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Solar Lead Battery Charger

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ABSTRACT

Solar concept is not new for us. As non-renewable energy sources are decreasing, usage of solar energy is increasing. This solar energy is not only used on the Earth but also used in space stations where no electrical power is available. Renewable energy is the latest research area which needs a revolution to make an effective solar panel charging system for the regulation of flow of current to the desired output and saving battery from receiving extra voltage and increasing life. Although the battery installation cost is relatively low compared to that of photovoltaic (PVs), the lifetime cost of battery is greatly increased because of limited service time. Lead battery which is being used in many devices get exhausted after some time. These batteries if rechargeable can be recharged through solar energy. Here is the simple project to recharge 4V, 1.0Ah rechargeable Lead-acid battery from the solar panel. This solar charger has over voltage cut off facility so as to protect the battery from overcharging and thus preventing it from getting destroyed. Also it displays the voltage of the solar panel and of the battery, which is measured by using ATMEGA328P IC on the LCD.

Keywords:— *Renewable Energy Resources, Photovoltaic Cell(PVC), Solar Panel,*

I. INTRODUCTION

As the conventional energy is getting depleted day by day, switching to alternative energy sources, like solar energy has become the need of the hour. Energy is one of the issues that is causing the most controversy as fossil fuels are the greatest pollutants and the greatest contributors to the greenhouse effect. The increasing importance of environmental concern, fuel savings and unavailability of power has led to the renewal of interest in renewable energies. Developing countries where the energy consumption rate is much high are in search of renewable energy that are in ample quantity and are inexhaustible such as Solar Energy. Solar energy can be used to generate power in two-ways: Solar thermal conversion and Solar Electric (photovoltaic) conversion.

Solar thermal is employed in heating of fluids to produce steam to derive turbines for large scale centralized generation while in solar electric (photovoltaic) there is the direct conversion of sunlight into electricity through photocells. Lead Battery which finds application in various places gets exhausted after some time. Thus the rechargeable lead battery can be charged through solar energy.

Advantage of the proposed method is better exploitation of the available PV energy by

means of increased battery lifetime due to higher level state of charge operation.

The use of new efficient photovoltaic solar cells (PVSCs) has emerged as an alternative measure of renewable green power, energy conservation and demanded-side management. Renewable energy is the only hope and it is the area of latest research which needs a revolution to make an effective solar panel charging system for the regulation of flow of current to the desired output and saving battery from receiving extra voltage and increasing life. Although the battery installation cost is relatively low compared to that of PVs, the lifetime cost of battery is greatly increased because of limited service time. The expected battery life time is reduced if there is low PV energy availability for prolonged periods.

II. Lead Acid Battery

A battery is a device that converts chemical energy into electrical energy and vice versa.

All lead acid batteries consist of flat lead plates immersed in a pool of electrolyte.

Lead acid batteries usually consist of two 6 -volt batteries in series, or a single 12-volt battery. These batteries are constructed of several single cells connected in series each cell produces approximately 2.1 volts. A six-volt battery has three single cells, which when fully charged produce an output voltage of 6.3 volts. A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts.

A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between. The plates are enclosed in a plastic battery case and then submersed in an electrolyte consisting of water and sulfuric acid as shown in Figure 1. Each cell is capable of producing 2.1 volts.

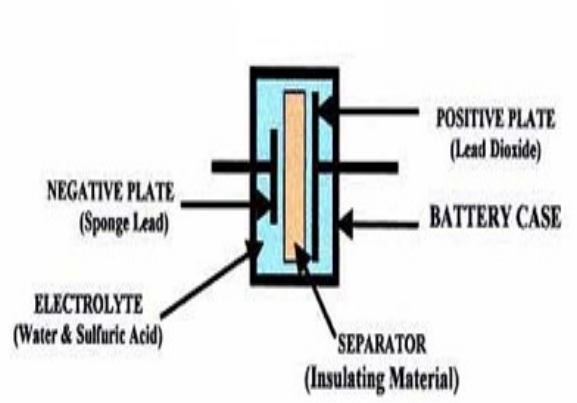

Figure 1: Battery Cell

In order for lead acid cell to produce a voltage, it must first receive a (forming) charge voltage of at least 2.1-volts/cell from a charger. Lead acid batteries do not generate voltage on their own; they only store a charge from another source. This is the reason lead acid batteries are called storage batteries, because they only store a charge.

The size of the battery plates and amount of electrolyte determines the amount of charge lead acid batteries can store. The size of this storage capacity is described as the amp hour (AH) rating of a battery. A typical 12-volt battery used in marine craft has a rating 125 AH, which means it can supply 10 amps of current for 12.5 hours or 20-amps of current for a period of 6.25 hours. Lead acid batteries can be connected in parallel to increase the total AH capacity.

When an SLA battery is being discharged; the lead (Pb) on the negative plate and the lead dioxide (PbO_2) on the positive plate are converted to lead sulphate ($PbSO_4$). At the same time the sulphuric acid (H_2SO_4) is converted to water (H_2O).

In a normal charge, the chemical reaction is reversed. The lead sulphate and water are electrochemically converted to lead, lead dioxide and sulphuric acid. During a full charge cycle any gasses produced need to be re-combined in a so called 'oxygen cycle'. Oxygen is generated at the positive plates during the latter stages of the charge cycle, this reacts with and partially discharges in the sponge lead of the negative plates.

As charging continues, the oxygen produced also re-combines with the hydrogen being produced on the negative plate forming water. With correct and accurate cell voltage control all gasses produced during the charge Guide to charging Sealed Lead Acid batteries cycle will be re-combined completely into the negative plates and returned to water in the electrolyte. If an SLA battery is over-charged, the excess cell voltage will result in the conversion of electrolyte into large amounts of hydrogen and oxygen gasses which cannot be recombined by the normal processes. A pressure-release valve will open and vent the excess gas, resulting in the loss of electrolyte and a loss of capacity. If the battery is undercharged; the low cell voltage will cause the charge current to diminish to zero well before full capacity is reached. This will allow some of the lead sulphate produced during discharge to remain on the plates, where it will crystallize, which also causes a permanent loss of capacity.

III. METHODOLOGY

PV generators are neither constant voltage sources nor current sources but can be approximated as current generators with dependant voltage sources. During darkness, the solar cell is not an active device. It produces neither a current nor a voltage. However, if it is connected to an external supply (large voltage) it generates a current ID, called diode current or dark current. The diode determines the I-V characteristics of the cell.

The photo voltaic voltage is used to charge the lead battery. The voltage between the Solar Panel and the battery is continuously compared by the microcontroller. When the voltage from solar panel is sufficient enough than it is used to charge the battery.

The circuit consisting of microcontroller checks whether the battery requires charging or not by comparing the battery voltage with the maximum battery voltage, if it requires charging then it check the availability of solar power and starts charging the battery through solar voltage if the voltage from solar panel is sufficient.

Whenever controller measures the maximum voltage of battery it stops charging it.

If controller does not find any voltage from solar panel, it assumes the absence of solar energy and the charge controller prevents the flow of back current from battery to solar panel, as at this time the voltage of the lead battery will be greater than voltage from the solar panel.

IV. CIRCUIT DIAGRAM

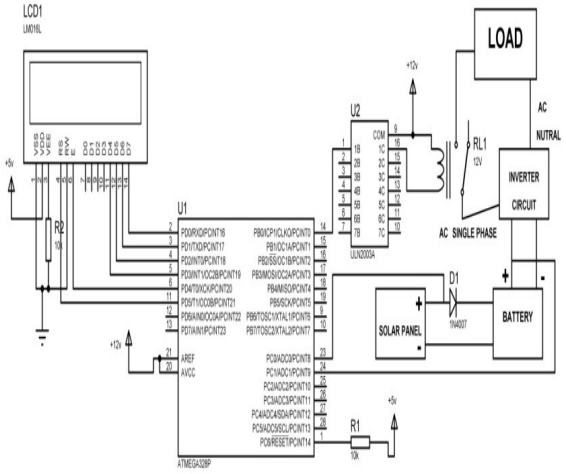

Figure 2: Circuit Diagram of the Project

V. FLOW CHART

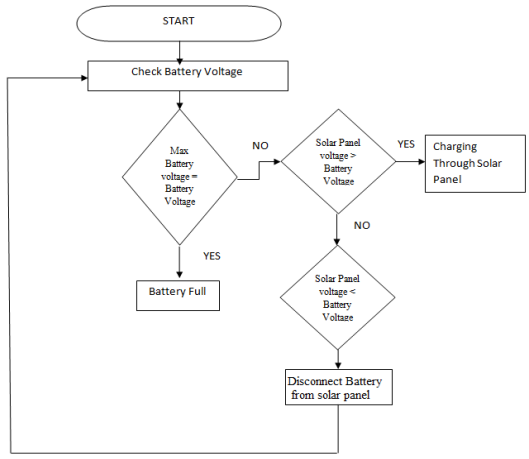

Figure 3: Flow Chart of Project

VI. FUTURE SCOPE

It is known that rechargeable batteries can be charged using commercial alternating current or using solar cells. Commercial alternating current has the drawback that it is typically used only indoors and cannot be used outdoors to immediately recharge electrical equipment the low batteries. For this reason, it is necessary to carry a spare battery. A further drawback of charging with commercial alternating current is that rectifying circuitry is required to convert the alternating current to direct current. This makes the charging circuit more complicated. On the other hand, rechargeable batteries can be charged by solar cells indoors or outdoors as long as the solar cells produce electricity. Therefore, batteries can be recharged even when they run-down while potable equipment is being carried about. Since solar cells do not use commercial alternating current, they are economical. Further, since solar cell output is direct current, no alternating current conversion circuitry is required.

Due to the technological developments in thin-film photovoltaic's (PVs), such as amorphous silicon and hybrid dye sensitized/PV cells, are leading to new generations of consumer portable solar arrays. These new arrays are lightweight, durable, flexible, to develop solar battery chargers for more portable batteries, such as NiMH and/or Li-ion batteries that can be carried by hikers.

Varadarajan et al. have designed the coin based Universal Mobile Battery Charger which charges the mobile battery when a coin is inserted at the coin insertion slot at the input stage. The basic concept used in this charging is the solar energy and charging is controlled by the software of the microcontroller.

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