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MULTIPURPOSE PESTICIDES SPRAYER PUMP

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Abstract - *India is a land of agriculture which comprises of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its versatility, cost and design. But multiple pesticide sprayer pumps is combination of both knapsack & Battery operated pump for better efficiency. This one is trolley operated system by using this we can reduce maximum effort required for spraying Pesticides as well as we can Spray Pesticides in any direction or around the crops at any height of crops. This is used for weeding, plugging etc. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time.*

KeyWords: Knapsack, Nozzle, Pump, Trolley, Pesticides, etc.

1. INTRODUCTION

India is set to be an agricultural based country approximately 75% of population of India is dependent on farming directly or indirectly. Our farmers are using the same methods and equipment for the ages e.g. seed sowing, spraying, weeding etc. There is need for development of effective spraying and weeding machine for increasing the productivity. India is a land of agriculture which comprises of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its versatility, cost and design.

Multiple pesticide sprayer pumps is combination of both knapsack & Battery operated pump for better efficiency. This one is trolley operated system by using this we can reduce maximum effort required for spraying Pesticides as well as we can Spray Pesticides in any direction or around the crops at any height of crops. This is used for weeding, plugging etc. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time.

1.1 Problem Statement

A backpack sprayer consists of tank 10 -20 liter capacity carried by two adjustable straps. Constant pumping is required to operate this which results in muscular disorder. Also the backpack sprayer can't maintain pressure, results in drifts/dribbling .Developing adequate pressure is laborious and time consuming .Pumping to operating pressure is also time consuming. Moreover, very small area is covered while spraying. So, more time are required to spray the entire land. Back pain problems may arise during middle age due to carrying of 10-20 liter tank on back.

1.2 Scope & Objective

- Decrease the operational cost by using new mechanism.
- Work reliably under different working conditions.
- Decrease the cost of machine.
- Decrease labor cost by advancing the spraying method.
- Machine can be operated in small farming land (5 acre).
- Making such a machine which can be able to perform both the operation (spraying and weeding).
- Maximum area of spraying in minimum time.
- Proper adjustment facility with respect to crop size & height.
- Attach the multiple nozzle & trolley.
- No. of instrument can added such as pilling, hilling, ploughing etc.
- System is eco-friendly by using a spray guard for spraying

2. METHODOLOGY

Fig -1: Multipurpose Pesticides Sprayer System

2.1 Frame

The frame are used support the all body parts. And it is also called as cheesy the frame material is mild steel. The main functions of a frame are: To support the chassis components and body& to deal with static and dynamic loads, without undue deflection or distortion.

2.2 Connecting Link

Material selected is M.S because of its having good strength, durable & cheap. Length is selected by considering stroke length & crank radius. Length is increases or decreases by reducing or increasing stroke length.

2.3 Nozzle

Fig -2:Nozzle

The nozzle is a critical part of any sprayer. Nozzles perform three functions:

- Regulate flow.
- Atomize the mixture into droplets.
- Disperse the spray in a desirable pattern.

2.4 Storage Tank

Fig -3: Storage Tank

These types of pump operate by using a reciprocating piston. The liquid enters a pumping chamber via an inlet valve and is pushed out via an outlet valve by the action of the piston or diaphragm. Reciprocating pumps are generally very efficient and are suitable for very high heads at low flows. This type of pump is self-priming as it can draw liquid from a level below the suction flange even if the suction pipe is not evacuated.

2.5 Weed Cutter Plate

Fig -4: Weed Cutter Plate

Weeding is the process of eliminating the competition of unwanted plants to the regular crops so that crops can be grown profitably. Management of weeds is an important component of production techniques as elimination of weeds is expensive and hard to achieve. Weeds are uprooted by the teeth of the weeder and buried in the mud by push and pull Operations of the weeder.

2.6 Ball Bearing

A bearing is a machine element that constrains relative motion and reduces friction between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts.

Fig -5:Ball Bearing

3. DESIGN SELECTION

3.1 Design of Sprocket:

Material Selection – M.S
Dia. D_g= 210 mm and no. of teeth Z_g = 48…….. PSG design data book

Gross weight of system = 50 kg = 490.5 N
Radius of rear wheel R_w= 340 mm
Designed acceleration t_a= 10 sec
Coefficient of rolling resistance Cr =0.17
Gradient resistance = 0^0

1. **Gradient Resistance** = W x Cr
   = 490.5 x Sin0
   = 0
2. **Rolling Resistance** = W x C
   = 490.5 x 0.017
   = 8.3305 N
3. **Accelerating Force(F_a)**=W*C/g*t_a

   = 490.5*2/9.81*10

   F_a= 10 N

Total Tractive Force = Rolling Resistance + Gradient Resistance + Acceleration
= 0 + 8.3305 + 10

F_T= 18.03305 N

Force Required to Drive a System =18.3305 N

3.2 Pulling Force Transferred to Handle F_r:

$F_r = (F*R_h*R_2)/(R_c*R_1)$

$= (18.3305*340*105) / (250*57.5)$

$F_r = 21.886$ N

Where, R_c = Distance between two centre = 520mm

R_2= Radius of rear sprocket = 105mm

R_1= Radius of free wheel = 57.5 mm

Torque $T_1 = F_r$ x distance

$= 21.886 \times 2$

$T_1 = 43.772$N.m

Power (P) = $(2*3.14*N*T)/60$

$= (2*3.14*3*43.772) / 60$

P = 13.7513 Watt

Design of Power $P_d = P \times K_a$

Ka= application factor……PSG. Design data book

$= 13.7513 \times 1.2$

P_d= 16.5013 Watt

3.3 Design of Nozzle:

Flat Fan Nozzle (Single Hole)

Nozzle selection basis on pressure (15 to 60 psi)

(15/14.1) + 1 = 2.06 bar Total Nozzle used = 6

6 x 2.06 = 8 ≈ 12.36 bar overall pressure

To design pump at 12.36 bar pressure

Mean Effective Pressure= Power

1 = 16.501/ Swept Vol.

Swept Volume V_s=0.016501 m^3/min

3.4 Design of Connecting Link:

(r) = 8 cm Crank Radius S = 2r = 2 x 8 = 16cm

Swept Volume $= 0.785 \times d^2 \times S$

$= 0.785 \times 0.0389^2 \times 0.16$

$= 1.672 \times 10^{-4}$ m^3/Rev.

$= 1.672 \times 10^{-4} \times N$

$= 1.972 \times 10^{-4} \times 6$

$V_s = 8.242 \times 10^{-4}$ m^3/min

M.E.P = Power Developed / Swept Vol.

$= (16.501 * 60 * 1000) / (8.242 * 10^{-4})$

$= 1.20 \times 10^{-6}$ Mpa

= 12 bar

Linear Velocity (V) = Stroke Length x Angular Velocity

$= 0.0575 \times W$

$= 0.0575 \times 0.628$

V = 0.0361 m/sec

Discharge (Q) = Area x Velocity

$= 0.785 \times 0.039^2 \times 0.0361$

$= 4.3136 * 10^{-3}$ m^3/min

Q = 2.5882 L/min

4. ADVANTAGES:

- It is multipurpose machine.
- Easy to operate and user friendly.
- Very less pollution on other models.
- It is portable.
- Unit cost is very cheap one.
- Maintenances cost is low.
- Easy to assemble.
- System is eco- friendly.
- Separate Time required for weeding, ploughing, hilling etc. is reduced.

5. FUTURE SCOPES:

- The suggested model has removed the back pain problem, also by using control valve we can maintain the fluctuation pressure.
- Imported different kind of nozzle we can achieve the better performance like as hollow cone nozzle we reduce the drifting problems.
- By using a flexible hose & lance we can spray the pesticides around the crop with respect to their size from one position.

- By using a sensor a required quantity or required proportion of pesticides can be sprayed respect to crop growth requirement.

6. CONCLUSIONS:

- 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 equipment will results more beneficial when it is subjected to moist soil for weeding purpose, due to moist soil the weed cutter can easily penetrate and dig out the soil and hence will easily accomplished the weeding process.

- The performance of the equipment will increase when it is operates on the smooth surface or less uneven surface and also it will be more effective when it is used on the crops having nearly similar height and having the less space between two crops.

7. PHOTOGRAPHS:

Fig -6: Spraying Pesticides by Horizontal Lance

Fig -7: Vertical Lance Arrangement

Fig -8: Inclined Lance Arrangement

Fig -9: Spray Guard Arrangement

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