Design And Fabrication Of Wheel Powered Spray Pump

S.Panneerselvam[1], I.Abdul Saleem[2],R.Arunkumar[3] , R.Harishkumar[4]
Department of Mechanical Engineering
[1]Assistant Professor, CK College of Engineering and Technology, Cuddalore
[2,3,4] UG Students, CK College of Engineering and Technology, Cuddalore

Abstract- *The project is intended to help the farmers as India being an Agriculture based country. It is a Pesticide Sprayer mounted on a Cart which is operated mechanically without any external source of energy. The aim of developing such a concept is primarily because of preventing the 3 major drawbacks of the pump being used currently- Firstly, the farmer has to carry the entire weight of the pesticide spraying (approx. 20+ kg) pump on his shoulder; secondly, he has to continuously use his one hand to pump using the handle; thirdly, the farmers don't take enough precaution which results in fatal diseases because of direct contact with the chemicals. All these factors have been taken care of in this project along with being cost effective, light in weight and good in strength.*

The pump which is already available with the farmer can be directly used in this mechanism. The handle of the sprayer will be mechanically operated through the rotating shaft of the wheels of the cart using an efficient mechanism. This will result into the reciprocating motion of the piston and hence pumping will be done. The user will now just have to pull the cart and the whole mechanism will be operated with ease. This will be a case of Pure Mechanical Automation

Keywords- Sprayer, Pesticide, Nozzle Pressure, etc.

I. INTRODUCTION

Agriculture plays a vital role in Indian economy. Around 65% of population in the state is depending on agriculture. Although its contribution to GDP is now around one sixth, it provides 56% of Indian work force. The share of marginal and small farmer is around 81% and land operated is 44 % in 1960-61. As far as Indian scenario is concerned, more than 75 per cent farmers are belonging to small and marginal land carrying and cotton is alone which provide about 80 % employment to Indian workforce. So any improvement in the productivity related task help to increase Indian farmer's status and economy. The current backpack sprayer has lot of limitation and it required more energy to operate.

The farmers who use conventional backpack sprayers faces many types of problems like fatigue, tiredness, pain in spiral cord and muscles etc. Following problems can take place by use of this conventional type of pump:

1. Heavy in weight causes difficulty in lifting manually.
2. Fatigue to the operator due to heavy weight.
3. Due to heavy weight during spraying, operator feels very tiredness and fatigue, which reduces his efficiency.
4. Big size of pump cause inconvenience to the operator.
5. Poor selection and quality of equipment. These problems combined with a lack of awareness and technical knowledge.

In the light of above, it becomes essential to search for alternative fuel, which can replace the petroleum products. The production of Cashew nut shell liquid is very simple and its auto-ignition properties are almost same as that of diesel fuels hence can be used in diesel engines with little or no engine modifications. Based on these facts, cashew nut shell liquid can be used as a substitute of diesel fuel.

India is the fifth largest cotton producing country in the World today, the first-four being the US, China, Russia, and Brazil. Our country produces about 8% of the World cotton. Cotton is a tropical plant.

It is a vegetable oil extracted from the soya bean, after the soya bean lint has been removed after being freed from the linters, the seeds are shelled and then crushed and pressed are treated with solvent to obtain the crude soya bean oil. Soya bean oil is one of the most widely used oil and it is relatively in-expensive and also readily available.

An objective of the present work aims to find out suitability of soya bean oil, and its blends with diesel. In this project soya bean oil and diesel blends are taken up for study on 5 HP, Single cylinder, four stroke, water cooled Kirloskar AV 1 model diesel engine and performance for different blends is tested and performance curves are drawn. Diesel either partially in the form of a blend or as a total replacement

II. SPRAYER

A sprayer is a device used o spray a liquid. In agriculture, a sprayer is a piece f equipment that is used to

apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors, with boom mounts of 60 –151 feet in length.

Knapsack Power Sprayer:

Any sprayer which is carried on the back of the operator is called a knapsack sprayer. The commonly used manually operated knapsack sprayer will have one hydraulic pump working inside the container. The plunger works inside the replacement well attached at the bottom of the container, for easier maintenance. The pump can be operated through the appropriate linkages by oscillating the handle, with the sprayer carried on the back. An agitator is also provided with the pressure chamber to agitate the fluid so that the particles in suspension will not be allowed to settle down. A delivery tube is attached on the other end of the pump which carries the pressurized fluid to the spray lance. The knapsack sprayer develops 30 - 40 psi pressure.

Knapsack Power Sprayer easy to use and highly durable. Designed in sync with the industrial standards, these sprayers are immensely used for garden spraying-weed, pest control, liquid fertilizing and plant leaf polishing. The general technical specifications of the sprayer are given in Table -1.

Table.1 Sprayer Specification

Parameters	Specification
Spraying Capacity	8 litres per min
Capacity of Chemical tank	25 Litres
Net Weight	10.5 kg

III. COMPONENTS OF A SPRAY PUMP

Every Spray pump must have:

1. A cut-off valve
2. An extension rod-straight or goose-neck
3. An appropriate nozzle

Cut-off valves are spring-activated (trigger control) or operated by means of a simple knob or trap.

Extension rods are Comes in varying lengths, according to customer requirements but lengths longer than 90 cm are difficult to handle.

Nozzles are used primarily where plant foliage penetration is essential for effective insect and disease control, and where drift is not a major consideration.

CONSTRUCTION AND WORKING

The construction and working set up for this study is shown in Figure 1.The wheel powered spray pump has a wheel. This wheel is connected to the crank through the chain. The connecting rod connects the crank and the piston of the pump. Tubes are provided for the spraying of the pesticide. The no. of nozzles provided to spray the pesticides. This device no needs any power requirements. Handles are provided to control the device.

Crank-Slotted Mechanism:

In crank-slotted mechanism crank is connected with slotted connecting rod. One end of connecting rod is connected with crank and the other end of rod is connected with the piston rod of pump. Center of this rod is fixed with the frame of trolley and the rod is oscillating on this point. This mechanism converts rotary motion into reciprocating motion.

So this mechanism converts sprockets rotary motion into reciprocating motion of piston of pump.

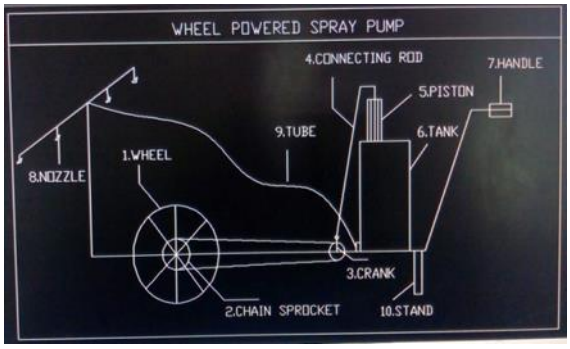

Figure 1: Construction of Wheel Powered Spray Pump

When we push the trolley, the wheel rotates, wheel connected to the crank trough the chain. So due to rotation of wheel the crank also rotates. This pulley is connected with piston by the connecting rod, this are worked under crank slotted mechanism. This mechanism converts rotary motion into reciprocating motion.

So due to reciprocation of piston the pressure develops in the hydraulic pump. In manual operation of pump this pressure can be developed by oscillating the handle of pump. So by this mechanism we can easily develop the pressure in the pump. This pressure chamber and other end is connected with the nozzle. Thus, the pressurized pesticide-water mixture comes in the discharge line and from there this mixture is come outside by the help of nozzle. So, in simple words when we push the trolley the wheel rotates which is rotating the crank which is connected with piston by the connecting rod. The piston of

pump is reciprocated and pressure develops inside the hydraulic pump. So the pressurized pesticide comes in the discharge line of pump. At the end of discharge line there are cut off valve by which we can control the pressurized pesticide and increase or decrease the flow of pressure.

The length of discharge line is adjustable so by adjusting the position of delivery pipe we can adjust the length of discharge pipe. When the distance between two rows of plant is more. Then we can increase the length of discharge pipe, so we can easily spray the pesticide to these rows and when this distance is so closed. Then we can decrease the length of discharge pipe and spray the pesticide easily. So in both situations we can easily spray pesticide very effectively. This is advantage of this mechanism.

IV. DESIGN CALCULATION

Selection of Wheel

Distance between two plants = 1.25 feet = 38 cm.

Line covered by one rotation of wheel = 4

38 * 4 = 152 cm

$152 = 2\pi r$

$r = 152/2\pi$

r = 25 cm

The diameter of wheel = 50 cm

Selection of Chain

Chain type roller chain.

ISO Chain no. 05B

Pitch = 0.25 mm

Discharge:

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

Discharge = Piston Area × stroke length × Speed

$$Q = \frac{\pi}{4} \times D^2 \times L \times N$$

$$Q = \frac{\pi}{4} \times (0.65)^2 \times 0.5 \times 0.6$$

$$Q = 0.00995 \ \frac{m^3}{s}$$

Normal speed in rpm

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

$10 \times x = 6$

$x = 0.6$

The no. of revolution in 1 second is 0.6 then how many revolution in 1 minute (60 seconds) $x = 0.6 \times 60$

$x = 36$

Normal speed in rpm = 36 rpm

5. COST ESTIMATION

The cost spends for the every parts of the device is explained in the following table.2

Table.2 Cost estimation

S.No.	Item	Quantity	Cost in Rupees
1	Wheel	2	750
2	Spracket	1	100
3	Chain	1	50
4	Crank	1	50
5	Connecting rod	1	120
6	Tank with piston	1	1500
7	Frame & handle	1	500
8	Ball bearing	2	150
9	Nozzle	2	120
10	Tube	5 metre	150
11	T joint	3	75
12	Welding- labour	-	500
13	Nut & bolt	-	58
14	Clamp	8	64
		Total	**4187**

V. RESULT

This project is definitely used for the future of agriculture and its cost also minimum so we can use this project in many agricultural places.

And also it reduces the time consumption to spray the pesticides. So it is definitely used for the growth of the agriculture.

The advantages of this pump over a traditional pump was tabulated in the following table.3

Table.3Comparison between
Traditional Vs Proposed

By Traditional Method	By Proposed Machine
Labour cost = Rs. 400 /day	Labour cost = Rs. 200 /day
Cost of Pump Rs 3000 -4000	Low Cost
A labour can spray 3 acre of land in one day	Can spray 6 acre of land per day
Operating cost is high (approximately Rs.5600 /day)	Operating cost is moderate (approximately Rs.3500 /day)

VI. CONCLUSION

The suggested model has removed the problem of back pain, since there is no need to carry the tank (pesticides tank) on the back.

As suggested model has more number of nozzles which will cover maximum area of spraying in minimum time and at maximum rate.

The c.f. valves can also be applied which help in reducing the change of pressure fluctuation and c.f. valves helps to maintain pressure.

Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.

Imported hollow cone nozzles should be used in the field for better performance.

Muscular problems are removed and there is no need to operate the lever.

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