Name: Moongyu Kang Name of Project Advisor: Thomas G Habetler Group Name: Solaire Rider Charging battery using solar panels

Introduction

It is a fact that human's primary energy source, fossil fuel, is running out, thus researching and developing renewable energy is one of the essential assignments for engineers and scientists. Especially, automobile industry has kept interested in the alternative source of fossil fuels. They have tried various types of researches and finally we're facing the blooming of electric cars these days. Almost all famous automotive companies jumped in developing Electric Vehicle(EV). The good aspects of EV can be lower cost in maintenance, quiet driving environment, relatively high output power with compare to gasoline cars, and last but important, much lower pollution rate. However, we have to focus on some of disadvantages too. First, EV industry just introduced to our society, it has low infrastructures such as charging stations. This is really important for the owners of EVs. Next, it takes too much time to be charged than gas-powered vehicles. Latter issue is the current big problem for people who will decide whether buying EVs or not. To compensate the longer charging problem, some engineers focus on adding alternative charging ways, in addition, to direct plugin. Thus, they have come out with some ideas and let's focus on solar panels as an alternative charging way. Although, it has much lower efficiency than a direct plugin, however, still good enough source as a secondary choice. In this document, let's investigate how solar panels can charge batteries.

Charging battery using solar panels

1) Batteries and Inverters in Solar Energy

According to the article, "Batteries and Inverters in Solar Energy", solar energy can be collected and transformed into electricity via solar panels and there are three main parts of solar energy systems: solar panels, solar charge controllers, and the inverter & battery system. Solar panels are composed of a bunch of photovoltaic cells, which are well known as PV cells. The function of the PV cell is converting sunlight directly into electrical energy. With this converted energy, we need to store this energy into batteries. However, this article indicates that when considering batteries, we have to consider some requirements that would fit into the solar energy storage. According to the article, 'Batteries in solar energy systems require a long lifespan because of the many charge/discharge cycles that occur during the day and night. Since the battery must power appliances during the overnight hours, it should also have a high capacity and be able to operate without damage when it is deeply discharged (this is known as deep-cycle storage capability). [1]. Compared with different types of batteries, flooded lead-acid batteries are the best option for solar energy systems since they are able to discharge up to 80 percent of entire capacity and there are no repercussions. Of course, there are also drawbacks, which these batteries can be evaporated, so in regular based it needs to be refilled. 'They must also have an exhaust system to prevent hydrogen gas from accumulating to dangerous levels, so the battery station requires ventilation'[1]. Next, inverters are existing because lots of appliances are using AC voltage. However, they are also functioning as charge controller. We need it due to protecting battery from overvoltage or deep discharging.

2) Solar Charging Batteries: Advances, Challenges, and Opportunities

Renewable energy is now expanding, however, the major concerns when using PV cells are a little amount of sunlight. Also, intermittent availability because of the coverage by cloud during daytime. Due to inconsistency of sunlight, the output power would be impacted and become one of the concerns for grid applications. To prevent this, batteries can be charged during the day and discharged during night, also batteries provide support during intermittency and desire ramp rate of PV power integration into the grid[2, p.2]. There is a traditional and advanced version of PV-battery charging systems. Traditionally, PV cells and batteries are separated, and these two independent parts are connected with wires. However, this used to be expensive as well as huge and inflexible. Furthermore, there is an energy loss through wires. To make remediation, the advanced design combines panels and batteries into single unit. By doing this, the system's volume is minimized also their efficiency also goes up. There are three types of integration in advanced system: 1) Three-electrode configuration. Although it has been improved by integrated method, there are still challenges in low efficiency, capacity, and stability of solar-powered batteries.

3) Complete Guide to Installing Solar Panels

This is introducing a direct way of installing solar panels to RV. The electricity generated by the solar panel goes through the solar regulator, after this step, electric currents flow into battery. Solar regulator manages how much voltage and the direction of current can go through the battery to prevent overcharging happens. Next, there are two types of panels: fixed or flexible. Choosing flexible solar panels can maximize the collection of solar energy by arranging direct sunlight to PV cells respectively in different range of angles. However, it is weak from security since it is not mounted. The fixed panel cannot get maximized energy since it has flat space, however, it can be covered by glass. The reason for doing this is temperature. Temperature is one of the factors that could affect output voltage. These are the basic steps for the solar panel installation. If additional space is available, multiple solar panels can be applied by connecting parallel to solar regulator.

4) Solar Powered DC Electrical Motor

Solar panels tend to be used storing electricity to the battery. However, this document showed the methods of directly connecting panels to DC motor. The typical way that we used battery to power motor is called indirectly powered by solar energy. It shows different types of circuits schematic to describe direct or indirect powering motors. To power directly to motor, motor is connected to solar panels in series without needing resistors. Next, to implement an indirect method, solar panel should be connected to battery in series with resistors and diode then, motors should be connected parallel to the resistor and battery. Resistors prevent the overflowing electrical energy in wires and diodes exist in a safety manner. 'Diodes keeps the electrical energy from flowing out of the battery and back to the solar panel when there is no light'[4]. There are also two switches on motor side and battery, while if its reversed, then its discharging stage.

5) 200-WATT FLEXIBLE SOLAR KIT

This is the real product sell-by 'Go Power!'. It is monocrystalline cell type and generates 200-Watt with flexible solar panels with bend up to 30 degrees. This panel can generate up to 17.5voltage with maximally produce current around 11.36A. Open circuit voltage and short circuit current are 21V and 12.56A respectively. This product is 1.7killograms with dimension of 1134*544*3millimeters. This kit comes with solar controller with nominal system voltage as 12V, max solar array current as 30A. The battery voltage range for this controller is 6V~15.5V. Other specs for the controllers are maximum solar panel input voltage, operating consumption and display consumption, which are 28V, 6mA, 10mA respectively.

6) Solar Battery Charger Circuit

The solar battery charger can be implemented by using several diodes, resistors, DC battery, and LM317 voltage regulator. When current is generated by solar panel, it goes to the LM317 voltage regulator bypassing diode. LM317 regulates output voltage. According to datasheet with LM317, output power is adjustable between 1.2V and 37V with maximum current of 1.5A. Charging battery for this circuit would be a lead-acid battery with specification of 12V/1.3Ah.

Reference

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