Development of Portable Solar Operated Pesticide Sprayer

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Abstract

India is an agriculture based country. Agriculture has a significant role in the socio-economic fabric of India. An Engineer is always focus on development and reduction in human efforts. So many inventions and development have been done in different fields including machinery, constructions, nanotechnology etc. It is now important to focus on agriculture field. Machine becomes an integral part of human being. Automation helps to give high production rate than manual production rate in the competition market. Engineer accepts the challenges and make the design into reality. "Solar operated pesticide sprayer is one of the best innovative product that reduces human efforts. It is actually physical design that show how sprayer uses solar energy instead of conventional energy to spray pesticide on crops. The experimental result shows that the theoretical analysis is approximately same and valid for the prototype as per given specifications. It reduces up to 30-40% of total cost.

Keywords- AC to DC Converter, Solar Energy, Solar Pump, Sprayer, Portable

I. INTRODUCTION

Toady India rank second worldwide in farm output. Agriculture like forestry and fisheries accounted for 13.7% of the GDP (gross domestic product) in 2013, about 50% of the workforce. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. So, increase the productivity is main aim of the pesticides. Proper techniques of application of pesticide and equipment used in applying pesticides are vital to the success of the productivity. A sprayer is a device used to spray a liquid .In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Types of sprayers:

1) Knapsack Sprayers: loaded on the back of the worker during operations. Tanks may be plastics or metal. Common knapsack sprayers are:
    1) Hydraulic
    2) Manual pneumatic
    3) Motorized pneumatic
2) Foot sprayers/ pedal pump sprayers
3) Traction pneumatic sprayers
4) Tractor mounted sprayers
5) Acrial sprayers

Solar energy is the non-conventional energy source. The energy which available from the sun are free of cost and non-polluting. Solar operated pesticide sprayer is based on solar energy. In this project solar energy is converted into electrical energy and stored in battery. Pump is used to spray the pesticide through nozzle by use of battery.

II. LITERATURE REVIEW

Many researches were conducted in the field of solar sprayer for increasing the efficiency and their uses, various papers were presented and any many of these were written in the field of development of solar pesticide sprayer. Some of the literatures are listed in support of development solar pesticide sprayer.

Virendra Patil, Prashant Patil, Pravin Patil published the paper on the 'Solar Pesticide Sprayer' on 2015 from this paper we get the knowledge of dc water pump. 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 wind) do not provides sufficient energy. 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.

Mr. Arunkumar, Mr. Kiran, Mr. Rangaswamy, Mr. Udedararavigouda published the paper on the 'Solar Pesticide Sprayer' on 2015, from this paper we get the knowledge on the discharge rate of the sprayer. 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.

Madurai Kamarajar University, Mohmad Sathak Polytechnic College published the paper on the 'Solar Pesticide Sprayer' on 2015, from this paper we get the knowledge on the power conversion efficiency. The solar cell Power Conversion Efficiency can be calculated by using the relation,

P = Incident Solar radiation x Area of the Solar Cell

The output power (P) = V * I out.

III. PROBLEM DEFINITION

Farmers usually uses hand operated pesticide sprayer (knapsack). The conventional sprayer having the difficulties such as it needs lot of effort to push the lever up and down in order to create the pressure to spray This conventional method is very hectic and having large human efforts. Another commonly used spraying technique is fuel operated pesticide spryer .The difficulty of petrol sprayer is to need to purchase the fuel which increases the running cost of the spray. By eliminating the use of fuels or lever, method can becomes more ecofriendly and reduces fatigue for user. This motivate us to develop pesticide sprayer operated by using solar energy.

To overcome this problems, use of non-conventional energy sources one of the best method. Non-conventional energy is considered the energy of the future. Considering the benefits of non-conventional energy generation, many countries have started producing this energy in large scale. There is continuous research for development of technology in this field to reduce the cost of production and to make it more cost-effective. Thus in order to find closest solution to these drawbacks of existing systems, this equipment is designed.

IV. OBJECTIVES

- Should run on green energy
- To make the equipment noise and vibration free
- A major objective is reducing costs
- It should use minimum human power
- It should easily carry

V. METHODOLOGY

Development of solar operated pesticide sprayer has following steps:

Selection of components:

1) Solar panel
2) Dc pump
3) Battery
4) Nozzle
5) Tank
6) Ac to Dc converter

A. DC Pump Specification

Weight of pump: (0.6 to 0.8) kg

Voltage: 12 V

Current: 3 Amp

Cut off pressure: 6 bar

B. Solar Panel

Power: 25 Watt
Open circuit voltage: 21.60 V
Short circuit current: 1.52 Amps
Max power voltage: 17.71 V
Max power current: 1.41 Amps
Dimensions: 580*374*30 mm
Weight: 3 kg

C. Battery

Voltage Rating: 12V
Current Rating: 7.2 Am hr.
Power Rating: 86.4 Watt-Hr.

D. Nozzle

Nozzles are precision device that facilitates dispersion of liquid into a spray. . A Standard flat fan type nozzle is a one which finds similar applications. Hence it is selected. It finds its application in all sprayers. It is a nozzle which is operated between 2-6 Bar pressure. And it proves useful for our application.

E. Tank

A tank of capacity 16 liters is selected as per our requirement of our project or equipment being designed.

F. CAD Model:

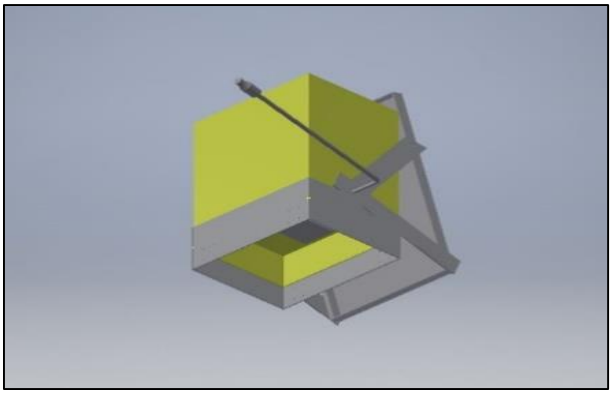

Fig. 1: CAD Model

G. Circuit

Circuit is provided to charge the battery by using AC power supply. It consists of different electronic components including transformer, resistors, ICs, diodes, capacitors, LEDs, switches. Arrangement of components is shown in the figure, First LED indicates power supply, Second LED indicates charging of battery and third LED indicates full charged battery.

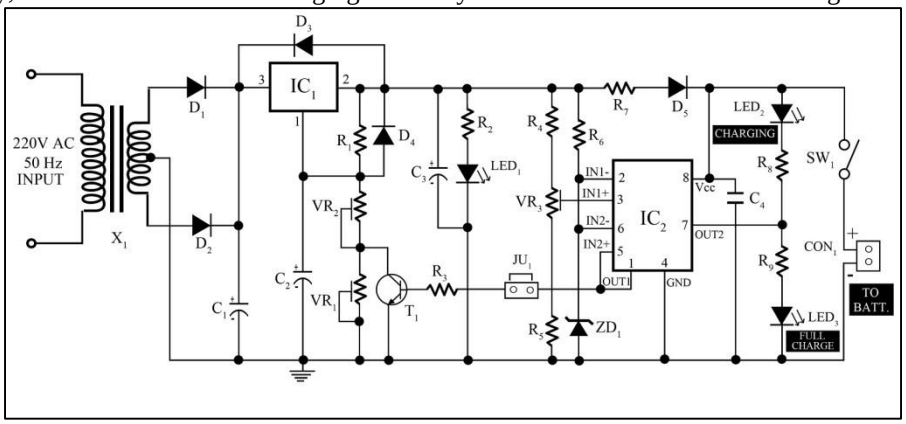

Fig. 2: Circuit

H. Resistors

R_1 = 270 Ω
R_2 = 2.2 KΩ
R_3, R_6 = 10 KΩ
R_4, R_5 = 22 KΩ
R_7 = 0.2Ω, 5W
R_8, R_9 = 4.7 KΩ
VR_1 = 2 KΩ
VR_2 = 5 KΩ
VR_3 = 20 KΩ

I. Capacitor

C1 = 2200 µF/40V
C2, C3 = 10 µF/25V
C4 = 0.1 µF
IC1 = LM317
IC2 = LM358
ZD1 = 6.8V Zener Diode
T1 = BC547
D1 – D5 = 1N4007
LED1 – LED3 = 5mm LED

J. Miscellaneous

X1 = 230V AC primary to 15V-0-15V, 1A secondary transformer
CON1 = 2-pin connector terminal
JU1 = 2-pin connector for jumper

K. Calculation

Current produced by solar panel
I = P/ v = 25/ 17.71 =1.41 Amp
Therefore time (T) required to charge the battery = Amp hr/ amp
=7.2/1.41 =5.10 hrs

VI. CONCLUSION

The proposed design is successfully fabricated. Thus the obtained conclusion of the equipment that we have designed, is as follows:

1) "Solar Operating Devices" are more efficient alternatives for "Fuel Operating Devices".
2) It is more economical and suitable for farmers.
3) It is portable and easy to operate.
4) No use of electricity or fuel.
5) The consequence is that we may face energy crisis in future if we are not careful today.
6) It is cheaper than other available method.
7) It is easy in construction.

VII. RESULT

The proposed system was tested with solar charging as well as AC charging. Practically time required to charge battery is 6.23 hrs. Full charge battery continuously can run for 5-6 hrs. If we charge the battery in day with solar panel it sprays approx. 190-200 litres of pesticide. Weight of system can be also reduce by replacing aluminium strips by strong fibre/ plastic which can hold the solar panel. Solar panel can removable for night spraying.

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