Self-Propelled Spraying Machine: A Proposed Model

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Abstract **This research paper aims to develop self-propelled spraying agricultural machine. The problems faced by farmers today are solved by developing a self-propelled spraying agricultural machine which can converted the energy obtained pushing the machine forward to spray the insecticides. The machine is made multipurpose so that it can spray insecticides just by pushing the machine forward. Since the machine is self-propelled no external form of energy is required and the energy obtained by pushing the machine itself is converted into necessary mechanical energy for building up the pressure inside the insecticide tank.**

Keywords —Back pain, Nozzles, Pipes, and Push operated, Tires, Drive Mechanism.

I. INTRODUCTION

Agriculture plays an essential role in Indian economy [7]. In the state 65% population is depends on agriculture [11]. Although its contribution to GDP is now around 1/6th, it supply's 56% of Indian work force [7]. Nearly 75% farmers are belongs to small and marginal land carrying. Only cotton provides about 80% of employment to Indian workforce [7]. The Indian farmer's status and economy is developed due to improvement in productivity related task [7].

In our country the service and industries sector development is increased day by day but farming is done by the traditional way [10] [1]. In agriculture sector spraying is done traditionally by labor carrying knapsack type sprayer andwhich requires more human effort [8]. To overcome the problem, we made a loyal attempt to minimize human efforts and development of the equipment which will be beneficial to the farmer for the spraying purpose [10].

To fulfill the requirement of food modernization of agriculture sector are important because the Indian population is increasing day by day [11]. Most of the farmers are attracted towards organic farming because chemical fertilizers decreases fertility of soil. In spraying devices fertilizers and pesticides are distributed equally on the farm by mechanization 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 [17]. Farmers are using same traditional methods for spraying fertilizers and pesticides [14]. Conventionally the spraying is done by labors carrying backpack sprayer manually [17]. The efforts required are more. It's beneficial for the farmers whose having small scale farming land [14].

II. LITERATURE REVIEW

We have studied the following research papers before starting with the actual model. The part from our study is given in the literature review. It consists of research work which is carried out by the authors.

LaukikP.Raut, Smith B.Jaiswal, Nitin.Y.Mohite [1]The author has worked on Design, development and fabrication of agricultural fertilizers sprayer with weeder. According to the authors survey the industrial and service sector has done lot of improvement as compare to agriculture sector [22]. The farmers sprays their farms by getting knapsack type sprayers which required more human efforts [1]. The weeding is generally done with the help of Bulls which becomes costly for farmers having small scale farming land [1]. So to overcome the above problems the author has design the machine which will valuable for farmers for both spraying and weeding operations.

Prof. Swati D.Kale, Swati V. Khandagale, Shweta S. Gaikwad [2], According to their research the application of pesticides and fertilizers in agricultural areas is of vital importance for crop yields. The use of aircrafts is more common in carrying out this task mainly because of its speed and efficiency. But there are some factors which affects the yield and also it can damage it. e.g. all the crop areas are not cover during the spraying process, at some part overlapping of spraying on crop areas. The climate conditions such as intensity and direction of wind creates complexity in spraying. In their research they describe unmanned aerial vehicles which can employed to control loop for the agriculture application.

S.R.Kulkarni, Harish Nayak, Mohan Futane[3], The author developed a portable foot operated agriculture fertilizer and pesticides spraying pump. According to them there are four types of cultivator are in India small, marginal, medium and rich [14].Small scale farmer use traditional way of spraying

by getting knapsack and with the help of hand pump they sprays their farms; it is user friendly equipment, it has ease of operation and cost effective machine. But it has some bad effects like it leads to human pain [7]; however this equipment can also leads to misapplication of chemical and ineffective control of target pest. This process is costly as well as hazardous to the environment [24]. Author suggested prototype of foot pump which is economical and it sprays maximum of the area within minimum time at maximum rate.

Sandip H. Poratkar, Dhanraj R. Raut[4] worked on manually operated knapsack type multi-nozzle spraying machine according to the small scale farmers who are interested in manually operated lever type machine[7]. It is low cost and its design is simple as compere to the others are in market. But this type of sprayer have some limitations like they cannot maintain the pressure throughout the spraying. But this sprayer has certain limitations like it cannot maintain required pressure, loss of pest due to dribbling or drift during operation [24]. This phenomenon not only adds cost of production but it also affects the environment [24].They suggest the multi-nozzle machine which performs maximum of work within minimum time. Constant flow valve can apply to nozzle for having equal supply through the nozzles [4].

III. PROPOSED METHODOLOGY

The methodology for the design of our project model is given as follows.

1) Market Study and Literature review:

2) This phase contains the study of different components available in market to fabricate the actual model. The required material is chosen from the market as per the requirement. This also involves the study of market scenario for such applications.

3) The chassis fabrication:

The chassis fabrication forms the important part as it holds the whole assembly components. The fabrication of the chassis is carried out during this phase. The chassis is fabricated in such a way that it is light in weight but it holds all the components..

4) The Scotch yoke mechanism and Push system:

In this project the scotch yoke mechanism is fabricated for making the pump crank as the machine is pushed. This phase involves development of scotch yoke mechanism and the push activated system.

5) Assembly and testing:

This is the final stage of the project which involves the assembly and testing.

IV. PROPOSED MODEL

The proposed model consist of single wheel body with Scotch Yoke mechanism [8]. The wheel is connected to mechanism with pump crank being pushed and pulled to result in pumping; building the pressure inside the tank for pesticides spraying [8]. The wheel is fixed on the front side and with the help of chain drive the mechanism pushes the piston rod in and out of the cylinder pumping the air pressure in to the tank [9].The main tank of the pesticides is fitted on the frame from which the pesticides are spread through the nozzles [8].

Figure given below shows the proposed construction and line diagram of project.

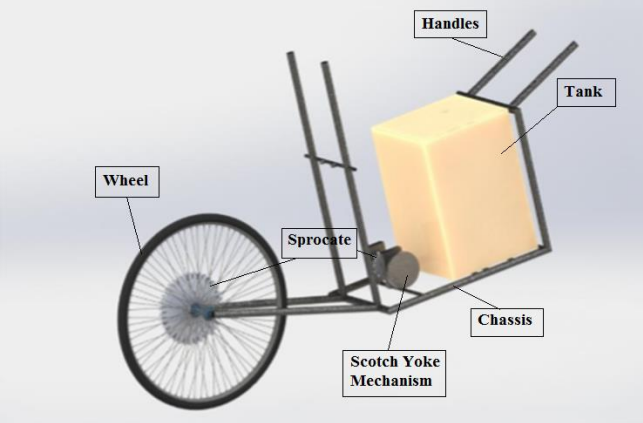

Figure 1.

When the machine is pushed in the forward direction with the help of handles wheel rotates, the sprocket mounted on the axel also starts to rotate and its rotation is then translated to the chain drive[23][7]. The mechanism connected with small sprocket changes the rotary motion which moves the rod connected to the mechanism in upward and downward direction [8]. The pressure is get generated inside the tank. Further the nozzles are connected with the help of connecting tubes through which the fertilizers are spread [9]. The nozzles can be adjusted as per the requirement of spraying crop area.

DESIGN CALCULATIONS

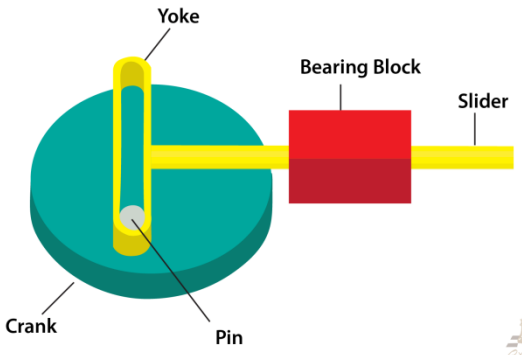

Figure 2.

Design of Scotch Yoke mechanism

L = 2r where r= radius

Therefore, r = 80mm Diameter of scotch disc D = 160 mm
Connecting rod length,
Lr = 300mm Thickness of disc, $Ts = 0.022Dto\ 0.033D$
Considering standard size available in the market

$$Ts = 4mm$$

Inner diameter of yoke pin,

$$dip = 2 \times = 8mm$$

Outer diameter of yoke pin,
$0p = 2.5 \times Ts$ $= 10\ mm$ Length of yoke, $= 160\ mm$
Angular velocity of scotch disc,

$$\omega = 2\Pi N\ 60$$

Where N=speed of connecting rod=208 RPM

$$\omega = 21.78\ rad/s$$

1. Cranking speed:

Assume the farmer is moving the machine at 10 RPM Speed of the Machine: Nm =10 RPM.
Wheel sprocket Teeth T1=44 Driven sprocket teeth

T2= 14

Therefore we have to find the wheel speed.

$$Nw\ /Nm = T1/T2$$

$$Nw = (T1/\ T2) \times Nm$$

Substituting the values in above formula we get speed of Crank Disc

$$Nw = 31RPM$$

For scotch and Yoke mechanism one stroke of is completed in 1 Revolution of crank
i.e. K=1
Stroke length of scotch-yoke mechanism L = 2r
Where r is the radius of the wheel.

In our case r = 80 mm

So $= 160\ mm$

Number of strokes

$$N = Speedofthewheel = Nw = 31$$

Therefore we know Velocity of Cranking the Sprayer pump

Vc = (L x N x (1 + K))/1000 m /min

Ratio of return time to cranking time $K = 1$
Therefore velocity of cutting pump cracking after substituting in the above equation.

$$Vc = 9.92\ m/min$$

V. STANDARD COMPONENTS

There are number of components are in the market for the fabrication machine [18]. However choosing optimum material was necessary for the better quality of model and it should be low cost as well [19].

Our project began with choosing appropriate material for chassis. The chassis is main component of our system as it holds the all assembly [18].

Selection of frame material: Since the chassis or frame is main part of system so care has to be taken while choosing the material for it [18]. The ideal requirement while choosing the material for frame are a) It should have enough space for all the components to mounted on it. b) Should be strong enough to sustain load. c) Should be economical. d) It should be light in weight.

Following two materials are ideal for chassis fabrication. The mechanism selection: Since the project involves development of push operated multipurpose machine with the major application being spraying, the mechanism needs to develop to convert rotary motion of the wheels of the machine into linear motion. There are Different mechanisms available for converting rotary motion to linear motion. We have chosen scotch yoke mechanism as it is economical and maintenance free.

The scotch yoke mechanism is constructed with iron bars. Here the crank is made in some length and the yoke is also made using the same material. It is noted that the minimum length of the yoke should be double the length of the crank. The crank and yoke is connected with a pin. Iron bars are welded to both sides of the yoke to get the reciprocating motion. The yoke with the iron bars is fixed on the display board with the help of c clamp. Now the crank is welded to the end of the shaft of the motor. Now the pin on the crank is connected to the yoke. The pin used to connect yoke and crank is a bolt.

In our project as the wheel rotates, the scotch yoke mechanism converts rotary motion of the wheel to linear one which is used for cranking the pump which builds up the pressure in the pump there by implementing the spraying operation.

The following operations were carried out during fabrication:

1. Cutting
2. Welding
3. Turning
4. Grinding
5. Finishing

VI. COCLUSION

When the equipment is pushed forward by using handles, wheel rotates and gives motion to the sprocket mounted at the axel of wheel. Then its rotation is transferred to the driven through chain drive.

- There is no need to operate the lever, therefore muscular problems are removed.
- The developed machine no need to carry the tank on the back, so problems like back pain are eliminated [7].
- Developed machine has no. of nozzles which will beneficial to cover maximum area of spraying in the farm in short time and also at maximum rate [7].
- Glass is provided for safety purpose to the machine to eliminate health related issue.
- As compared to existing machineries this machine proves that the single wheel operated machine can work very efficiently within short time and cover maximum area.

- Also it seem economical due to manual operation, therefore self-propelled spraying it become more economical.

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