

# SOLAR OPERATED SPRAY PUMP SYSTEM

<sup>1</sup>Ms. . Avhad Jayshri C, <sup>2</sup> Mr. Tribhuvan Pallav K, <sup>3</sup>Mr. Kadam Pratik B, <sup>4</sup>Mr. Ghorpade Shyam S, <sup>5</sup>Prof. V. L. Kadlag

<sup>1,2,3,4</sup> Students, of Mechanical Engineering Department, Sir Visvesvaraya Institute of Technology, Chincholi, Nashik, Maharashtra, India

<sup>2</sup> Assistant Professor, Mechanical Engineering Department, Sir Visvesvaraya Institute of Technology, Chincholi, Nashik, Maharashtra, India

## 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 spray pump. A sprayer of this type is a great way to cover large areas such as lawns quickly and easily. A sprayer typically consists of a tank for carrying the liquid to be sprayed, a solar panel, a motor for pumping out this liquid, spray nozzles on automatically disperse the liquid in a downward direction over an appreciable area, ball valves, a chassis with wheels on which the sprayer is mounted, and a hose attachment for spraying. The device is mechanically pushed from behind and as the supply to the pump is switched on, the liquid is sprayed. This type of sprayers is typically used for spraying lawn chemicals such as pesticides including herbicides, insecticides and fungicides.

**Keyword:** - Sprayers, herbicides, valves, chassis, insecticides and fungicides .

## 1. INTRODUCTION

In our country farming is done by traditional way, besides that there is large development of industrial and service sector as compared to that of agriculture. The spraying is traditionally done by labor carrying backpack type sprayer which requires more human effort. So to overcome these above two problems, we tried to eliminate these problems and designed the equipment which will be beneficial to the farmer for the spraying operations.

We are developed agriculture sprayer in one new RND mechanical project. This project provides farmer spray in shortly explanation of each part as follow.

From time immemorial, the sun has been the prime source of energy for life on earth. The solar energy was being used directly for purposes like drying clothes, curing agricultural produce, preserving food articles, etc. Even today, the energy we derive from fuel-wood, petroleum, paraffin, hydroelectricity and even our food originates indirectly from sun.

Solar energy is virtually inexhaustible. The total energy we receive from the sun far exceeds our energy demands. It is probably the most reliable form of energy available everywhere and to everyone, unlike other sources. With dwindling supplies of petroleum, gas and coal, tapping solar energy is a logical and necessary course of action.

Ever since the industrial revolutions human have been dependent on fuels, electricity and wind energy. For human development in many countries there is research and trials are going on the Solar energy and the wind energy, but in our country, manpower is available in large proportion, So we make our new concept solar operated mechanical boom sprayer in these concept we lifts water in tank for spraying on the agricultural products or on small plants in lawns and gardens.

Well-maintained lawns and gardens can create a beautiful, functional landscape around your home and provide shelter for a variety of wildlife. Through good cultural and integrated pest management (IPM) practices, the outdoor greens cape in the urban environment can remain healthy and thriving.

Along with proper plant selection and care, controlling pests in your lawn or garden is an important part of maintenance. Many cultural practices complement IPM control methods, such as: efficient and appropriate watering practices and judicious use of pesticides. Pesticide should be limited where possible, but when necessary, use them responsibly.

Always read and follow the pesticide label instructions before applying, such as with insecticides or herbicides, to reduce the risk of exposing humans or non-target animals. Take care to protect the environment, which includes the proper use of pesticides to prevent contamination of water resources.

## 2. LITERATURE SURVEY

### Spraying Methods

One of the more common forms of pesticide application, especially in conventional agriculture, is the use of mechanical sprayers.



Fig 1:- Backpack type spraying

### Hand Driven Sprayer

Hand driven pumps consist of a flexible diaphragm made of synthetic rubber connected to the pump handle by a crankshaft mechanism, a rigid diaphragm chamber and either flat or ball-type inlet and outlet valves. These pumps typically operate between pressures of 1 and 3 bar (15-44 psi) and it is suitable for herbicide application where large droplets are required to minimize spray-drift



Fig 2:- Power spraying

### Fuel Operated Sprayer

The power sprayer consists of an integrated or external spray tank; a high pressure piston pump usually powered by a petrol engine a pressure regulating valve and a hose of up to 50 m of length. Spray tanks are too big to be carried as a knapsack. The power sprayer is produced in a number of versions. Most simple and common is an engine driven pump mounted on a frame without wheels, a 200 l drum and hose and lance. Flow regulation is to be done via a pressure regulating valve and/or by restrictors (basic power sprayer) and the size of the nozzle. At the other end of

sprayers mounted on wheels, equipped with pressure regulators. Technically, the power sprayer has a lot in common with the motorized knapsack-sprayer. The unit is generally set for high volume spraying, transporting the droplets with high pressure. Hollow cone nozzles are the preferred type of nozzles.

### Battery operated sprayer

Battery operated sprayer requires charging of battery before operation and its application is limited where electric power is not available.

### 3. PROPOSED SYSTEM

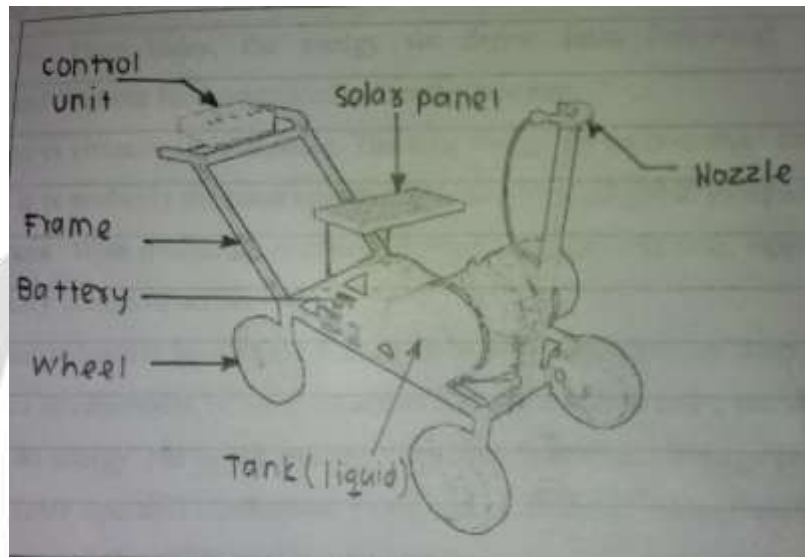


Fig 3:- System Architecture

### WORKING

1. The above dig. Shows of solar operated spraying system.
2. The design of solar operated sprayer pump consist of three main part,
  - a. solar panel unit
  - b. Storage battery unit
  - c. Rotating motor with nozzle
3. In the solar sprayer with solar panel is combined with storage battery and rotating motor. The acting of rotating motor could be control by a switch attach with control unit. In the assembly solar panel arrangement has been provided at the top of unit to charge the storage battery.
4. The unit of solar panel storage battery and rotating dc motor were mutually attached with one another a solar panel size of 30x20 semi area with and output power of 57 watt has been mounted on stand .which fixed the with the help of screw. The solar panel arrangement was made parallel to earth it should not create trouble to the person who is operating more over it is able to receive maximum solar radiation continuously from the sun during the operation of the unit.
5. The frame which is manufactured at the workshop. We drill 4 hole unit. 4 bolt which has size of 8mm had inserted that 4 holes and the pipe is inserted on the bolt [30mm]. To avoid wear and tear the washer is inserted along the wheel in the bolt then 2 nut tights. The same process is applied for 3 wheel.
6. The plastic water tank is place on the frame for fixed is position weld two additional support for tank for a fixed position of tank we cut sheet [clip] from workshop and with help of 4 screw.
7. For a battery we make a stand with the help of paper sheet.
8. For solar panel we make a stand on frame and fixed it with the help of two screw.
9. For control unit we make a stand on frame fixed it with the help of screw.
10. For stand of nozzle use of holder and this holder is situated on the shaft of stepper motor.

11. Submersibles pump inserted in water tank the hose is joined to the nozzle and submersible pump.

### Working:

Working of this system is simple. Solar panel collects the solar energy into electricity and supplies it to battery. Battery uses this electricity to charge itself. This battery next is used to operate motor. Motor attached at the bottom of tank sucks the liquid from tank and deliver it. The 'ON' and 'OFF' of motor is controlled with control switch attached at handle. A switch is given there to operate its function. As the switch is pressed, the valve of gun is released and at the same time the switch is pushed which supplies the current to motor. Thus motor sucks liquid and deliver it through delivery pipe.

### Battery

Desirable attributes of high-power batteries for HEV applications are high-peak And pulse-specific power, high specific energy at pulse power, a high charge acceptanceto maximize utilization, and long calendar and cycle life.

### Currently used battery:

Lead acid batteries, used currently in many electric vehicles, are potentially usable in hybrid applications. Lead acid batteries can be designed to be high power and are inexpensive, safe, and reliable. A recycling infrastructure is in place for them. But low specific energy, poor cold temperature performance, and short calendar and cycle life are still impediments to their use. Advanced high-power lead acid batteries are being developed for HEV applications.

### Other usable batteries:

- Nickel-Cadmium batteries
- Nickel-metal hydride batteries
- Lithium-ion batteries
- Lithium-polymer batteries

### The battery chosen for hybrid vehicle is sealed lead acid battery of the following technical Specifications:

Type : Sealed lead acid

Rated voltage : 12V

Rated current: 7.2Ah.

Number of batteries: 1

Size 150(L) x 65(D) x 93(H)mm

Charge current 720mA for 10-14 hour

Discharge current 20 hr. rate 350Ma



Fig 4:-Battery

### Submersible Pump

A submersible pump is the one that is immersed in water it pumps water by displacement. Submersible pumps are suited both to deep well and to surface water sources. Most deep wells use submersible pumps. These pumps are costlier but have a longer and greater reliability than surface pumps. These pumps are designed for high head and medium flow applications. The inverter optimizes the power input and thus enhances the overall system efficiency. The use of centrifugal pump, for wide range of applications, is due to its following features. It has only one rotating part (impeller). Hence the mechanical losses are negligible. There are no oscillating, reciprocating parts as valves, piston etc. Hence the maintenance cost is very low. Throughout the operation it gives discharge at constant pressure. Obviously, the input torque required is also constant. The rotating parts are perfectly balanced, thus the working is



smooth, noiseless and without vibrations. It can handle highly viscous or contaminated fluids without any problem. Discharge can be infinitely controlled. The construction being simple, it is low in cost and compact in size.

### What is a Submersible Water Pump?

A submersible water pump operates beneath the earth's surface. A submersible water pump will not operate if it is not submerged in liquid. A submersible water pump pushes water to the surface, instead of sucking the water out of the ground like above ground water pumps. Most submersible pumps are long cylinders that are about 3 to 5 inches around and 2 to 4 feet long. Submersible water pumps have a hermetically sealed motor that is close-coupled to the body of the water pump. Having a hermetically sealed motor prevents the water from getting inside the pumps motor and causing a short circuit. Other components of a submersible water pump are the cable, which is connected to the motor, and a pipe that transports the water to the surface of the well.



Fig 5:- Submersible Water Pump

## DC MOTOR

### Introduction

Geared DC motors can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

### Gear Arrangement

The gear assembly is set up on two metallic cylinders whose working can be called as similar to that of an axle. A total of three gears combine on these two cylinders to form the bottom gear assembly out of which two gears share the same axle while one gear comes in between them and takes a separate axle.

The gears are basically in form of a small sprocket but since they are not connected by a chain, they can be termed as duplex gears in terms of a second cog arrangement coaxially over the base. Among the three gears, two are exactly same while the third one is bigger in terms of the number of teeth at the upper layer of the duplex gear. The third gear is connected to the gear at the upper portion of the gear head. The manner in which they are located near the upper part of the gear head can be seen through the image shown Fig 6.

After the gear assembly is removed, gear head's connection to the DC motor and its gear can be easily seen. The machine has a smaller gear in comparison to the gear head's gear assembly.

### Working of the DC Geared Motor:

The DC motor works over a fair range of voltage. The higher the input voltage more is the RPM (rotations per minute) of the motor. For example, if the motor works in the range of 6-12V, it will have the least RPM at 6V and maximum at 12 V.

In terms of voltage, we can put the equation as:

$RPM = K1 * V$ , where,

K1= induced voltage constant

V=voltage applied



Fig 6 :-Gears of Motor



Fig 7:-Working of Motor

The working of the gears is very interesting to know. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more RPM than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfers energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gear rotates is always the opposite of the gear adjacent to it. In any DC motor, RPM and torque are inversely proportional. Hence the gear having more torque will provide a lesser RPM and converse. In a geared DC motor, the concept of pulse width modulation is applied.

In a geared DC motor, the gear connecting the motor and the gear head is quite small, hence it transfers more speed to the larger teeth part of the gear head and makes it rotate. The larger part of the gear further turns the smaller duplex part. The small duplex part receives the torque but not the speed from its predecessor which it transfers to larger part of other gear and so on. The third gear's duplex part has more teeth than others and hence it transfers more torque to the gear that is connected to the shaft.

## Bicycle Wheel

### Introduction:

A bicycle wheel is a wheel, most commonly a wire wheel, designed for bicycle. A pair is often called a wheel set, especially in the context of ready built “off the shelf” performance-oriented wheels. Bicycle wheels are typically designed to fit into the frame and fork via dropouts, and hold bicycle tires.

### Construction

The first bicycle wheels followed the traditions of carriage building: a wooden hub, a fixed steel axle (the bearings were located in the fork ends), wooden spokes and a shrink fitted iron tire. A typical modern wheel has a metal hub, wire tension spokes and a metal or carbon fiber rim which holds a pneumatic rubber tire.



Fig 8:- Wheel

### Axle:

The axle is attached to dropouts on the fork or the frame. The axle can attach using a

- **Quick release** – a lever and skewer that pass through a hollow axle designed to allow for installation and removal of the wheel without any tools (found on most modern road bikes and some mountain bikes).
- **Nut** – the axle is threaded and protrudes past the sides of the fork/frame. (often found on track, fixed gear, single speed, BMX and inexpensive bikes)
- **Bolt** – the axle has a hole with threads cut into it and a bolt can be screwed into those threads. (found on some single speed hubs, Cannondale Lefty hubs)
- **Thru axle** – a long axle, typically 20 mm (110 mm width), [they can be 9 mm (100.33 mm width) in diameter for durability], onto which the fork/frame clamps (found on most mountain bike forks).
- **Female axle** – hollow center axle, typically 14, 17, or 20 mm in diameter made of chromyl and aluminum, with two bolts thread into on either side. This design can be much stronger than traditional axles, which are commonly only 8 mm, 9 mm, 9.5 mm, or 10 mm in diameter.

Modern bicycles have adopted standard axle spacing: the hubs of front wheels are generally 100 mm wide fork spacing, road wheels with free hubs generally have a 130 mm wide rear wheel hub. Mountain bikes have adopted a 135 mm rear hub width, which allows clearance to mount a brake disc on the hub or to decrease the wheel dish for a more durable wheel. Free ride and downhill are available with 150 mm spacing.

### Bearings

The bearings allow the hub shell (and the rest of the wheel parts) to rotate freely about the axle. Most bicycle hubs use steel or ceramic ball bearings. Older designs used “cup and cone”, whereas some modern wheels use pre-assembled “cartridge” bearings. A “cup and cone” hub contains loose balls that contact an adjustable ‘cone’ that is screwed onto the axle and a ‘race’ that is pressed permanently into the hub shell. Both surfaces are smooth to allow the bearings to roll with little friction. This type of hub can be easily disassembled for lubrication, but it must be adjusted correctly; incorrect adjustment can lead to premature wear or failure. In a “cartridge bearing” hub, the bearings are contained in a cartridge that is shaped like a hollow cylinder where the inner surface rotates with

respect to the outer surface by the use of ball bearings. The manufacturing tolerances, as well as seal quality, can be significantly superior to loose ball bearings. The cartridge is pressed into the hub shell and the axle rests against the inner race of the cartridge. The cartridge bearing itself is generally not serviceable or adjustable; instead the entire cartridge bearing is replaced in case of wear or failure.

## Solar Panel

### Introduction

Photovoltaic cells are able to turn the energy in solar radiation into electricity due to an energy transfer that occurs at the sub-atomic level. Solar energy comes in small packages called photons. These photons hit the outer level electrons in the photovoltaic cells like the flappers hit the metal ball in the pin ball machine. The dislocated electrons form the electrical current. Silicon is one of the elements used as a base material for the production of photovoltaic cells. A silicon atom has four valence electrons which are shared with adjacent silicon atoms in covalent bonding. To produce the positive-charged side of a photovoltaic cell, boron atoms which have only three valence electrons are introduced into the lattice structure of pure silicon. The boron atoms occupy a lattice position within the silicon structure, and a positive-charged whole forms in place of the missing fourth electron. Silicon material with boron impurities is called a positive or p-type semiconductor.

To produce the negative charged side of a photovoltaic cell, phosphorus atoms which have five valence electrons are introduced into the pure silicon structure. The phosphorus atoms occupy a lattice position within the silicon structure and form a negative or n-type semiconductor.

Photovoltaic cells are made by putting a layer of n type and a layer of p-type semiconductor material together. When the photons in solar radiation strike a photovoltaic cell, the kinetic energy of the photons is transferred to the valence level of electrons.

The freed electrons and positive-charged holes attract each other and create positive-negative pairs. The formation of these pairs creates electricity. Solar Power Put most simply, Solar Power is a way of converting sunlight into a useful energy source. There are two ways of using solar energy; as heat and as electricity. Devices like solar water heaters, driers and solar cookers use the heat to produce hot water, to dry grains or to cook food respectively. This way of using solar energy is called solar thermal. On the other hand, solar panels use the light to produce electricity, which can then be used for a multitude of purposes.



Fig 9:- Solar Panel

## Nozzle

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. . Drift can be minimized by selecting nozzles that produce the largest droplet size while providing adequate coverage at the intended application rate and pressure. Nozzles are made from several types of materials. The most common are brass, plastic, nylon, stainless steel, hardened stainless steel, and ceramic. Brass nozzles are the least expensive but are soft and wear rapidly. Nylon nozzles resist corrosion, but some chemicals cause thermoplastic to swell. Nozzles made from harder metals usually cost more but will usually wear longer.



Fig 10:- Nozzle

#### 4. RESULT

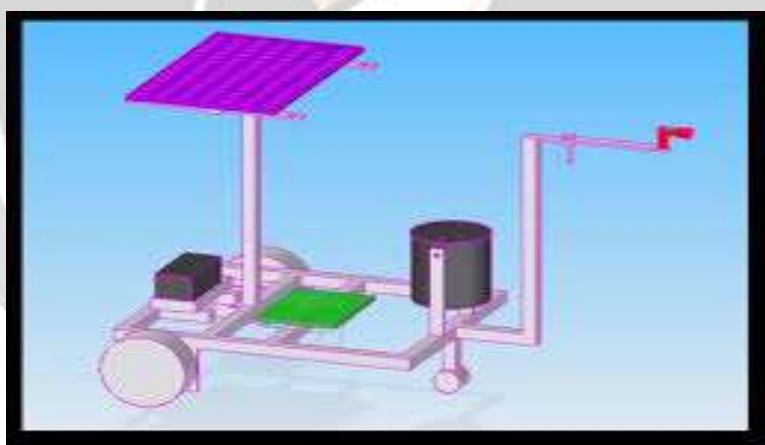


Fig 11:- SOLAR OPERATED SPRAY PUMP

#### 5. CONCLUSION

It is observed that, this model of solar sprayer pump for agriculture is more cost effective and gives the effective results in spraying operation. As it runs on the non conventional energy source i.e. solar energy, it is widely available at free of cost. In now days where world is moving towards the finding the new ways for the energy requirement, it can be a better option for the conventional sprayer. We have given the best option to farmer who economically challenged and facing electrical problem like load shading now days. As India is a developing country, this product can be become more popular in rural areas.

##### **Future scope:**

1. The overall weight of the tank can be minimized by modeling techniques.
2. The battery backup can be increased by adopting some new technology in electronic fields.

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