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Battery Charging of an Electric Car Using Solar Panel

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ABSTRACT: Greenhouse gas emission from transportation is one of the major environmental issues and its emission rate is increasing at faster rate. So solar power for transportation can solve this problem. In this project, a cheap & cleaner source of transportation, where the dependency on fossil fuels is minimized has been designed. An ICE vehicle has been dismantled, modified and manufactured to a fully electric vehicle. The modification started by connecting a powerful brushless DC motor and this motor is powered by rechargeable batteries (4 lead-acid batteries, 12V each). Efficient Solar Panels have been utilized as a source of power to charge the batteries and this reduces the dependency of the vehicle on external power sources. The aim of proposed work is to contribute a technology that supports Green energy, consider a scheme we could use a solar energy to charge electric vehicle that too solar panels are inbuilt in the vehicle.Through our project, we have tried to depict the scheme relating to the utility of this vehicle on small commercial level, extracting power from solar panel, replacement of IC engine by dc motor, control of motor via dc drive and various other supporting features have been added as the part of this vehicle which can be considered as cost effective.

KEYWORDS: Solar panel, blocking diode, battery.

I. INTRODUCTION

Solar energy is one of the most important renewable energy sources that have been gaining increased attention in recent years. It is abundantly and universally available source of renewable energy. The amount of energy supplied to the earth in one day by the sun is sufficient to power the total energy needs of the earth for one year. Solar energy is clean and free of emissions, since it does not produce pollutants or by-products harmful to nature.The main component to build a solar car is the solar panel. The solar cells collect a portion of the sun's energy and store it into the batteries of the electric car.The conversion of solar energy into electrical energy has many application fields. Solar to electrical energy conversion can be done in two ways namely solar thermal and solar photovoltaic. Solar thermal is similar to conventional AC electricity generation by steam turbine excepting that instead of fossil fuel, heat extracted from concentrated solar ray is used to produce steam and apart is stored in thermally insulated tanks for using during intermittency of sunshine or night time. Solar photovoltaic use cells made of silicon or certain types of semiconductor materials which convert the light energy absorbed from incident sunshine into DC electricity. To make up for intermittency and night time storage of the generated electricity into battery is needed.

In the near future, the costs of small solar-power modular units and solar-power plants will be economically feasible for large-scale production and use of solar energy. In this paper we have presented the photovoltaic solar panel's operation. The foremost way to increase the efficiency of a solar panel is to use a Maximum Power point Tracker (MPPT), a power electronic device that significantly increases the system efficiency. By using it the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus an MPPT maximizes the array efficiency, thereby reducing the overall system cost. A charge controller is used to maintain the proper charging voltage on the batteries. As the input voltage from the solar array, the charge controller regulates the charge to the batteries preventing any overcharging. So a good, solid and reliable PV charge controller is a key component of any PV battery charging system to achieve systems maximum efficiency.

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II. SYSTEM MODEL AND EXPLANATION

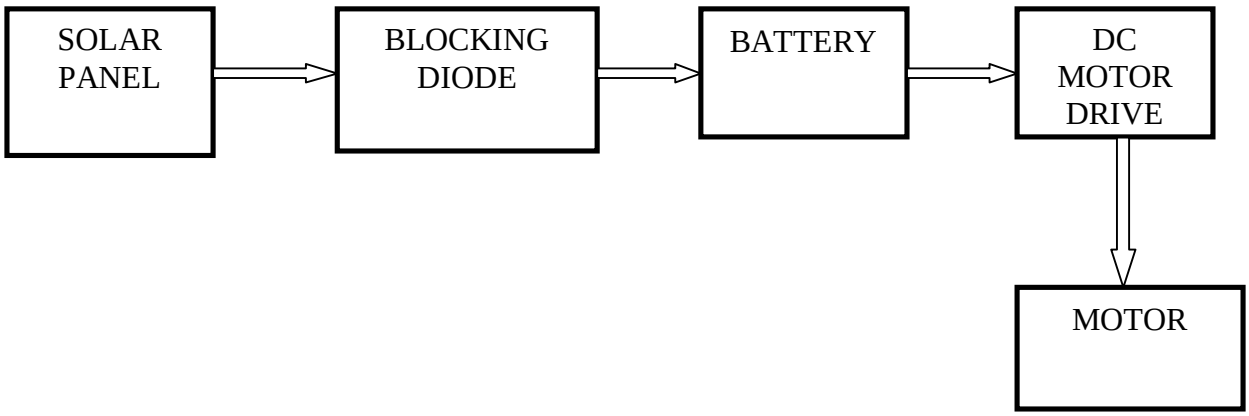

Fig. 1 Main block diagram of proposed system

The main block diagram of the proposed system is shown in fig.1. It mainly consists of solar panel, blocking diode and a battery arrangement.

A. SOLAR PANEL

A solar panel is a packaged connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Solar panels use light energy photon from the sun to generate electricity through the photovoltaic effect. Electrical connections are made in series to achieve a desired output voltage and or in parallel to provide a desired current capability. Each panel is rated by its DC output power under standard test conditions, and typically ranges from 100 to 350 watts. A single 325W Monocrystalline solar panel is used in this project. Depending on construction, photovoltaic panels can produce electricity from a range of light frequencies, but usually cannot cover the entire solar range. The I-V characteristics of a solar panel is shown in fig.2. The maximum power in an ideal situation for a solar panel can be found using the IV curve. The peak would be the optimum point of power for the panel. The advantages of solar panels are, it is the most readily available solar technology, they can last a lifetime, they required less maintenance and they operate best on bright days with little or no obstruction to incident sunlight.

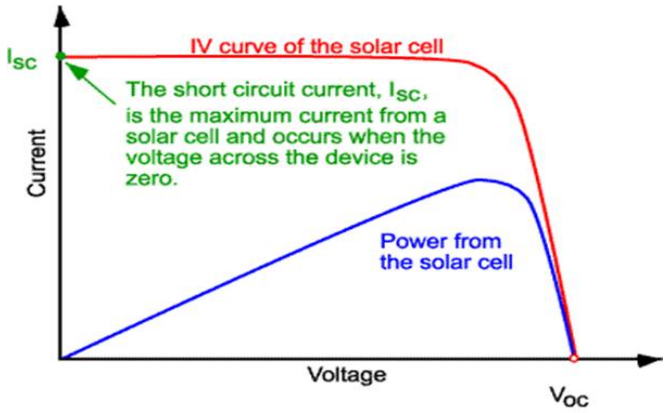

Fig. 2 solar cell I-V characteristics

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B. BLOCKING DIODE

A diode is an electric check value, allowing current to flow in one direction, but not the other. This will allow the panel to charge the battery, but not let the battery to discharge into the solar panel at night.it is used to prevent the reverse flow of current from the battery instead of a charge controller. However, in the dark when no voltage is being produced by the panels the voltage of the battery would cause a current to flow in the opposite direction through the panels, discharging the battery. It does not happen if a blocking diode is used in the circuit.

C. BATTERY

Batteries are used to store the excess charge developed during the day time electricity generation which can be used later in the non-sun shine hours. The rechargeable batteries used are lead acid battery, Li-ion battery, Nickel Cadmium battery, etc. The storage battery is such battery where electrical energy can be stored as chemical energy and this chemical energy is converted into electrical energy as when required. In this project it is proposed to use Lead acid battery because it offers longest life cycle, offers good performance at low and high temperature, require less maintenance and its charging time is less. They are known for delivering higher flow of currents and lower internal impedance. Lead-Acid Batteries are not as highly reactive as Lithium Batteries, ad require an easier circuit connection to be charged by Solar Panels. Lead-Acid batteries use a chemical reaction to do work on charge and produce a voltage between their output terminals. This project will be using four Lead-Acid batteries with a voltage of 12 V each and AH (Ampere Hour) capacity of 100 AH. The batteries will be connected in series to deliver more voltage and thus more power. Fig. 3 shows the four batteries connected in series, giving a power pack of 48 V. it is proposed to use 4 lead acid batteries (12V each) in series to obtain 48V, which is the required voltage to run our DC Motor in this project.

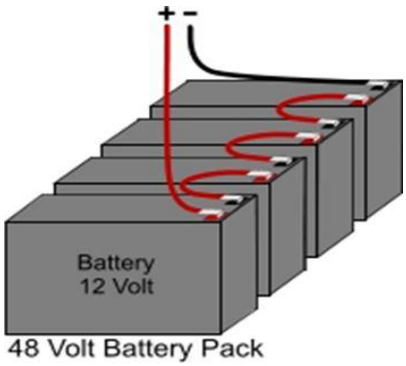

Fig. 3 four batteries of 12v connected in series

D. MOTOR

The BLDC motors are used in this project for the overall control. The battery output is connected to the motor through a DC motor drive. The energy stored in the battery is used to drive the motor. The brushless dc motor is called BLDC motor. It is commuted by electronically and does not have brushes. It has a permanent magnet which rotates around the fixed armature. The BLDC motors offers high torque, high efficiency, reduced noise and longer life time, speed control is very easy.Applications of BLDC Motor includeComputer hard drives and DVD/CD players, Electrical vehicles, hybrid vehicles, and electric bicycles, Industrial robots , CNC machine tools, and simple belt driven systems, Washing machines, compressors and dryers, Fans, pumps and blowers.

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III.DESIGN OF PROPOSED SYSTEM

Battery backup time in hours=2.4 hrs.
To calculate no. of batteries,
Watt hour rating of battery=12V*100Ah=1200Wh
Load=2kW=2000W
Back up time for one battery=1200/2000=0.6 hrs
Therefore no. of batteries=2.4/0.6=4
Therefore batteries of 12V, 100Ah capacities are connected in series to get 48V, 100Ah capacity for this system
Charging current=10% of battery capacity=100*(10/100) =10A
Charging time required=Battery capacity/Charging current=100/10=10 hrs. (Ideal case)
It has been noted that 40% of losses occurred during the battery charging. But due to these losses the charging time for a 48V, 100Ah battery would be:
Losses in battery=100Ah*(40/100) =40 (100Ah*40% losses)
Now, the battery rating=battery capacity + losses=100Ah+40Ah=140Ah
Then required charging time for the battery =140Ah/10A=14 Hours.

IV. WORKING

Solar panel is used to charge the battery. It extracts energy from sunlight and converts the solar energy to electrical energy. A single 325W solar panel is used and it is mounted on the roof of the car. It has a short circuit current of 6.03A and maximum power voltage of 57.6V. The output of solar panel is given to the blocking diode. Blocking diodes are used to allow the flow of current in one direction only. This will allow the panel to charge the battery, but not let the battery to discharge into the solar panel at night. If the panel maximum amperes or short circuit current rating is below 8% of the battery's ampere hour capacity, then the panel will never overcharge the battery. Here the short circuit current of solar panel is less than 8% of battery capacity. Hence the solar panel can be directly connected to battery without using a charge controller. Storage battery receives electrical energy from solar panel and store in the form of chemical energy. The stored energy is used to drive the DC motor.

V. FUTURE SCOPE

Implementation of Electric Cars is possible in all developed countries.Solar Panels can be used in Electric cars to have cleaner energy, due to abundance of sunlight throughout the year. The durability and convenience to consumer can be improved by using this type of vehicle.Use of this vehicles produce no noise pollution and reduce the emission of greenhouse gases.Charging stations are not required because in this car the solar panel is mounted on the roof of the vehicle.

VI. CONCLUSION

Fossil Fuels are still considered as an essential and ideal source of energy. Reducing the dependency on fossil fuels is considered to be a huge challenge. This project utilizing a cleaner source of energy and this was achieved by using electric batteries, Dc motor and a solar panel to charge the batteries.An electric car replaces the IC engine by a DC motor. In this project it is proposed to use a battery charging system using solar panel. It provides pollution less transportation and utilization of non-conventional energy. MPPT charge controller can be used to extract maximum available power from PV module by making them operate at most efficient voltage. In this use of solar energy reduces the CO2 emission and fuel cost. Since the solar panel is mounted on the roof of the car no charging stations are required. Battery will be charged during the time of traveling and parking.

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