

Fabrication of Automatic Agriculture Pesticides Spraying Machine

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Abstract - Spraying of pesticides and other chemicals in the farm is a tedious and laborious task. The mechanically operated conventional fully manually operated sprayers available in the market require manual effort to operate. In this project we'll take a look at Mechanically Operated as well as Solar Operated Sprayer. In this equipment rotary motion of tire is converted into reciprocating motion and this is attached to piston of pump so pressure is generated and by using controller sprayer is operates.

Solar panel generates the power that power is dc power its positive and negative charges are connected to a battery in order to save the power. A hydraulic motor which runs on dc supply is attached to the battery and by using switch it operates. We can also adjust the height of sprayer and direction of spray that in vertical or horizontal direction as well as put spraying unit at appropriate height. In this way the "AUTOMATIC PESTICIDE SPRAYER" operates efficiently and effectively.

Keywords: Solar Panel, Water pump, Battery.

I. INTRODUCTION

Spraying of pesticides and other chemicals in the farm is a tedious and laborious task. The mechanically operated conventional fully manually operated sprayers available in the market require manual labor to operate, and nowadays labor is difficult to find due to interest of farm laborers toward cities. The small farmers cannot afford to buy the power operated sprayer available in the market, as these are very costly and are of not much use to small farmers due to small land holdings.

In this project we'll take a look at mechanically operated as well as solar operated sprayer i.e. it operates mechanically as well as on solar energy. In this sprayer rotary motion of tire is converted into reciprocating motion and this is attached to piston of pump so pressure is generated and sprayer is operates by using controller .A hydraulic motor which runs on dc supply is attached to the solar panel the solar panel generates the power that power is Direct Current power its positive and negative charges are connected to a battery in order to save the power and use it when the sun rays are not present by using this device we can spray pesticide to the herbs and plants and any agriculture spraying with control by using switch.

We also adjust the height of sprayer and direction of spray that in vertical or horizontal direction as well as put spraying unit at appropriate height. If crops are small then we can spray pesticide by tilting sprayer in horizontal direction and at appropriate height and if height of crop is more then we put sprayer unit vertically and at appropriate height.

II. LITERATURE REVIEW

2.1 Spraying Methods:

One of the common forms of pesticide application, especially in conventional agriculture, is the use of mechanical sprayers Backpack (Knapsack) Sprayer:

2.1.1 Knapsack Sprayer:-

One type of backpack sprayer is a compressed air sprayer with a harness that allows it to be carried on the operator's back. Another type of backpack sprayer has a hand operated hydraulic pump that forces liquid pesticide through a hose and one or more nozzles. The pump is usually activated by moving a lever. A mechanical agitator plate may be attached to the pump plunger. Some of these sprayers can generate pressures of 100 pounds per square inch (psi) or more. Capacity of both these types of backpack sprayers is usually 5 gallons or less



Fig.1: Knapsack Sprayer

Hydraulic sprayers consist of a tank, a pump, a lance (for single nozzles) or boom, and a nozzle (or multiple nozzles). Sprayers convert a pesticide formulation, often containing a mixture of water (or another liquid chemical

carrier, such as fertilizer) and chemical, into droplets, which can be large rain-type drops or tiny almost-invisible particles. This conversion is accomplished by forcing the spray mixture through a spray nozzle under pressure. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced, or a combination of both. Large droplets have the advantage of being less susceptible to spray drift, but require more water per unit of land covered. Due to static electricity, small droplets are able to maximize contact with a target organism, but very still wind conditions are required. But, in this type of spraying, the labour has to carry all the weight of the pesticides filled tank which causes fatigue to labour and hence reduces the human capacity.

2.1.2 Lite-Trac:-

A trading name of Holmes Farm Supplies Ltd, a manufacturer of agricultural machinery registered in England and based in Peterborough. The Lite-Trac name comes from "lite tractor", due to the patented chassis design enabling the inherently very heavy machines manufactured by the company to have a light footprint for minimum soil compaction



Fig.2: Lite-Trac

Holmes Farm Supplies Ltd agricultural products, sold under the Lite-Trac name, include tool carriers, self-propelled lime and fertilizer spreaders, sprayers, granular applicators and tank masters. Lite-Trac is currently the manufacturer of Europe's largest four-wheeled self-propelled crop sprayers. The company's products are identifiable by the combination of unpainted stainless steel tanks and booms with bright yellow cabs and detailing. A Lite-Trac crop sprayer, or liquid fertilizer applicator, mounts onto the SS2400 Tool Carrier centrally between both axles to maintain equal weight distribution on all four wheels and a low centre of gravity whether empty or full. The stainless steel tanks are manufactured in capacities of up to 8,000 litres, whilst Pommier aluminium booms of up to 48 meters can be fitted, making these Europe's largest four-wheeled self-propelled sprayers.

2.1.3 Motorcycle Driven Multi-Purpose Farming Device (Bullet Santi):-

In 1994, Mansukhbhai Jagani, developed an attachment for a motorbike to get a multi-purpose tool bar. It which addresses the twin problems of farmers in Saurashtra namely paucity of laborers and shortage of bullocks. This motor cycle driven plough (Bullet Santi) can be used to carry out various farming operations like furrow opening, sowing, inter-culturing and spraying operations. Mansukhbhai's intermediate-technology contraption proved efficient and cost-effective for small-sized farms.



Fig.3: Bullet Santi

It could plough one acre (0.4 hr) of land in less than half an hour on just two liters of diesel oil. Using motorbike-santi, the cost of weeding a typical field was found to be just Rs 8/hr because as much as 10 hr land could be covered in a single day. But, this spraying equipment needs fuel for its running and proper operation which increases its operating cost.



Fig.4: Aerial Sprayer

2.1.4 Aerial Sprayer:-

Aerial sprayer is another type of spraying; it is beneficial for the farmers having large farms. This technique is not affordable by farmers having small and medium farm. It is modern technique in agricultural field. In aerial spraying the spraying is done with the help of small helicopter controlled by remote. On that sprayer is attached having

multiple nozzles and sprayed it on the farm from some altitude. It is less time consuming and less human effort required to spray fertilizers.

III. NEED AND OBJECTIVE OF PROJECT

3.1 AIM:-

We aim at providing some mean for spraying pesticide in agriculture field which requires less human effort, considering cost effectiveness, easy to operate and portable mechanism. The basic aim of our project is to provide a way to spray pesticide in horizontal, vertical and in front direction as per crops specification with no stress to human body.

3.2 OBJECTIVE:-

Primary object of the present invention is to provide an apparatus for spraying pesticide using mechanical as well as on solar energy.

To provide cost effective, easily operated & portable sprayer.

To provide Automatic pesticide sprayer which is compact so that it can easily handle and easy to carry from one place to another.

Yet another object of the present invention is to provide a more reliable pesticide sprayer than ones which uses petrol/diesel to operate.

Yet another object of the present invention is to provide a sprayer with long life.

Yet another object of the present invention is to provide a pesticide sprayer which can be dual operated through hydraulic pump (solar panel) as well as mechanically.

IV. DESIGN

Design consists of application of scientific principle, technical information, and imagination for development of new mechanism to perform specific function with maximum economy and efficiency. Hence careful design approach has to be adopted. The total design work has been split into two parts.

System design

Mechanical design

4.1 SYSTEM DESIGN:

System design is mainly concerns the various physical constraints and ergonomics, space requirements, arrangement of various components on frame at system, man-machine interaction, no. of controls, position of

controls, working environments, of maintenance, scope of improvement, weight if machine from ground level, total weight of machine and a lot more.

In system design we mainly concentrated on the following parameter:-

4.1.1 System selection based on constraints

Our machine is used in small-scale so space is major constrain. The system is to be very compact so that it can be adjusted in small space.

4.1.2 Arrangement of various components

Keeping into view the space restrictions all components should be laid such that their easy removal or servicing is possible. Every possible space is utilized in component arrangements.

4.1.3 Man machine interaction

Friendliness of machine with the operated that is operating is an important criterion of design.

4.1.4 Chances of failure

Losses incurred by owner in case of any failure are important criterion of design. Factor of safety while doing design should be kept high so that there are less chances of failure. Moreover periodic maintenance is required to keep unit healthy.

4.1.5 Servicing facility

Layout of components should be such that easy servicing is possible. Those which require frequent servicing can be easily disassembled.

4.1.6 Scope of future improvement

Arrangement should be provided in such way that if any changes have to be done for future scope for improving efficiency of machine.

4.1.7 Height of machine elements from ground

All the elements of the machine should be arranged to the height from where it is simple to operate by operator. Machine should be slightly higher than the waist level, also enough clearance should be provided from the ground for cleaning purpose.

4.1.8 Weight of machine

Total weight depends on the selection of material of all components as well as their dimensions. Higher weight will result in difficulty in transportation; it is difficult to take it to workshop because of more weight.

4.2 Selection Of Motor, Battery & Solar Pannel:-

4.2.1 According To Spraying Capacity & Discharge Capacity of Spray Motor is Selected

Weight Of The Motor : 275gm (Approx.)

Current :4.69amp

Operating Voltage : 12.4v

Motor Speed: 1,600 Rpm.

Discharge Capacity : 500-600 M3/Sec

Fluid Pressure : 1.6kgf/Cm2

4.2.2 According To Motor Operating Power Battery is Selected

Weight Of The Battery: 3.4 Kg.

Cost Of The Battery : Rs.1445

Output Power: 28 Watt.

Operating Voltage : 12.4v

4.2.3 According To Battery Output Power Solar Panel Is Selected

Power : 5 Wp +/- 3%

Dimension : 397*278*25 Mm

Weight : 1.6 Kg

Open Circuit Voltage : 21volt

Short Circuit Current : 0.31amp

Operating Current: 12 Amp.

Voltage At Max Power(Vamp) : 18v

Current At Max Power(Imp) : 0.28A

4.2.3 Analytical Calculation Of Current & Charging Time Of The Battery:-

The current produced by the solar panel (I) was calculated by knowing the maximum power (P) of the solar panel and the voltage rating (V) of the battery that is given by $I=P/V$

Therefore, $I=5.88/21 = 0.28$ Ampere

Charging time (T) was computed by taking the ratio rating of battery in ampere hour (Ah) to the total current consumed by the solar panel.

$T= (\text{battery rating in ampere hour})/(\text{total current consumed by the solar panel})$

Therefore, $T=3.8/0.28=13.57$ hours

4.3 Comparison of parameters

Comparison of proposed sprayer with conventional sprayer is shown in table, it is clear from the table that the proposed sprayer is having an average value in all the aspects like weight, discharge, product cost, maintenance cost, and pressure.

Table 1 Comparison parameters

Parameter	Hand operated Sprayer	Automatic sprayer	Fuel operated sprayer
Weight	4-7 kg	5-7.5 kg	12-16 kg
Discharge	0.8-1.5 Lit/min	2-2.8 Lit/min	6-8 Lit/min
Product cost	Rs. 2000	Rs. 6121	Rs. 15000
Maintenance cost	Low	Low	High
Pressure	1.5-2 bar	4.8-5 bar	8-12 bar

4.3.1 Weight: Though the weight of the proposed sprayer is more than hand operated sprayer, the

requirement of manual effort for the operation is eliminated, and obviously the weight is less than the fuel operated sprayer.

4.3.2 Discharge: The hand operated sprayer gives a discharge of about 0.8 to 1.5 lit/min it needs the operator to operate the sprayer till the pesticides are deposited by a sufficient amount. However the fuel operated sprayer gives a discharge about 6 to 8 lit/min which leads to wastage of pesticides. These problems are eliminated in the proposed sprayer system.

4.3.3 Pressure: The hand operated sprayer having a pressure about 1.5 to 2 bar is not sufficient for large crops. The fuel operated sprayer having a pressure about 8 to 12 bar it may damages the crops. The moderate pressure achieved by the proposed device can efficient spraying.

V. CONSTRUCTION

Components of Automatic Pesticide Sprayer:-

The Main Parts of Automatic Pesticide Sprayer Are:-

5.1 Solar Plate:-

Solar Panel Is The Main Component Of The System. Solar Panel (Also Solar Module, Photovoltaic Module Or Photovoltaic Panel) Is A Packaged, Connected Assembly Of Photovoltaic Cells. The Solar Panel Can Be Used As A Component Of A Larger Photovoltaic System To Generate And Supply Electricity In Commercial And Residential Applications. Each Panel Is Rated By Its Dc Output Power Under Standard Test Conditions, And Typically Ranges From 100 To 320 Watts. The Efficiency Of A Panel Determines The Area Of A Panel Given The Same Rated Output - An 8% Efficient 230 Watt Panel Will Have Twice The Area Of A 16% Efficient 230watt Panel.



Fig. Solar Panel

Specifications:

Voltage: 21 V

Normal Operated Coil Temp: 45.5 0c

Temp Coeff. : - 1.036 W/ 0

5.2 DC Water Pump:-

For People Living In Remote Areas, Solar Water Pumps Are Usually The Only Solution As There Is No Access To Diesel. If There Is Diesel, Solar Water Pumps Are The Only Solution Or An Excellent Alternative For Diesel As The Cost Of Running Power Lines Or Diesel Pumping May Be Too Great.

A Solar Powered Water Pump Differs From A Regular Water Pump Only In That It Uses The Sun's Energy To Supply Electricity For The Pump. The Solar Panels Absorb The Sun's Energy And Convert It To Electrical Energy For The Pump To Operate. All The Pumped Water Is Stored In A Water Tank So That There Is Constant Supply Even In Bad Weather Conditions And During Night Time Where There Is Insufficient Power To Generate The Solar Water Pumps. Solar Powered Water Pumps Represent A Higher Initial Investment, However, Over A Period Of 5 Years They Represent A Cost Benefit Due To Minimal Maintenance Costs Compared To Ac Pumps Run With A Generator.



Fig. Dc Water Pump

Specifications:

Voltage : 12 Volt

Current 7 Amp

Speed 30 Rpm

5.3 Battery:-

Dc Battery Is Power Source For This Sprayer Pump. This Battery Is Charged By Solar Panel And Removable.

Specifications:

Current- 8ah

Voltage -12v

5.4 Wheels:-

A Wheel Is A Circular Component That Is Intended To Rotate On An Axial Bearing. The Wheel Is One Of The Main Components Of The Wheel And Axle Which Is One Of The Six Simple Machines. Wheels, In Conjunction With Axles, Allow Heavy Objects To Be Moved Easily Facilitating Movement Or Transportation While Supporting A Load, Or Performing Labour In Machines. Wheels Are Also Used For Other Purposes, Such As A Ship's Wheel, Steering Wheel, Potter's Wheel And Flywheel.



Fig. Wheels

Common Examples Are Found In Transport Applications. A Wheel Greatly Reduces Friction By Facilitating Motion

By Rolling Together With The Use Of Axles. In Order For Wheels To Rotate, A Moment Needs To Be Applied To The Wheel About Its Axis, Either By Way Of Gravity, Or By The Application Of Another External Force Or Torque.

Specification:

Tubeless Tires

Diameter : 60 Cm

Light In Weight

5.5 Crank (Piston Rod):-

A Crank Is An Arm Attached At Right Angles To A Rotating Shaft By Which Reciprocating Motion Is Imparted To Or Received From The Shaft. It Is Used To Convert Circular Motion Into Reciprocating Motion, Or Vice-Versa. The Arm May Be A Bent Portion Of The Shaft, Or A Separate Arm Attached To It. Attached To The End Of The Crank By A Pivot Is A Rod, Usually Called A Connecting Rod. The End Of The Rod Attached To The Crank Moves In A Circular Motion, While The Other Ends Usually Constrained To Move In A Linear Sliding Motion. The Term Often Refers To A Human-Powered Crank Which Is Used To Manually Turn An Axle, As In A Bicycle Crank Set Or A Brace And Bit Drill. In This Case A Person's Arm Or Leg Serves As The Connecting Rod, Applying Reciprocating Force To The Crank. There Is Usually A Bar Perpendicular To The Other End Of The Arm, Often With A Freely Rotatable Hand Pedal Attached.

5.6 Storage Tank With Piston Cylinder Arrangement:-

In This Tank Pesticide With Water Is Stored. A Piston Cylinder Arrangement Is Provided In This, By Using This Arrangement Presser Is Created For Spray.

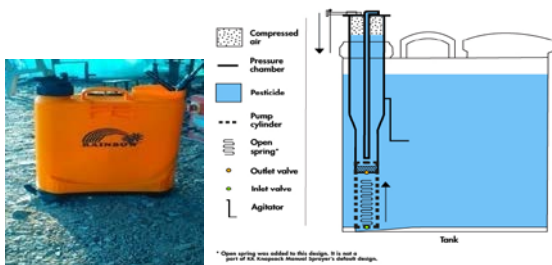


Fig. Storage Tank With Piston Cylinder Arrangement

Specifications:

20 Liters Capacity.

Light In Weight.

Leakage Free.

5.7 Chain Sprocket:-



The Chain Sprocket Is Used To Transmit Rotary Motion Of Wheels To Shaft And To Piston Rod Into Reciprocating Motion Of Piston.

5.8 Spraying Units:-

It Consist Of Two Unit In Which Four Nozzles Per Unit. In Each Unit Three Nozzles Are Used For Spraying The Pesticide While One Nozzle Is Use For Motor Connection.

5.9 Nozzles:-

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.

The Hydraulic Spray Nozzle Used In The Application Of Pesticides Has Several Functions. One Of Its Main Purposes Is To Convert The Spray Solution Into Droplets For Efficient Target Coverage. The Target May Be Foliage, Bark, Stumps, Soil Or Insects. In Association With Other Variables, E.G. Height Above Target, Travelling Speed, Operating Pressure, The Nozzle Also Has A Role In Spray Pattern Delivery, Volume Rate Delivered And Sprays Quality Produced. Various Nozzle Types Are Required To Accomplish These Roles Within A Range Of Operating Variables. Nozzles Are Generally Best Suited For Certain Purposes And Less Desirable For Others. In General, Herbicides Are Most Effective When Applied As Droplets Of Approximately 250 Microns; Fungicides Are Most Effective At 100 To 150 Microns, And Insecticides At About 100 Microns. Nozzles Determine The Rate Of Pesticide Distribution At A Particular Pressure, Forward Speed And Nozzle Spacing. Nozzles Made From Harder Metals Usually Cost More But Will Usually Wear Longer.

5.10 Pipes:- The Steel Pipes Are Used For Spraying Unit To Which Output Of Piston Cylinder Is Attached As Well As Motor Output Pipes Are Attached Nozzles Are Fitted On This Pipe. And A Plastic Tubes Are Used To Connect Pump To Spraying Unit.

5.11 pedestal Bearing:- A Cylindrical Hole Formed In A Cast Iron Machine Member To Receive The Shaft Which Makes A Running Fit Is The Simplest Type Of Solid Journal Bearing. Its Rectangular Base Plate Has Two Holes Drilled In It For Bolting Down The Bearing In Its Position As Shown In Figure. An Oil Hole Is Provided At The Top To Lubricate The Bearing. There Is No Means Of Adjustment For Wear And The Shaft Must Be Introduced Into The Bearing Endwise. It Is Therefore Used For Shaft, Which Carry Light Loads And Rotate At Moderate Speeds.

Specification :

Typev : Pillow Black

Model Number: P205

Unit Number : Ucp204d1

Inside Diameter: -20 Mm

Length :-127 Mm

Bolt Size :-10 Mm

Weight:- 0.49 Kg

Material Gray Cast Iron Or Ductile Iron

Colour : Green , Blue Or According To Customer's Requirements

VI. WORKING PRINCIPLE

In this sprayer rotary motion of wheels is converted into reciprocating motion and this is attached to piston of pump so pressure is generated and sprayer is operates. And also operated on solar energy. This project operates mechanically as well as on solar energy. In this sprayer rotary motion of tire is converted into reciprocating motion and this is attached to piston of pump so pressure is generated and sprayer is operates. The design is also accomplished by the use of solar panel, a centrifugal pump which runs on dc supply is attached to the solar panel the solar panel generates the power that power is dc power its positive and negative charges are connected to a battery in order to save the power and use it when the sun rays are not present by using this device we can spray pesticide to the herbs and plants and any agriculture spraying. Mechanically operated as well as solar operated sprayer i.e. it operates mechanically as well as on solar energy. In this sprayer rotary motion of tire is converted into reciprocating motion and this is attached to piston of pump so pressure is generated and sprayer is operates by using controller. A hydraulic motor which runs on dc supply is attached to the solar panel the solar panel generates the power that power is dc power its positive and negative

charges are connected to a battery in order to save the power and use it when the sun rays are not present by using this device we can spray pesticide to the herbs and plants and any agriculture spraying with control by using switch.

We also adjust the height of sprayer and direction of spray that in vertical or horizontal direction as well as put spraying unit at appropriate height. If crops are small then we can spray pesticide by tilting sprayer in horizontal direction and at appropriate height and if height of crop is more then we put sprayer unit vertically and at appropriate height.

VII. CONCLUSION

The proposed sprayer gives the average values in all aspects like weight, discharge, pressure and cost.

The proposed sprayer requires 10 hours for complete charging and fully charged battery gives 4 hours of backup to application. It reduces the discomfort to operator while spraying and it creates the awareness about renewable energy to the farmers. The proposed system has got very good aesthetic design and the operator feels easy to operate this new sprayer because of it is light weight, easy to carry, portable and environment friendly. The proposed sprayer is most suitable for small and medium scale farmers and remote areas like field, forest where fuel is not available easily.

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