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Portable Solar Washing Machine

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***Abstract*- Washing machine quickly washes the clothes but consumes a lot of electrical energy. The proposed portable solar washing machine is a light weight machine that can efficiently wash the clothes by the use of solar energy. The cost of this washing machine is low and requires less maintenance. It is expected that by using this portable solar washing machine both the water and the electrical energy consumption can be reduced easily.**

***Keywords*- Solar washing machine, washing machine, portable washing machine, cheap washing machine**

I. INTRODUCTION

Washing machine is a machine that quickly washes clothes, linens and other item. Before the invention of the washing machine, people spent hours doing their laundry by hand. Some people soaked their clothes in stream and then beat them on rocks to get out of dirt. The rapid advancement in technology has been given rise to the washing machine which is widely used in present day`s society [1]. Portable washing machine is a very light weight machine operated with dc motor which is connected to battery which is charged by the solar cell so portable DC washing machine uses nonconventional energy source.

II. COMPONENTS OF PROPOSED MACHINE

A. Solar panel

A solar panel is a device that collects photons from sun light which are very small packets of electromagnetic radiation and convert them into electrical energy which can be used to power electrical loads [2]. Fig. 1 shows a general solar panel. A solar electric system is potentially less expensive and can provide power for a long time if properly maintained. Energy from solar system is clean and is a renewable source of energy [2-3].

Fig.1 Solar Panel

B. Battery

The life expectancy of the complete solar system is about 20 years and the cost of battery is significant [4].

Fig.2 Battery

The battery is rechargeable which has one positive and one negative electrode placed in electrolyte. In a rechargeable (12v, 7.5AH) lead-acid battery the electrolyte consists of sulphuric acid (H_2SO_4) diluted in water; the positive electrode is made of lead dioxide (PbO2) and the negative of lead (Pb). During discharging the electrochemical energy stored in the batteries is consumed as electric power. In the chemical process sulphuric acid is absorbed from the electrolyte and lead sulphate (PbSO4) is formed at both electrodes. The reverse reaction takes place during charging, when electric power is transformed and stored electrochemically in the battery. Lead is formed at the positive electrode and lead dioxide at the negative, while sulphuric acid is released to the electrolyte.

$$PbO2 + Pb + 2H2SO4 \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} 2PbSO4 + 2H2O$$

If the battery is fully charged and the charging power is not disconnected; the water will be electrolyzed into oxygen and hydrogen gas. This process is called gassing, and since the gases escape into the air water is lost [5]. There are a number of various practical designs and different types of lead-acid batteries. But, there are some components that most types have in common.

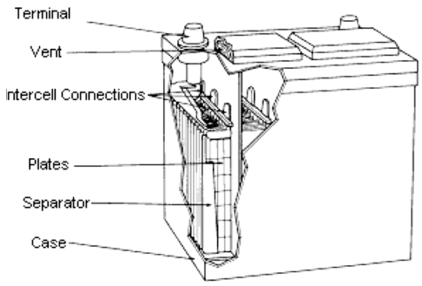

Fig. 3 Principal Components in a Typical Lead-Acid Battery

The electrodes mentioned above are shaped as thin plates and each consists of two parts, the grid and the active material. The grid is made of solid lead and serves both as a mechanical support and as a conductor of the current. It contains a porous sponge, the active material, made of lead at the negative electrode and lead dioxide at the positive. This is where the chemical reactions take place. The active material increases the electrochemically active area, facilitates the penetration of electrolyte and speeds up charging and discharging. A number of plates are placed next to each other, alternately positive and negative. To hinder the plates from making electrical contact a porous plastic material is placed between them. These, so called separators, allow the electrolyte to flow freely, but prevent short circuits. A battery can be made up of one or several cells and each lead-acid battery cell, when fully charged, has an output around 2 V. For instance in a 12 V lead-acid battery there are 6 cells connected in series by inter-cell connections. The cells have different characteristics and the battery is never better than the worst cell. Variations can also deteriorate with time, and so-called equalization charges can be performed once in a while to prevent this [5]. These consist in a moderate overcharge to bring all the cells to the same state. The electrolyte can either be liquid as in so-called flooded battery or in gel form as in gel batteries. This study is only dealing with flooded batteries and they are consequently the only ones described here. The electrolyte, as mentioned above, consists of sulphuric acid (H_2SO_4) diluted in water. When a battery is fully charged all the sulphate ions are in the electrolyte, and when the battery is uncharged the active material has absorbed most of them. The density, also called specific gravity, of sulphuric acid is higher than that of water. Accordingly the specific gravity is high when the battery is charged and low when it is uncharged. This is utilized to measure the state of charge in each cell.

C. Control circuit

A solar charge controller is used in conjunction with a standalone (off grid) system or a grid connects solar power system that incorporates a backup battery bank. For a grid connect solar power system that doesn't use batteries, solar charge controller is not needed. A solar charge controller is a small box consisting of solid state

circuitry which is placed between a solar panel and battery. Its function is to regulate the amount of charge coming from the panel that flows into the deep cycle battery bank in order to avoid the batteries being overcharged. A regulator can also provide a direct connection to appliances, while continuing to recharge the battery; i.e. you can run appliances directly from it, bypassing the battery bank; but the batteries will continue to be charged. Modern solar charge controllers are very efficient and will out perform just about any 3 stage mains power battery charger [6].

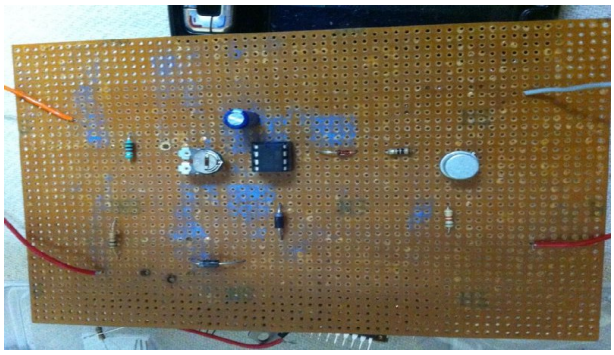

Fig. 4 Solar Charge Controller

The solar radiation falling on the solar panel is converted into electrical energy then it is stored in the battery to utilize for the further application. Now we know that after sometime the battery is fully charged. If any action is not taken to protect the battery it will overcharge. Hence for protecting battery from overcharge we uses solar charge controller. In the controller we uses the IC723 and a zener diode(12v) . The zener diodes rating is such that it will breakdown after the battery terminal voltage reaches it limit. The other D1(Forward bias),D3(12V)are also used. Hence the battery can be protected from the overcharging.

A solar charge controller requires no maintenance aside from regular checks of the wired in connections to see that they are tight and corrosion free. A solar charge controller should be mounted out of direct sunlight and in an area where there is decent air flow. While the solar charge controllers of today are extremely robust; performance and serviceable life will suffer in extreme heat.

D. Bucket

For the outer container of portable washing machine we used a plastic bucket. Which is capable to wash 3- 4 clothes at a time. Bucket used in our project is shown in fig. 5.

Fig. 5 Bucket

E. D.C. Motor

DC motor consists of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator. If electrical energy is supplied to a conductor lying perpendicular to a magnetic field, the interaction of current flowing in the conductor and the magnetic field will produce mechanical force [7-8]. Two conditions are necessary to produce a force on the conductor. The conductor must be carrying current, and must be within a magnetic field. When these two conditions exist, a force will be applied to the conductor, which will attempt to move the conductor in a direction perpendicular to the magnetic field. This is the basic theory by which all DC motors operate. The force exerted upon the conductor can be expressed as follows.

$$F = B\,i\,l \text{ Newton}$$

Where, B is the density of the magnetic field, *l* is the length of conductor, and *i* the value of current flowing in the conductor. The direction of motion can be found using Fleming's Left Hand Rule.

Fig.6 D.C. Motor

III. WORKING OF WASHING MACHINE

Portable D.C washing machine works on the very simple principle as the all other washing machine that is the water is rotated in the bucket in which clothes are placed. The portable washing machine uses solar energy for its operation. The motor is d.c. operated by the battery which is charged by the solar panel.

Fig.7 Complete Diagram of Portable Washing Machine

Fig.8 Portable D.C. Washing Machine

Comparison with other washing machine:

Portable dc washing machine is a light weight machine it has its own advantage

i) Energy saving: It uses solar energy for its operation while other machine requires ac supply which is costly.
ii) Light weight: Portable washing machine has light weight.
iii) Low cost: Its cost is low as compare to other machine.
iv) Easy maintenance: Due to less number of equipments its maintenance is easy.
v) Fewer complexes: As it has very less components so complexity is less.

IV. CONCLUSION

The washing machine has greatly influenced people's life styles by providing easy means of washing clothes and drying them out to a considerable extent. It not only saves time and amount of water used but also helps the user to wash and dry clothes with a lot of ease due to its fully automatic nature. Most of the raw materials used in the manufacturing process of the portable DC washing machine have unacceptable social and environmental impacts in their life cycle. Therefore, it is quite important to mitigate these effects and look at

other possible alternative materials while achieving the functionality of the product.

Due to the many drawbacks in various stages of washing machine manufacture, alternative options of washing need to be looked at portable dc washing machine which is solar operated. A service can be provided where dirty laundry will be located on a weekly basis, washed, dried, ironed and then returned to users amidst some feasibility problems. It is believed that by providing such a central service, material use and water and energy consumption patterns could be minimized to a great extent by using the potable dc washing machine. Hence we can say that the portable dc washing machine has wider scope in the future.

In the future, Hybrid model can also prepared, which may based on non conventional sources (solar energy, wind energy) as well as by main supply.

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