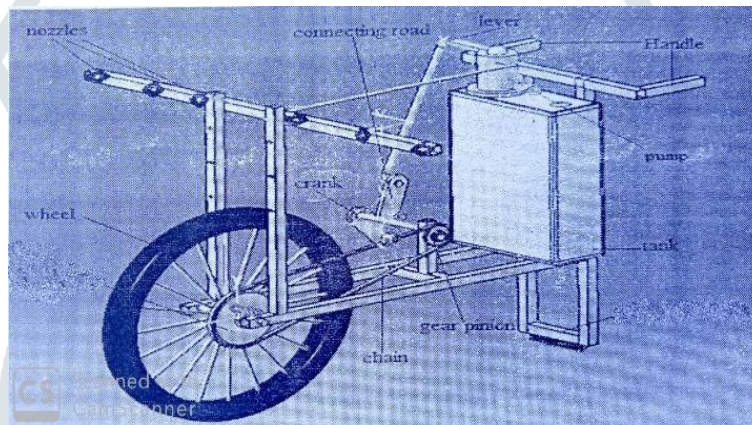


Fig .8 Wheel pump (schematic view)



Fig .9 Wheel pump (Top view)



Fig .10 Wheel pump (Front view)

4.1. Calculation

Discharge

Discharge is defined as the volume of water flows or rate of water flow through given cross sectional area is called as discharge.

$$\begin{aligned} \text{Discharge} &= \text{Area of piston} \times \text{stroke length} \times \text{r.p.s} \quad Q = \pi/4 d^2 \times L \times \text{r.p.s} \\ &= \pi/4 (0.65)^2 \times 0.5 \times 0.6 \\ &= 0.785 \times 0.4225 \times 0.03 \\ &= 0.00994988 \text{ mm}^3/\text{s} \end{aligned}$$

Discharge (Q) = 0.00001 m³/s 5.2 Normal speed in r.p.m

6 revolutions in 10 seconds, then how many revolutions in 1 second. 10 - 6

$$1 - X?$$

$$10 * x = 6$$

$$x = 0.6$$

The no. of revolution in 1 second is 0.6 then how many rev. in 1 minute (60seconds)

$$1 \text{ sec} - 0.6 \text{ revs.}$$

$$1 \text{ minut} - x?$$

$$X = 0.6 \times 60$$

$$X = 36 \text{ rpm}$$

Normal speed in rpm = 36 rpm

4.2. Advantages

- It does not require any kind of non-renewable energy is mechanical and pressure energy
- It reduces the fatigue of operator during the operator
- It increases the efficiency of operator
- It can cover more area of land during spray
- It can adjust the height of spray by using adjustable
- Cost is low

4.3. Application

- It 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.

CONCLUSION

The suggested model has removed the problem of back pain, since there is no need to carry the tank on the backbone and solder. More no of nozzle which cover maximum area of spray in minimum time at maximum rate. Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result in less pollution. The Imported hollow cone nozzle should be used in the field for the better performance. Muscular problem is removing and there is no need to operate the

lever. This alone pump can use for multiple crops. After having a trial, we have found that one finds it easy to operate push type machine. The pump can deliver the liquid at sufficient pressure where the 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. It is less heavy, but efficiently working in rough conditions of the farm. It is economical, therefore affordable for all kinds of farmers. 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. Also, it can be used for any crop as its maximum width is not more than one foot. Its nozzles can be adjusted to any height

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