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Solar operated pesticide sprayer for agriculture purpose

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Abstract - *Sprayers are mechanical devices that are specifically designed to spray liquids quickly and easily. They come in a number of different varieties. In this project we'll take a look at solar operated mechanical sprayers. A sprayer of this type is a great way to use solar energy. Solar based pesticides sprayer pump is one of the improved version of petrol engine pesticide sprayer pump. It is vastly used in the agriculture field & also used for many purposes. This is having more advantages over petrol engine sprayer pump. It uses the solar power to run the motor. So it is a pollution free pump compared to petrol engine sprayer pump. In this charged battery can also use for home appliances like glowing of CFL bulbs, mobile charging etc The solar panels make up most (up to 80%) of the systems cost. The size of the PV-system is directly dependent on the size of the pump, the amount of water that is required (m^3/d) and the solar irradiance available. The solar sprayer has many advantages. Besides reducing the cost of spraying, there is a saving on fuel/petrol. Also, the transportation cost for buying petrol is saved. The solar sprayer maintenance is simple. There is less vibration The operation of solar powered pumps is more economical mainly due to the lower operation and maintenance costs and has less environmental impact than pumps powered by an internal combustion engine (ICE). Solar pumps are useful where grid electricity is unavailable and alternative sources (in particular as compared to the petrol sprayer. The farmer can do the spraying operation by himself without engaging labour, thus increasing spraying efficiency.*

Keywords: Solar Panels, DC Pump, Sprayer, Photovoltaic Cell (PV), Electricity

1. 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 solar sprayer In our design, here we can eliminate the back mounting of Sprayer ergonomically it is not good for farmer's 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. Solar spray are the ultimate cost effective solution at the locations where spraying is required. This solar-powered spray pump system uses solar energy as source. Solar energy is first used to charge a storage battery. The solar energy stored in the battery is utilized to operate motor which functions as pump. As the name of the paper suggests, it deals with the constant discharge of pesticide, compress air control system, solar power, battery charging, monitoring as well as timer and non-conventional power controlling techniques. As far as controlling is concerned, it include the parameters such as pressure, pesticide level, battery voltage, current, solar cell and discharge condition.

In this paper we are trying to make unique equipment for cultivation users. Mostly in the forming process pesticide spray is taking a critical role due to poison properties of chemical. So, in this paper we have committed to do something unique and useful equipment with non-conventional source technique. Also reduce the weight of unique solar spray jet as compare to diesel spray jet.

2. CLASSIFICATION OF SPRAYING SYSTEMS

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

1) Hand operated sprayer.

2) Engine operated sprayer/fuel operated sprayer.

3) Electric motor pump sprayer.

1) Hand operated sprayer

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

2) Engine operated sprayer/fuel operated sprayer as we know that engine operated sprayer is working on petrol. Petrol is costly fuel so in farmer economical point of view it is not good.

3) Electric motor pump sprayer.

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

1) Hand operated sprayer cannot be use continually spraying. We can say that it cannot be used for long time.

2) Engine operated sprayer can be operated on petrol so it is not possible to use every farmer.

3) Here 70% of people can be live in rural areas. In rural areas there are insufficient electricity. So it is not possible to use electric motor pump for spraying.

3. PROBLEM IDENTIFICATION

A. in India, 73% of population is directly or indirectly dependent upon the farming. Hence India is now an agricultural based company. But till now farmers face numerous problems.

A. Pests:

Farmer's productivity is threatened by pests. Pests are a major threat to food production. Climate change produces warmer temperatures and increases CO2 gases, rainfall and drought that enhance disease, pests and weeds. Better knowledge and understanding of pest behavior under different projected scenarios is required to adopt and develop new technologies to respond to threats resulting from climate change.

B. Lack of Mechanization:

In spite of the large-scale mechanization of agriculture in some parts of the country, most of the agricultural operations in larger parts are carried on by human hand using simple and conventional tools and implements like wooden plough, sickle, etc. This is specially the case with small and marginal farmers. Due to poor mechanization and crude agricultural techniques the farmers don't get a good value for their produce. Strenuous efforts are being made to encourage the farmers to adopt technically advanced agricultural equipment.

C. Short supply of electricity:

Rural areas face serious problems with the reliability of power supply. In a country like India most of the people in rural areas depend on agriculture. They also face a problem of erratic and random electricity supply in villages. Because of this, farmers have to make multiple visits to the farms at odd timings just to turn on the pumps.

D. Existing methods - Ergonomically imperfect:

Most of the existing spraying techniques are either very heavy to use or incompletely mechanized which results in problem relating to their health and economic condition. Demanding efforts are being made to reduce the stress and fatigue caused during farming activities in order to carry out farm operations timely and to economize the agricultural production process.

B. OBJECTIVES

The main objective is to utilize the inherently available solar energy in spraying operations.

- To cut down the cost employed for spraying machines.
- Decreasing the operational cost by further introducing new mechanisms.
- To decrease labor costs by advancing the spraying methods.
- To consume zero electricity.
- Uninterrupted spraying operation at the field throughout the year.

4. COMPONENTS

Several components and materials are required for assembling the final model.

A. Solar Panel:

Solar power is arguably the cleanest, most reliable form of renewable energy available, and it can be used in several forms to help power appliances. Solar-powered photo-voltaic (PV) panels convert the sun's rays into electricity by exciting electrons in silicon cells using the photons of light from the sun. This electricity can then be used to supply renewable energy to battery. By lowering utility bills, these panels not only pay for themselves over time, they help reduce air pollution caused by utility companies. We chose a solar panel of 20w.

Fig 4.1 Solar Panel

B. Battery:

In the modern era, electrical energy is normally converted from mechanical energy, solar energy, and chemical energy

etc. A battery is a device that converts chemical energy to electrical energy.

Fig. 4.2: Battery

This is a 12V/7.2Ah lead acid battery. 12V is one of the most diverse of all batteries. The sizes of 12 volt batteries vary widely based on the amp hours they are designed to produce. This battery is charged using solar panel to provide electrical charge when needed to run the pump.

Pump:

A pump is a device that moves fluids, by mechanical action. Pumps operate by some mechanism consume energy to perform mechanical work by moving the fluid.

Fig. 4.4: Pump

We selected a pump with the flow rate of 4.5lpm according to the calculations of pump capacity. This pump has two outlets. It develops suction when connected to a battery and lifts the pesticide from the tank via one outlet and supplies to the nozzle through the other outlet.

5. LAYOUT OF THE SYSTEM

The first unit of proposed system is energy conversion unit. Solar energy obtained by the sun is converted into electrical energy using solar panel by photovoltaic effect. The output 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.

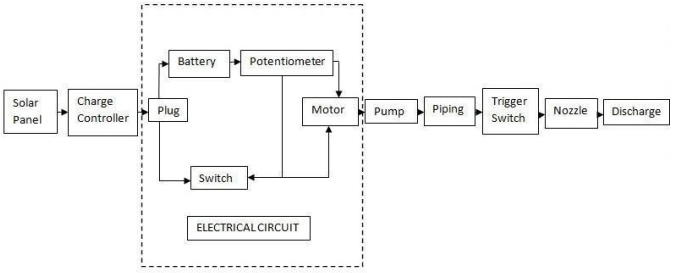

Fig. 5.1 Block Diagram of Spraying System.

Thereby, preventing overcharging and protecting against over voltage. It employs the Pulse Width Modulation (PWM) technique which gradually stops charging the battery, when it exceeds a set high voltage level and gradually re-enables the charging, when the battery voltage drops back below the safe level. The main advantage of PWM is that the power loss in the switching device is very low. This circuit is designed to control the RPM of the motor by controlling the amount of resistance between the motor and the battery while simultaneously providing a charging supply for the batter

5.1 Calculations and Results

5.1.1 Selection of Spray Pump

According to spraying capacity, the spray pump is selected. Type: Centrifugal Pump. Liquid Discharge = 2.9 lit/min. Speed= 3600 rpm. Power=3.5 W

5.1.2 Selection of Battery

According to pump operating power, battery is selected.

Type: Lead acid battery. Voltage=12 V Current=8 A When the circuit is short then, Voltage =12 V, Current = 2.4 A Power = Voltage x Current = 12 x 2.4= 28.8 W

5.1.3 Selection of solar panel

According to battery output power, solar panel is selected. Power = 20 W Dimensions: 500 mm x 22 mm x 340 mm Weight =2.0 kg Open Circuit Voltage =21.6 V Short Circuit Current =1.318 A Operating Current =1.176 A

5.1.4 Current produced by panel 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 = 1.66 A

(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 = 8 / 1.66 = 4.79 hr

6. WORKING PRINCIPLE

The system consists of Solar panel, charging unit, battery, pump and sprayer. The solar panel delivers an output in the order of 12 volts and 20 Watts power to the charging unit. The charging unit is used to strengthen the signal from the solar panel. The charging unit delivers the signal which charges the battery. According to the charged unit, the pump operates, such that the sprayer works. Here fertilizer can be stored in tank. When the sun rays are falling on the solar panel electricity will be generated through the solar cells and stored in the battery. By the electric power in the battery the pump operates and therefore fertilizers from the tank is sprayed out through the sprayers. The layout of solar sprayer is shown in fig.1. There is no maintenance cost and operating cost as it is using solar energy and no pollution problem. Its working principle is very easy and it is economical for the farmers, which has one more advantage that it can also generate power that power is saved in the battery and it can be used for both for spraying and well as to light in the houses when there is no current supply.

Fig.4: Fabricated solar pesticide sprayer

[6]Results and Conclusions:

[A]Results:

Based on the experimentation, it is found in this project that the Solar panel provides 17V, 1A during day time between 9.30 AM to 4.30 PM. Since the pesticide sprayers are used in this duration, testing is as carried out in this time. The 12V, 8Ah battery can be charged fully in 7 hours during this time at 1.3A. Hence this module can be operated to spray continuously 7 to 8 hour which is not possible with electrical pesticide sprayer. The model cost will not exceed Rs.7000. Hence the proposed model is cost effective and compatible with other models available commercially.

[B]Merits:

- The pesticide sprayer operates with zero pollution.
- The solar energy stored in the battery bank is 12V.
- Low maintenance cost and low operating cost.

[C] Advantages:

The main findings of the designed and fabricated solar sprayer are:

1. The prepared solar operated sprayer is environment friendly and cost efficient

2. The prepared solar operated sprayer can be used largely in agriculture field effectively.

3. The prepared solar pesticide sprayer is the best option to farmer who economically challenged and facing electrical problems like load shedding etc.

4. It does not create air pollution and noise.

5. It does not require fuel hence it is a zero fuel operated equipment.

6. It can use in municipality for killing insects and mosquitoes.

7. It is maintenance free device.

8. It is easy to operate and portable. The solar operated sprayer will help the farmers of those remote areas of country where fuel is not available easily.

9. They can perform their regular work as well as saves fuel up to large extent. At the same time they can do their pesticide spraying work with very less environment pollution.

[D] Conclusion:

Main objective of the project was to utilize inherently available solar energy in spraying operations thus achieving zero electricity.

- Proposed model made it possible using simple and effective principle of storing sun energy in battery through constant supply of voltage from solar charge controller and then with the use of selected pump and nozzle, spraying operation can be carried out.
- Fatigue and Stress that usually generates during working condition for the farmers has been reduced considerably after adopting ergonomic techniques during designing.
- Hence analyzing the function v/s cost with the presently available equipment in market, solar sprayer equipment is more efficient with comparatively lesser cost.

[E] FUTURE SCOPE

Battery capacity can be increased in the future depending upon the requirements.

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