Design and Fabrication of Solar Operated Sprayer for Agricultural Purpose

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***Abstract*—** Today's Energy Demand is the great challenge for our Socitye. Conventional Energy (fossil fuel,coal, nuclear energy etc) can be widely used in India such as Textial industry,Power plant etc. using Conventional Energy there are many Exhaust that can be come out after pollutant which is harmful to our Environments, In Such situation we should move towards some Non-conventional energy (Solar energy,Wind energy,Tidal energy) Non-conventional becomes very popular for all kinds of developments activites such as drying agriculture product,irrigation purpose and for spraying purpose, In this paper we are trying to make unique equipment for cultivation users. My contribuction on my project is that from enquri on 20 framer I can collect data regarding spraying and how exactly farmer can facing problem while spraying. farmers mainly use hand operated or fule operated spray pump for this task.this conventional sprayer causes user fatigue due to excessive bulky and heavy construction. This motivated us to desing and fabricated a model that is basically trolly based solar sprayer In our project here we can eliminating the back mounting of sprayer bcz Ergonomically it is not good for farmer health point of view during spraying in this way here we can reduce the users fatigue level.

Keywords*-Solar Panel, Renewable Energy, Fertilizer, sprayer, DC Pump.*

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I. INTRODUCTION

Spraying of pesticides is an important task in agriculture for protecting the crops from insects. Farmers mainly use hand operated or fuel operated spray pump for this task. This conventional sprayer causes user fatigue due to excessive bulky and heavy construction.

This motivated us to design and fabricate a model that is basically trolly based solar sprayer

In our design,here we can eliminate the back mounting of sprayer ergonomically it is not gud for farmars health point of view during spraying.in this way here we can reduce the users fatigue level.

There will be elimination of engine of fuel operated spray pump by which there will be reduction in vibrations and noise. The elimination of fuel will make our spraying system eco-friendly. So with this background, we are trying to design and construct a solar powered spray pump system.

Now days there are non conventional energy sources are widely used. The energy which is available from the sun is in nature at free of cost. In India solar Energy is available around 8 months in year .so it can be used in spraying operation.

Solar pesticide sprayer can give less tariff or price in effective spraying. Solar energy is absorbed by the solar panel which contains photovoltaic cells. The conversion of the solar energy into electrical energy is done by these cells. This converted energy utilizes to store the voltage in the DC battery and that battery further used for driving the spray pump.

II. CLASSIFICATION OF SPRAYING SYSTEMS

In india there are different different types of sprayer can be used according to the grouth of different types of crops as fallow:

1)Hand operated sprayer.
2)Engine operated sprayer/fule operated sprayer.
3)Electric moter pump sprayer.

1)Hand operated sprayer

hand operated sprayer is operated by hand so that the discomfort occur while spraying.

2)Engine operated sprayer/fule operated sprayer

As we know that engine operated sprayer is working on petrol.petrol is costly fule so in farmer economical point of view it is not gud.

3)Electric moter pump sprayer.

Electric moter pump sprayer is used electricity for charging battery.in this way the pump can e drive according to battery charging, In the above sprayer there are some drawbacks such as

1)hand operated sprayer can not be use continuslye spraying.we can say that it can not be use for long time.
2)engine operated sprayer can be operated on petrol so it is not possile to use every farmer.
3)here 70% of people can be live in rural areas. in rural areas there are insufficent electricity. so it is not possible to use electric moter pump for spraying.

III.DESIGN APPROACH AND EXPERIMENTAL SETUP.

Methodology :

Design and fabrication of solar powered pesticide sprayer has following steps,

Selection of components

The selection of component has been done according to the requirements .following are the list of components,

1. Tank
2. Solar panel
3. DC Motor
4. DC Battery
5. Nozzle type

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6. Connecting pipe/boom
7. charge controller
8.Trolly Assembly
9. Mounting element

Tank -
Pesticide tank has capacity of 25 liters.PVC material tank is use for it .
Solar panel -
Solar panel is the main component of the system.
It has the following specifications,
Capacity of panel - 40 watts
Panel Size : 355×295×20mm
Weight of the panel : 1.306 kg
Maximum Power : 10 W
Voltage @max. Power : 16.5 V
Current @max. Power : 0.61 A

DC motor -
DC motor is used to lift the pesticide from tank and delivers to the spray gun. DC motor has following specifications,
Weight of the motor : 500 gm.
Operating power required : 10 W
Operating voltage : 12 V
Operating current : 0.8 A
Motor speed : 1500 RPM
Liquid Discharge : 1ltr/Min

DC battery -
Weight of the battery : 2.5kg
Cost of the battery : 1050 ₹
Operating voltage : 12v
Rated current : 8 Ah

Nozzle type
Six (6) Full cone nozzle of Discharge rate 0.5 Lt/min.

Solar energy obtained by the sun is converted into electrical energy using solar panel by photovoltaic effect. The out put of the energy conversion is given to charge a deep cycle lead acid battery through a charge controller. The charge controller limits the rate at which electric current is added to the battery.preventing overcharging and protecting against over voltage. It employs the Pulse Width Modulation (PWM) technique which gradually stops charging the battery, The main advantage of PWM is that the power loss in the switching device is very low.
The output from the chargecontroller is given to the battery by a 3 pin socket through an electrical network as shown in Fig. 1.

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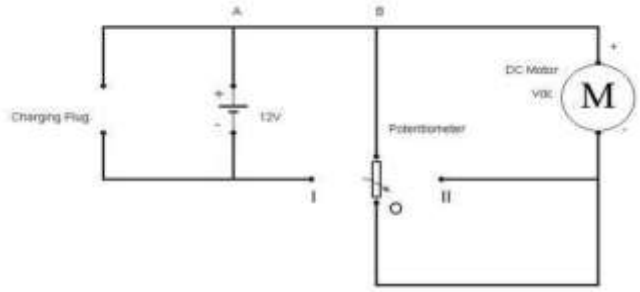

figure1.Electric Circuit for speed control of moter.

Figure 2. Trolly Based Solar Operated Pesticide Sprayer.

The circuit has 3 states.

1) **O state**
In this state, the switch is off. The circuit is in the dead state but the battery will be charged through the plug.

2) **II state**
In this state, the 2nd part of the circuit is switched on. VA=VB=12V. Hence, there is no current flowing through theconnecting wire AB here the plug charges the battery but the motor does not run.

3) **I state**

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In this state, the switch is turned to I. Thus, the entire circuit is switched on. The motor operates while there is simultaneous charging of the battery through the plug. The motor's RPM is controlled by the value of the variable resistance.

The output of the dc motor is used to actuate the diaphragm of the diaphragm pump for pumping the fluid

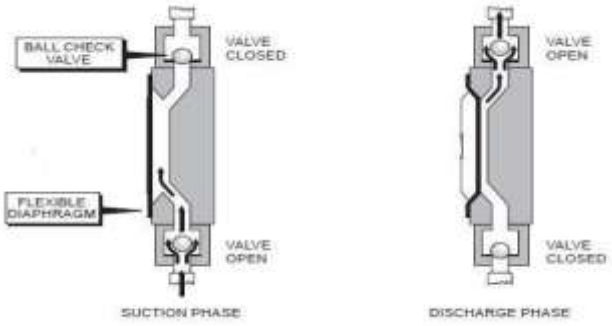

figure3.Working of water diaphragm pump.

IV. DESIGN CALCULATIONS.

According to Spraying Capacity & Discharge Capacity Of Spray pump Is Selected
Type : Centrifugal Pump.
Liquid Discharge : 0.5lit/min to 1lit/min.
Speed : 1500 rpm.
Suction Head (hs) = 0.5m.
Discharge Head (hd)= 3m.
Suction pipe Diameter : 12mm =12*10^-3m.
Discharge pipe Diameter : 8mm =8*10^-3m

Overall Efficiency Of The Pump
$\eta = \frac{W*Hm}{1000}$/S.P.
Where, S.P = Power Required To Drive The Pump.
Hm = Monometric Head (in m)
η= Overall Efficiency Of The Pump (Assume it is 60%)
$\eta = \frac{\rho*g*Q*Hm}{1000}$/S.P
$\eta = \frac{\rho*g*Q*Hm}{1000*S.P}$
$\eta = \frac{1000*9.81*8.33*10^{-6}*Hm}{S.P}$ where, Q= 1lit/min= 1.66*10^-5 m^3/sec.
Assume Overall Efficiency of Pump η=60%
Hm= Manometric Head.
$Hm = (\frac{Po}{\rho*g} + \frac{Vo^2}{2*g} + Zo) - (\frac{Pi}{\rho*g} + \frac{Vi^2}{2*g} + Zi)$
Where , $\frac{Po}{\rho*g}$ = Pressure head at outlet of pump (hd) = 3m.
$\frac{Vo^2}{2*g}$ = Velocity head at outlet of pump = $\frac{Vd^2}{2*g}$
$\frac{Pi}{\rho*g}$ = Pressure head at inlet of pump (hs) = 0.5m.
$\frac{Vi^2}{2*g}$ = Velocity head at inlet of pump = $\frac{Vs^2}{2*g}$
$Hm = (\frac{Vd^2}{2*g} + 3) - (0.5 + \frac{Vs^2}{2*g})$

Vd(Velocity at Discharge)= $\frac{Discharge}{Area\ of\ Delivery\ pipe} = \frac{1.66*10^{-5}}{\frac{\pi}{4}*8*10^{-3}}$
= 2.16*10^-3 m/sec.
Vs(Velocity at Suction) = $\frac{Discharge}{Area\ of\ suction\ pipe} = \frac{1.66*10^{-5}}{\frac{\pi}{4}*12*10^{-3}}$ = 1.76*10^-3 m/sec.
$Hm = 3 + (\frac{(2.16*10^{-3})^2}{2*9.81}) - 0.5 + (\frac{(1.76*10^{-3})^2}{2*9.81})$
Hm = 14.71-2.45
Hm = 12.26 meter.
Now,
We know that ,
Overall Efficiency of the pump
$\eta = \frac{W*Hm}{1000}$/S.P.
putting the above value in the equation, we get the power of pump.
Rearrangement of Above equation
$S.P = \frac{\rho*g*Q*Hm}{1000*\eta}$
$= \frac{1000*9.81*1.66*10^{-5}*12.26}{1000*0.60}$
= 3.327*10^-3
= 0.00327*10^3
= 3.27 Watte ~ 3.50 Watte .
Power required to the pump is 3.50 Watte.

According To Pump Operating Power Battery Is Selected
Type : Lead Acide Battery.
Voltage : 12 V
Current : 7 Amp
Power = Voltage*Current
= 12*7
= 84 Watte(Maximum power when the ckt is open)
When the circuit is short then,
Voltage: 12 v
Current: 1.5 Amp
Power = Voltage*Current
= 12*1.5
= 18.Watte

Cost of the battery : Rs.1200

According to Battery Output Power Solar Panel Is Selected
Power : 20 watt
Dimension : 397*278*25 mm
Weight : 1.6 kg
Open Circuit Voltage : 21.5 volt
Short Circuit Current : 0.82Amp
Operating Current : 12 Amp.
When the Battery is connected to the Solar Panel Through Charge Controller then some amount of load is Applied on solar Panel (that is short ckt)
Actul power of Solar Panel = voltage* short circuit current
= 21.5*0.82
= 17.63 Watte.

Theoretical calculation of current and charging time of the battery.
(i).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 =20/12=1.66Amp

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

T =battery rating in ampere hour/ total current consumed by the solar panel

Therefore,

T = 7/1.66=4.21 Hrs.min

V. ADVANTAGE

More economical
Easy to clean and maintain
It is a renewable energy source
It does not create air pollutant & noise
Easy to handle
Do not required fuel hence cost reduce for spraying

VI. CONCLUSION

The solar powered agricultural pesticide sprayer has been fabricated according to the design parameters My project aim was to confomt the farmer while spraying due to trolly based sprayed here we can elimantaed back mounting of spayer and it is gud for farmer health point of view Ergonomically

VII. REFERENCEES

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