CONSTRUCTION OF A 12 VOLTS BATTERY CHARGER

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OCTOBER, 2016

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BY

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14/06/3845	14/06/4059

A RESEARCH REPORT SUBMITTED TO SCIENCE LABOURATORY TECHNOLOGY DEPARTMENT, SCHOOL OF SCIENCE, ABRAHAM ADESANYA POLYTECHNIC, IJEBU IGBO, OGUN STATE, NIGERIA

IN PATIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF NATIONAL DIPLOMA IN SCIENCE LABORATOY TECHNOLOGY

OCTOBER, 2016.

CERTIFICATION

This is to certify that this research was carried out by **14/06/3885, 14/06/3191,14/06/3853, 14/06/3869, 14/06/3873, 14/06/3845, 14/06/3840 , 14/06/3887, 14/06/3839, 14/06/3837, 14/06/3207, 14/06/3845, 14/06/4059** of the Department of Science Laboratory Technology, Abraham Adesanya Polytechnic, Ijebu Igbo, Ogun State, under my supervision and guidance.

25/10/2016

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HOD

DEDICATION

This research project is dedicated to Almighty God, who has being our comforter from the beginning to the end of our national diploma programme and the completion of the project.

We will also give thanks to our parent for their support morally and financially. God will continue to bless you more.

ACKNOWLEDGEMENT

All praises, glory, honour and adoration goes to the Lord God Almighty for his protection over us, without whose blessings, this project would never have seen the light of the day.

We owe a debt of gratitude to our parents for their moral and financial support throughout our stay in school.

We also wish to extend our profound gratitude to our HOD, Mrs. Oluwabiyi, and Our Amiable project supervisor Kotoye (Mr.), who's thoroughly and useful suggestion contributed to the success of this work.

Special thanks go to our lecturers for the knowledge they impacted into our life and also the laboratory attendant and all non-teaching staff members in the department.

Our special gratitude goes to our siblings who have been of tremendous assistants and help to us. However we can't but say a big thanks to all our friends and colleagues.

In completing all, we say a very big thank you to every members of our family and to every one whose have been omitted. Please change to our hand and not our heart, because in our heart there we hold you dear, we appreciate you and we say a big thanks to you all.

ABSTRACT

We have used locally sourced electronic components to construct a 12V electric battery charger. So also, four solar panels of 40W each were installed in series to charge 12V batteries.

Attempts were made to compare the charging rates of the two sources of power. However, difficulties were experienced because public power supply was electrical inadequate to power the charger and the solar panels could not charge optimally either because due to the season.

Upon construction, the charger was found to be working perfectly while the solar panel arrangement gives maximum output with respect to its rating with maximum solar irradiation.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

In this modern society, electricity has a great influence most daily activities ranging from domestic to industrial. Electric may be generated for public consumption in different ways including the use of water, wind or steam to drive the turbine as well as more recently the use of gas. Generators, solar energy and nuclear energy are also source of electricity.

In Nigeria, there is inconsistent supply of electricity by the power supplying company to consumers. Hence the use of additional electric power source such as electric power generators and most recently the use of semi conductors, power devices such as the Bipolar Transistor, Transistor and particularly MOSFET to generate electric power in conjunction with a direct current (DC) battery of few kilowatts. An inverter offers a better additional power source to generators considering its long duration, cost effectiveness and maintainability. In our society today, all type of electronic devices requires power supply from electric power for their operation. This source can be either generator or a battery. The need for power supply cannot be over emphasize, because the provision of goods and services could be completely cut off without power supply. For one to fully enjoy the betterment of living in this new dispensation there should be an

adequate stable source of power supply. Over the years electricity has been generated through energy conversion from one form to another. Some of these energy sources are,

- Solar
- Thermal
- Wind
- chemical

They have proved to be quite reliable and efficient but over the years, due to various reasons, they fail the users at one time or the other. As such, the need for standby power supply is essential which brought into existence an alternative mean utilizes solar energy for generating electrical energy.

1.2 STATEMENT OF THE PROBLEM

The instability of electricity has brought the need for an inverter due to inadequate supply of electricity to charge our solar and electricity battery, this leads to construction of a charger. Hence, batteries can require the need for chargers cannot be overemphasized. Solar charging is particularly useful due to lack of public supply.

1.3 AIM AND OBJECTIVES

The aims of this project work are:

(i) To construct a charger that can charge 24volts battery.

(ii) To demonstrate how a 12 volt battery charger works.

(iii) To compare the charging rate of solar energy with electrical energy.

(iv) To have an alternative means of charging batteries when electricity is not available

1.4 SCOPE OF THE STUDY

This project work is limited to the construction and demonstration of a battery charger of 12volts. The circuit input voltage is 230volts from the A.C supply mains which will be stepped down by a step-down transformer to 12volts. The 12volts A.C is rectified through a bridge rectifier and filtered through capacitor connected in parallel from the positive terminal of the bridge rectifier. The output voltage is used to charge a battery.

1.5 SIGNIFICANCE OF THE STUDY

A 12volts battery charger is a circuit that comprises of different component that are soldered together on a circuit board to give or produce a require function. Therefore, the importance of this project work is to aid both technicians and students on how to construct any battery charger circuit and how it works. It is hoped that after the construction of this charger circuit, it will be kept on the laboratory to be used for 12volts battery charging and for practical and other academic functions.

1.6 LIMITATION OF THE STUDY

During the project work, some problems were encountered, which in one way or the other have made the task more difficult. These include: financial problems, time factor and scarcity of documented materials. Other challenges encountered included inadequate epileptic power supply, weather condition. Weather condition was a challenge because the solar panels were installed during the rainy season, therefore, there was little sunlight and so, the panels could not charge the batteries adequately.

1.7 DEFINITION OF TERMS

The definition are arrange in alphabetically order

1.7.1 Doping: In semiconductor production, doping intentionally introduces impurities into an extremely pure intrinsic semiconductor for the purpose of modulating its electrical properties. The impurities are dependent upon the type of semiconductor and the properties that it needs to have for its intended purpose. Lightly and moderately doped semiconductors are referred to as extrinsic semiconductors. A semiconductor doped to such high levels that it acts more like a conductor than a semiconductor is referred to as a degenerate semiconductor (http://en.wikipedia.org).

1.7.2 Solar energy: This is a radiant energy from sun harnessed using a range of ever evolving technologies such as solar heating, photovoltaic solar thermal energy, solar architecture and artificial photosynthesis solar power system to generate electricity (http://en.wikipedia.org).

1.7.3 Solar panel: Solar panel refers to a panel designed to absorb the sun rays as a source of energy for generating electricity or heating. Solar photovoltaic panel constitute the solar array of a photovoltaic system that generate and supplies solar electricity in commercial and residential application. Solar panels usually consist of one or two layers of silicon based on semiconductors wafers. Silicon is the material used in formation of solar panels, it is in group four in the periodic table because it four electrons in its outermost shell.

1.7.4 Small signal or Small current diode - These diodes assumes that the operating point is not affected because the signal is small.

1.7.5 Large Signal diodes - The operating point in these diodes get affected as the signal is large.

1.7.6 Transient voltage suppression diodes - This diode is used to protect the electronics that are sensitive against voltage spikes.

1.7.7 Gold doped diodes - These diodes use gold as the doping and can operate at signal frequencies even if the forward voltage drops increase.

1.7.8 Power quality: is the combination of voltage quality and current quality. Power quality is concerned with deviations of voltage and/or current from the ideal.

1.7.9 Voltage magnitude variation: is the increase or decrease in voltage magnitude due to load variations, transformer tap–changing, switching of capacitor banks or reactors etc.

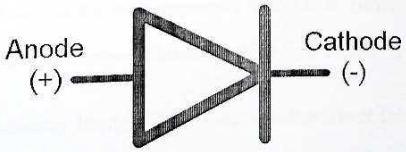
1.7.10 Voltage frequency variation: is the variation in frequency of supply voltage due to the imbalance between load and generation units.

1.7.11Voltage fluctuation: The fast variation in voltage magnitude is called voltage fluctuation or 'voltage flicker' and can affect the performance of the equipment.

1.7.12Voltage notching: In three phase converters during commutation from one device to another, short circuits for short durations can cause voltage reduction or notching. Voltage notching leads to higher order harmonics.

1.8 DIODES

Diodes are a semiconductors device which allows the passage of current in one direction only. That applies equally to vacuum tube diodes. Diodes however are far more versatile devices than that. Diodes can be used as voltage regulators, turning devices in RF tuned circuits, frequency multiplying device in RF circuits, mixing devices in RF circuits, switching applications of can be used to make logic decisions in digital circuits. There are also diodes which emit "light", these are known as light-emitting-diodes of



LED's.

Fig 1.0Symbol for Diode

1.8.1 TYPES OF DIODE

1.8.1.1 Light Emitting Diode (LED): It is one of the most popular types of diodes and when this diode permits the transfer of electric current between the electrodes, light is produced. In most of the diodes, the light (infrared) cannot be seen as they are at frequencies that do not permit visibility. When the diode is switched on or forward biased, the electrons recombine with the holes and release energy in the form of light (electroluminescence). The color of light depends on the energy gap of the semiconductor

1.8.1.2 Avalanche Diode: This type of diode operates in the reverse bias, and used avalanche effect for its operation. The avalanche breakdown takes place across the entire PN junction, when the voltage drop is constant and is independent of current. Generally, the avalanche diode is used for photo-detection, wherein high levels of sensitivity can be obtained by the avalanche process.

1.8.1.3 Laser Diode: This type of diode is different from the LED type, as it produces coherent light. These diodes find their application in DVD and CD drives, laser pointers, etc. Laser diodes are more expensive than LEDs. However, they are cheaper than other forms of laser generators. Moreover, these laser diodes have limited life.

1.8.1.4 Schottky Diodes: These diodes feature lower forward voltage drop as compared to the ordinary silicon P-N junction diodes. The voltage drop may be somewhere between 0.15 and 0.4 volts at low currents, as compared to the 0.6 volts for a silicon diode. In

order to achieve this performance, these diodes are constructed differently from normal diodes, with metal to semiconductor contact. Schottky diodes are used in RF applications, rectifier applications and clamping diodes.

1.8.1.5 Zener Diode: This type of diode provides a stable reference voltage. The diode runs in reverse bias, and breaks down on the arrival of a certain voltage. A stable voltage is produced, if the current through the resistor is limited. In power supplies, these diodes are widely used to provide a reference voltage.

1.8.1.6 Photo diode: Photodiodes are used to detect light and feature wide, transparent junctions. Generally, these diodes operate in reverse bias, wherein even small amounts of current flow, resulting from the light, can be detected with ease. Photodiodes can also be used to generate electricity, used as solar cells and even in photometry.

1.8.1.7 Rectifier Diode: These diodes are used to rectify alternating power inputs in power supplies. They can rectify current levels that range from an amp upwards. If low voltage drops are required, then Scotty diodes can be used, however, generally these diodes are PN junction diodes (http://en.wikipedia.org).

A P-N junction simply means a boundary or interface between two types of semiconductors materials, p-type and n-type inside a single crystal of semiconductor. The "p" (positive) side contains an excess of electron holes while the "n" (negative) side contains an excess of electrons

CHAPTER TWO

LITERATURE REVIEW

2.1 HOW SOLAR PANEL WORKS

A solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprises many, smaller units called photovoltaic cells. (Photovoltaic simply means that they convert sunlight into electricity). Many cell linked together makeup a solar panel. Each photovoltaic cell is basically a sandwich made up of two slices of semi-conducting material; usually silicon which is also used in microelectronics. To work, photovoltaic cells need to establish on an electric field. Much like a magnetic field, which occurs due to opposite poles, an electric field occurs when opposite charges are separated. To generate this field, manufacturers "dope" silicon with other materials, giving each slice of the sandwich a positive or negative electrical charge specifically, they seed phosphorous into top layers meanwhile, the bottom layer gets a dose of boron which results in fewer electron and positive charge. These all add up to an electric field at the junction between the silicon layers. Then, when a photon of sunlight knocks and electron free, the electric field will push the electron out of the silicon junction and some other components of the cell turn this electron into usable power. Metal conductive plates on the side of the cell collect the electron and transfer them to wires at that point the electron can flow like any other source of electricity. There are other types of solar power technology including

solar thermal and concentrated solar panel (CSP) that operate in a different fashion than photovoltaic solar panels, but all hardness solar energy to either create electricity or to heat water or air (Ulanoff and Musk 2015).

2.2 HISTORY OF BATTERY

A battery is a device consisting of two or more electrochemical cells that convert, stored chemical energy into electrical energy. Each cell has a positive terminal, or cathode, and a negative terminal, or anode. The terminal marked positive is at a higher electrical potential energy than the terminal marked negative. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Although the term battery technically means a device with multiple cells, single cells are also popularly called batteries. Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a lot of portable devices. Secondary (rechargeable batteries) can be discharged and recharged multiple times; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics.

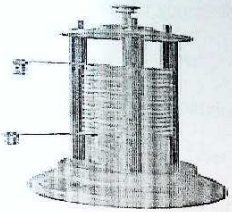


Fig 2.1 Picture of a voltaic pile, the first battery

The usage of "battery" to describe a group of electrical devices dates to Benjamin Franklin, who in 1748 described multiple Leyden jars by analogy to a battery of cannon(Benjamin Franklin borrowed the term "battery" from the military, which refers to weapons functioning together). Alessandro Volta built and described the first electrochemical battery, the voltaic pile, in 1800. This was a stack of copper and zinc plates, separated by brine-soaked paper disks, which could produce a steady current for a considerable length of time. Volta did not appreciate that the voltage was due to chemical reactions. He thought that his cells were an inexhaustible source of energy, and that the associated corrosion effects at the electrodes were a mere nuisance, rather than an unavoidable consequence of their operation, as Michael Faraday showed in 1834. Although early batteries were of great value for experimental purposes, in practice their voltages fluctuated and they could not provide a large current for a sustained period. The Daniel cell, invented in 1836 by British chemist John Frederic Daniel was the first practical source of electricity, becoming an industry standard and seeing widespread

adoption as a power source for electrical telegraph networks. It consisted of a copper pot filled with a copper sulfate solution, in which was immersed an unglazed earthenware container filled with sulfuric acid and a zinc electrode. These wet cells used liquid electrolytes, which were prone to leakage and spillage if not handled correctly. Many used glass jars to hold their components, which made them fragile. These characteristics made wet cells unsuitable for portable appliances. Near the end of the nineteenth century, the invention of dry cell batteries, which replaced the liquid electrolyte with a paste, made portable electrical devices practical.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wrist watches to battery banks the size of rooms that provide standby power for telephone exchanges and computer data centers.

Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline(Nihal,2007). This is somewhat offset by the higher efficiency of electric motors in producing mechanical work, compared to combustion engines. Some types of batteries are discussed below.

2.2.1 TYPES OF BATTERIES

2.2.1.1 DEEP CYCLE BATTERIES: A deep-cycle battery is a lead-acid battery designed to be regularly deeply discharged using most of its capacity. In contrast, starter batteries (e.g. most auto motive batteries) are designed to deliver short, high-current bursts for cranking the engine, thus frequently discharging only a small part

of their capacity. While a deep-cycle battery can be used as a starting battery, the lower "cranking current" implies that an oversized battery may be required.

The type of battery fitted to a car or truck is designed to give a high current for starting the vehicle but this would normally only discharge the battery by a maximum of 10%

For a solar powered home, however, batteries designed for Deep Cycle use are required. These batteries, while not being able to supply the high current of a Starting Battery, will cope with regular discharging by 40% and occasional discharging of 10% (Windsun.com).

2.2.1.2 OGIV BATTERIES: These are of flat plate design but are semi-sealed or Valve Regulated Lead Acid (VRLA). Valve Regulated batteries have the following advantages which may or may not be important when used in a solar power setup:

i. Release of hydrogen during charging is significantly reduced, reducing (though not eliminating) the need for ventilation.
ii. No topping up of the cells with distilled or de-mineralized water is required
iii. There is no chance of acid spillage
iv. Batteries can be designed to be place horizontally or to be stacked, reducing floor space requirement.

There can however be disadvantages with the VRLA design, including:

i. No ability to top up the battery if the electrolyte should be low
ii. May not cope with higher temperatures as drying out may occur.

iii. Lithium-ion battery (sometimes Li-ion battery, Lion battery, or LIB) is a member of a family of rechargeable battery types in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery. The electrolyte, which allows for ionic movement, and the two electrodes are the constituent components of a lithium-ion battery cell. Lithium batteries are widely used in products such as portable consumer electronic devices

In general, the electrochemical reaction occurring in the cell is not reversible, rendering the cell rechargeable. As a primary cell is used, a chemical reaction in the battery use up the chemicals that generate the power; when they are gone, the battery stops producing electricity and it is useless. In contrast, in a secondary cell, the reaction can be reversed by running a current into the cell with a battery charger to recharge it, regenerating the chemical reactants. (windsun.com)

2.2.1.3 THE LEAD ACID BATTERY: It consists of individual cells, each producing approximate 2volts. Each cell consists essentially of two electrodes of lead, in a 33% solution of sulphuric acid. As the battery is charged however, chemical changes occur in both the electrodes and the electrolytes (sulphuric acid) (Nihal, 2007).

2.2.2 DISCHARGING OF BATTERY

In a battery there are two electrodes immersed in an electrolyte. When an external load is connected to these two electrodes, oxidation reaction starts occurring in one electrode and at the same time reduction occurs in other electrode. The electrode, where oxidation takes place, the number of electrons becomes excess. This electrode is referred as negative electrode or anode. On the other hand during discharging of battery, the other electrode involves in reduction reaction. This electrode is referred as cathode. The electrons which are excess in anode, now flow to the cathode through external load. In cathode these electrons are accepted, that means cathode material involve in reduction reaction.

Now the products of oxidation reaction at anode are positive ions or cations and that will flow to the cathode through the electrolyte and the same time products of reduction reaction at cathode are negative ions or anions and that flow to anode through the electrolyte. Let us take a practical example for illustrating discharge of battery. Let consider a nickel cadmium cell. Here, cadmium is anode or negative electrode. During oxidation at anode cadmium metal reacts with OH^- ion and releases two electrons and becomes cadmium hydroxide.

$$Cd + 2(OH) \Rightarrow Cd(OH)_2 + 2e$$

The cathode of this battery is made of nickel ox hydroxide or simply nickel oxide. In cathode, reduction reaction takes place and due to this reduction reaction, nickel oxyhydroxide becomes nickel hydroxide by accepting electrons. (Broussely,2007).

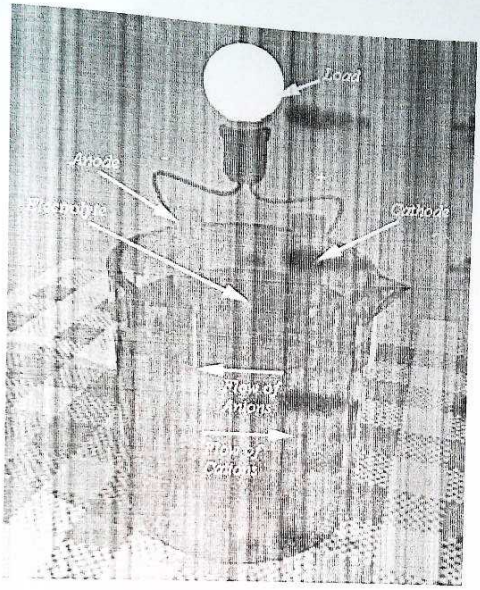


Fig 2.2 Picture showing the discharging of battery

2.2.3CHARGING OF BATTERY

During charging of battery, external D.C source is applied to the battery. The negative terminal of the DC source is connected to the negative plate or anode of the battery and positive terminal of the source is connected to the positive plate or cathode of the battery.

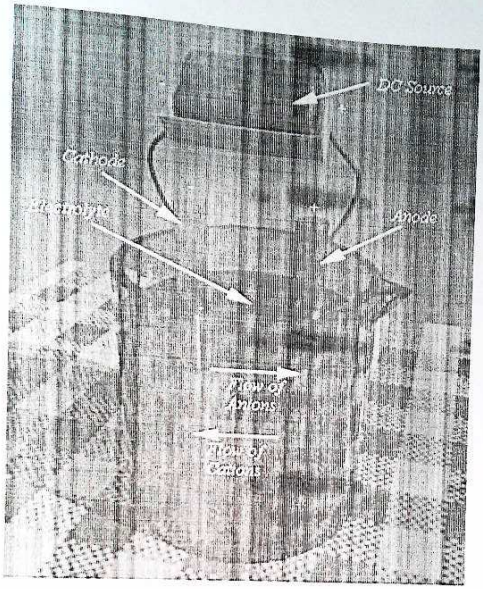


Fig 3.2.3 Picture showing the charging of battery

Now, due to external DC source, electrons will be injected in the anode. Reduction reaction takes place in the anode instead of cathode. Actually in the case of discharge of battery, reduction reaction takes place at cathode. Due to this reduction reaction, the anode material will regain electrons and return to its previous state when the battery was not discharged. As the positive terminal of the DC source is connected to the cathode, the electrons of this electrode will be attracted by this positive terminal of DC source. As a

result oxidation reaction takes place at the cathode and cathode material regains its previous state (when it was not discharged). This is overall basic of charging of battery. Now take an example of rechargeable nickel cadmium cell. During charging of battery, the negative and positive terminals of charger DC source are connected to the negative and positive electrode of the battery. Here at anode, due to presence of electrons from dc negative terminal, reduction takes place due to which cadmium hydroxide again becomes row cadmium and releases hydroxide ions (OH^-) to the electrolyte.

$$Cd(OH)_2 + 2e \rightleftharpoons Cd + 2OH^-$$

At cathode or positive electrode, due to oxidation, nickel hydroxide becomes, nickel oxyhydroxide release water in the electrolyte solution.

$$Ni(OH)_2 + OH \rightleftharpoons NiOOH + H_2O + H_2O + e$$

During charging of battery, the secondary battery becomes to its original charged state and ready for further discharging of battery.(Nihal, 2007)

2.2.4 TYPES OF CHARGING

2.2.4.1 SOLAR CHARGING: Solar chargers convert light energy into direct current (DC) current. They are generally portable, but can also be fixed mount. Fixed mount solar charges are also known as solar panels. Solar panels are often connected to the electrical grid whereas; portable solar chargers are used off the grid (i.e. cars, Boats, e.tc). Although portable solar chargers obtain energy from the sun only, they still can (depending on the technology) be used in low light (i.e. cloudy) conditions.

2.2.4.2 SIMPLE CHARGING: A simple charger works by supplying a constant direct current (DC) or pulsed direct current (DC) power source to battery being charged. The simple charger does not alter its input based on time or the charge on the battery. This simplicity means that a simple charger is inexpensive, but there is trade off in quality. Typically, a simple charger takes longer time to charge a battery to prevent severe over-charging. Even so, a battery left in simple charger for too long will be weakened or destroyed due to over-charging. These chargers can supply either a constant voltage or a current to the battery.

2.2.4.3 TRICKLE CHARGING: A trickle charger is typically a low current (500-1500Ma) battery charger. A trickle charger is generally used to charge small capacity batteries (2-30Ah). These types of chargers are also used to maintain charger capacity batteries (> 30Ah) that are typically found in cars, boats and vehicles. In larger applications, the current of the battery is sufficient only to provide maintenance or a trickle current (trickle is commonly the last charging stage of most battery charger) depending on the technology of the trickle charger.

2.2.4.4 INTELLIGENT CHARGER: A "smart charger" should not be confused with a "smart battery". A smart battery is generally defined as one containing some sort of electronic device or "chip" that communicate with a smart charger about battery characteristic and condition. A smart battery generally requires a smart charger it can communicate with. A smart charger is defined as a charger that can respond to the

condition of a battery and modify its charging actions accordingly. Some smart chargers are designed to charge "smart battery" While designed to charge "dumb" batteries, which lack any internal electronic circuitry. The term "smart charger" is ambiguously since it is not clear whether the adjective "smart" refers to the battery or only to the charger. The output current of a smart charger depends upon the battery state. A intelligent charger may monitor the battery's voltage, temperature or time under charging to determine the optimum charging current and to terminate charging for NI-Cd and NiMH batteries. The voltage across the battery increases during the charging process, until the battery is fully charged. After that, the voltage decreases which indicate to intelligent charger that the battery is fully charged. Such chargers are often labeled as a DV, ''delta V'', or sometimes ''delta peak'' charger indicating that they monitor the voltage charge. A typically intelligent charger fast charges a battery up about 85% of if maximum capacity in less than an hour, then switches to trickle charging which takes several hour to fully charge the battery.

2.2.4.5 INDUCTIVE CHARGING: Inductive battery chargers use electromagnetic induction to charge batteries. A charging station sends electromotive energy through inductive coupling to a electrical device, which is achieved without the need for metal contacts between charger and battery. It is commonly used is electrical toothbrushes and other device used in bathrooms; because there are no open electrical contacts, there is no risk of electrocution.

2.2.4.6 USB BASED CHARGING: Since the universal serial bus specification provides for a five volt power supply it is possible to use a USB cable as a power source for recharging batteries. Products base o this approach includes chargers for cellular phones and digital audio player. They may be fully compliant USB peripheral devices adhering to USB power discipline (Nihal, 2007).

2.3 DRY CELL

A standard dry cell comprises a zinc anode, usually in the form of cylindrical pot with a carbon cathode in the form of a central rod. The electrolyte is ammonium chloride inform of a paste next to the zinc anode. Dry cell batteries are different from wet cells because their electrolytes are contained in a low-moisture paste; while a wet cell has electrolytes contained in a liquid, hence the difference in names. A chemical reaction within the battery creates an electrical charge that flows from inside to an outer circuit that is connected to an electrical device. Dry cell batteries, regardless of their size, typically have the same basic components. At the center of each, there is a rod called a cathode, which is often made of carbon and surrounded by an electrolyte paste. Different chemicals can be used to create this paste, such as ammonium chloride and manganese dioxide, depending on the type of battery. The cathode and electrolyte paste are wrapped in paper or cardboard and sealed into a metal cylinder called an anode, which is typically made of zinc. The anode in the dry cell battery has two terminals, one that is positive and one that is negative. This works when a load is connected to the battery's terminals, a chemical reaction occurs between the anode and the paste that

produces is roughly 1.5 volts of electricity. A pin or "collector" in the middle of the battery conducts this charge out of the battery to an external circuit. This circuit physically connects to the electronic device; the battery will now provide the charges necessary for the device to function. Each set of anode, electrolyte, and cathode acts as a single cell, and multiple cells can be connected together within one dry cell battery to produce a higher overall voltage. After the load has been connected for a long time, the battery's chemicals break down and no longer produce a charge. Primary batteries should be discarded once they reach this point, while secondary batteries can be recharged through special devices.

32.150 Battery cut vertically

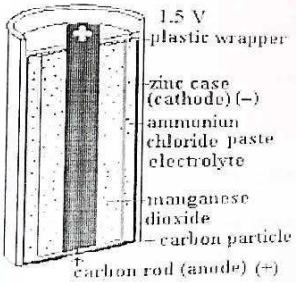


Fig 2.4 Sectional view of a dry cell

This effectively reverses the chemical reaction within each cell, allowing the battery to continue working. Dry cell has different types;

(i) Primary cell: It is a battery that is designed to be used once and discarded, and not recharged with electricity and reused like a secondary cell (rechargeable battery) e.g. Zinc-carbon cells, also known as Leclanché cells, Alkaline cell, Lithium cell, Mercury cell, silver oxide cell.

(ii) Zinc–carbon battery: This is a dry cell battery that delivers a potential of 1.5 volts between a zinc metal electrode and a carbon rod from an electrochemical reaction between zinc and manganese dioxide mediated by a suitable electrolyte. It is usually conveniently packaged in a zinc can which also serves as the anode with a negative potential, while the inert carbon rod is the positive cathode. General purpose batteries may use an aqueous paste of ammonium chloride as electrolyte, possibly mixed with some zinc chloride solution. Heavy duty types use a paste primarily composed of zinc chloride. Zinc–carbon batteries were the first commercial dry batteries, developed from the technology of the wet Leclanché cell, and made flashlights and other portable devices possible, because the battery can function in any orientation. They are still useful in low drain or intermittent use devices such as remote controls, flashlights, clocks or transistor radios.

(iii) Alkaline cell Alkaline batteries are a type of primary battery dependent upon the reaction between zinc and manganese(IV) oxide (Zn/MnO_2). A rechargeable alkaline battery allows reuse of specially designed cells. Compared with zinc-carbon batteries of the Leclanché or zinc chloride types, alkaline batteries have a higher energy density and

longer shelf-life, with the same voltage. The alkaline battery gets its name because it has an alkaline electrolyte of potassium hydroxide, instead of the acidic ammonium chloride or zinc chloride electrolyte of the zinc-carbon batteries. Other battery systems also use alkaline electrolytes, but they use different active materials for the electrodes. Alkaline batteries are used in many household items such as MP3 players, CD players, digital cameras, pagers, toys, lights etc.

2.4 SECONDARY CELL

It is a rechargeable battery, storage battery or accumulator. It is a type of battery which can be charged, discharged into a load, and recharged many times, while a non-rechargeable or primary battery is supplied fully charged, and discarded once discharged. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Examples include Nickel-cadmium cell, Lithium ion cell, Nickel metal hydride cell and lead acid battery.

2.4.1 NICKEL-CADMIUM BATTERIES (NICD): The nickel cadmium battery is the first rechargeable battery that was reasonably priced and available in standard cylindrical sizes (AA, AAA etc).

These batteries come in two types: vented cells and hermetically sealed cells. Vented cells must e positioned so they can properly and also require water for maintenance. They are commonly used in commercial and military applications. Hermetically sealed

batteries, however, do not require any maintenance, and they do not need to be specially positioned. Ni-Cd batteries are used in low- to moderate- discharge devices such as scanners, portable radios, cordless phones and power tools. Because these batteries contain cadmium, a toxic heavy metal, they require special disposal. All Ni-Cd batteries are identified by environmental protection agency (EPA) as hazardous waste and must be recycled. The recycling process recovers cadmium and nickel for steel production.

2.4.2 LITHIUM-ION AND LITHIUM-ION POLYMER BATTERIES (LI-ON)

Lithium-ion batteries can be recycled, to recover the metal content. These batteries only come in rectangular or cylindrical shapes. There is no issue of a memory effect, meaning they can be recharge before they are completely discharge without affecting the energy capacity. They are smaller, lighter and provide more energy than nickel-cadmium or nickel-metal hydride batteries. Lithium-ion batteries are most often used in a cell phones and mobile computing devices. They should not be stored in high temperatures, as they can easily ignite or explode.

2.4.3 NICKEL-METAL HYDRIDE BATTRIES (NIMH)

The main difference between this battery and the Ni-CD battery is the metal hydride used instead of cadmium. Nickel- metal hydride batteries are also available in the standard cylindrical sizes. These batteries also have two to three times the capacity of nickel-cadmium, and memory effect is not as significant. Memory effect is when a battery's

maximum energy capacity gradually decreases as a result of being recharged before the battery has completely discharged. Nickel-metal hydride batteries are commonly used in high-discharged devices like portable power tools, digital cameras, cell phones and laptops. They are considered non-hazardous waste, but do contain elements that can be recycled, often into stainless steel.

2.4.4 LEAD ACID BATTERIES (AUTOMOTIVE & SEALED LEAD-BASED)

Lead acid batteries are the oldest type of rechargeable battery. It's essential to recycle the battery, because of the hazardous materials and valuable resources inside them. Over 97% of all battery lead used is automotive and commercial batteries between 1997 and 2001 was recycled, making lead acid battery recycling one of the most successful recycling programs in the world.

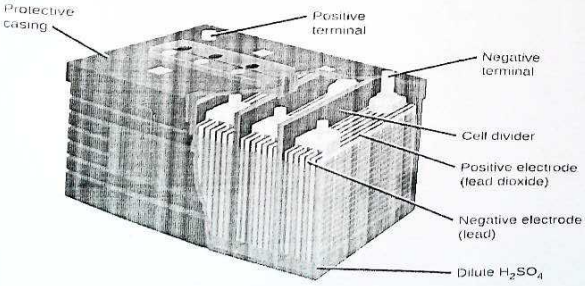


Fig 2.5 Sectional view of an accumulator

2.5 CHARGER

A charger is a device use for charging a battery or battery-powered equipment. It is also a device used to put energy into a secondary cell or rechargeable batteries by forcing current through it i.e. push and pull. For this project two devices are used as charger. These are:

(i) Solar charger:

(ii) Electric charger

A solar charger makes use of the sun to recharge a battery. A solar plate is a light sensitized steel backed polymer material which generates electrons upon irradiation by the sun.Solar power is energy from the sun that is converted into thermal or electrical energy. It is one the cleanest and most abundant renewable energy source available.

An electric charger on the other hand makes use of the electricity to recharge a battery.

CHAPTER THREE

MATERIALS AND METHODOLOGY

3.1 CONSTRUCTION OF LAMINATED CORE TRANSFORMER

The project was constructed in a modular form and it is explained in this section.

Basic Power Supply Design

There are many types of power supply. Most are designed to covert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken into a series of blocks, each of which performs a particular function.

A transformer either steps down high voltage to low voltage or steps up low voltage to high voltage depending on the number of turns in the primary and secondary coils.

A rectifier converts alternating current to direct current.

The materials used for this work are listed as follows:

(i) Coated copper wire, primary (size 21) & secondary (size 17)

(ii) Plastic format

(iii) Lamination (E & I)

(iv) Stands

(v) Bolts and nuts

(vi) Screw-driver and case.

Procedures:

i. The transformer was wound in an automated method.

ii. Primary wire was turned on the format using left hand to hold the format and right hand to wind the primary wire on the format and was counted after each turns, and by making sure the primary wire was well laid.

iii. After the winding of a roll, application of cello paper was done for easy counting.

iv. Counting of turns [primary wire winding]

v. Primary coil $= 53\text{turns} + 50\text{turns} + 50\text{turns} + 53\text{turns} + 52\text{turns} + 53\text{turns} + 53\text{turns} = 367\text{turns}$

vi. After the whining of the primary coil which is 367 it was then followed by the whining of the secondary coil, been doubled together in pair (19) using bifilar method.

vii. The fixation of induction E & I, both were done in an alternate 4x4.

viii. The stands were fixed and tighten with the application of bolts and nuts.

ix. And the settings were cased.

Calculation of the primary output

$$x=12v$$

$$\text{Primary}= 53+50+50+53+52+53+54=367\text{turns}$$

$$367turns \times 12v = X \times 220$$

$$4404v = X \times 220V$$

$$X = \frac{4404}{220}$$

$$X = 20.01 \text{ turns}$$

Also,

The kind of transformer used in this design is IL5408 ac power conversion, and it works as expected.

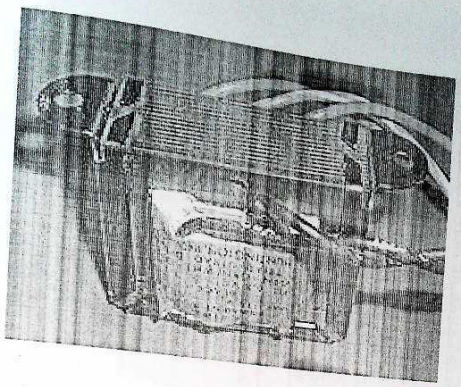


Fig 3.1 Picture of Laminated core transformer

3.2 BRIDGE RECTIFIER

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses the entire AC wave (both positive and negative sections). Bridge rectifiers are rated by the maximum current they can pass and the maximum reverse voltage they can withstand (this must be at least three times the supply RMS voltage so the rectifier can withstand the peak voltages).

By contrast, rectifier diodes and bridges for use in power suppliers are heavy objects with current ranging from 1A to 25A or more breakdown voltages going from 100 volts to 1000 volts. They have relatively high leakage. For this project, IL5408 is used up in the bridge rectifier.

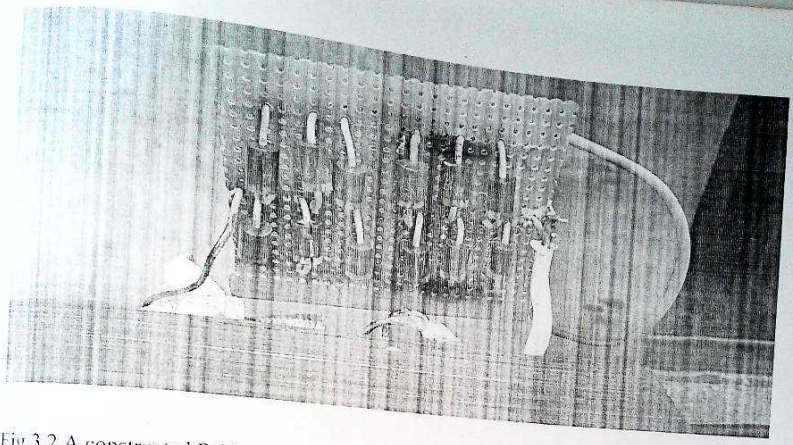


Fig 3.2 A constructed Bridge rectifier circuit

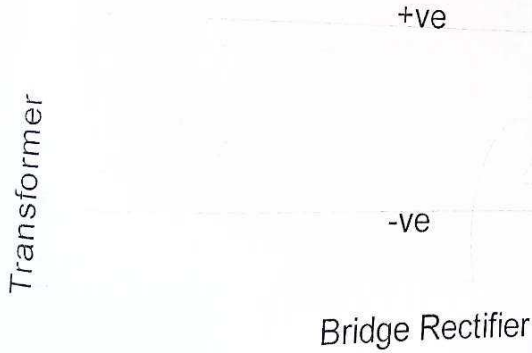


Fig.3.3 Schematic diagram of the constructed bridge rectifier

Current Flows is the bridge rectifier for both positive and negative swigs of the transformer. there is a forward path through the diode bridge. Both conduction paths cause current to flow in same direction through the load resistor, accomplishing full-wave rectification. While one set of diodes is forward biased, the other set is reverse biased ad effectively eliminated from the circuit.

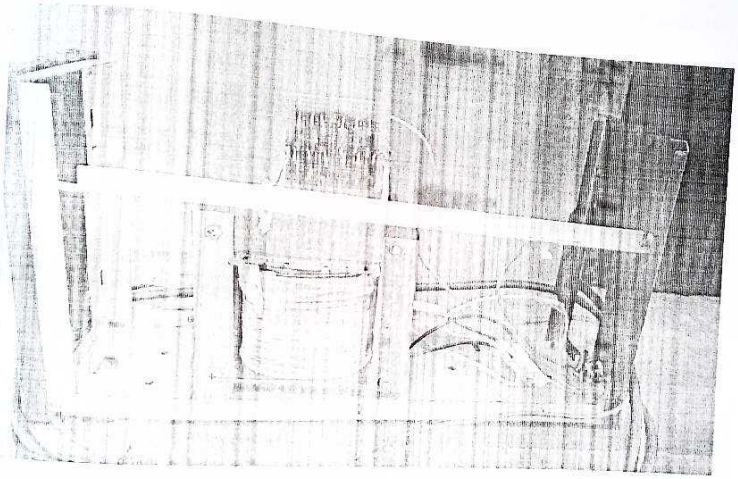


Fig 3.4 A diagram showing the constructed transformer and bridge rectifier

CHAPTER FOUR

RESULT CONCLUSION AND RECOMMENDATION

4.1 RESULT

The work piece developed in this project is designed to charge majorly 12volts 100Ah using solar energy and electricity power. A transformer with an output AC 230volts is used which step down the AC voltage to low AC voltage of 12volts. A bridge rectifier is connected to the transformer. The bridge rectifier is made up of 16 individual diodes which are used to convert the low AC voltage to DC voltage. Here the voltage remains 24volts. Hereafter, a capacitor is connected to the bridge rectifier.

The capacitor of 22000μF 50V is used to store charges and smoothen current from the diode. The capacitor is mainly connected to the input and the common. To determine if the circuit is powered, a LED which signal light is used is connected directly.

Lastly the output of the whole circuit gives the desire voltage which is 12volts which can charge our battery of 100Ah without any damage.

4.2 PRECAUTIONS

i. We made sure that the coated wire used was not peeled when turning so as to avoid the surface of the wire from contacting each other.

ii. Cello paper was applied after every turn of the primary wire to aid easy counting.

iii. The format used was smooth.

iv. Lamination (E&I) was cleaned so as to make it free from carbon and was well fixed to avoid the transformer from vibrating when working.

v. The stands were fixed and tightened properly with the application of bolts and nuts to prevent it from losing.

4.3 CONCLUSION

This project work has been able to design two ways of charging two 100Ah lead acid batteries both together and separately. The two ways are either via the use of solar panels or an electric charger. The solar panel charges the batteries through the direct conversion of solar energy into electricity. The panels, which are four in number with an output power rating of 40W each were connected in series and installed in the month of September. Since this falls within the rainy season, solar irradiance has been very low. Consequently, it takes between two and three days of exposure to sunlight (18hrs- 27hrs, between 8am - 5pm each day) to charge a single battery to full capacity (12v). It was however observed that sunny day especially in early august and mid-September, minimum charging was achieved within two days of sunlight (18hrs). The two batteries were not connected together for charging.

The epileptic nature of public power supply has hindered charging with the electric charger. However, it was powered with a 5KVA generator set, and it took an average

about 12hour to charge to full capacity while connected in series. The batteries were not charged singularly using a generator set.

4.4 RECOMMENDATION

It is recommended that the charging rate of the solar panel can be studied in the dry season, when there would be more solar irradiation. This would allow for a comparison of charging rates in both seasons. Also, the batteries should be charged both in series and parallel connections. So also, a smaller generator which is more affordable for many people should be used to power the electric charger so that a comparison can be made between the charging rates of both the big and small generators. In both cases, the batteries should be charged both in series and parallel connection so as to determine the configuration in which batteries charge faster.

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