DESIGN, CONSTRUCTION AND TESTING OF AN EMERGENCY LIGHTING SYSTEM.

BY

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92/2530

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DEDICATION

This project work is dedicated to my parents, Alhaji Ibrahim Naibi, Alhaji Shehu, Mallama Aishatu Shehu Naibi, My dear brothers Abubakar Umar, Mohammed Idris, Zakari A.S. Yahaya, Abdullahi Salihu, Adamu Kasimu, for given me the courage to forged towards an end of this project work.

ACKNOWLEDGEMENT

My gratefulness goes first to Almighty Allah whose infinite mercy, love and providence guided me through this programme.

I will like to express my pleasure and gratitude to Mr shehu Ahmed Mahmood, My able and worthY supervisor, a distinguished educator and researcher. His accessibility, simplicity and approach to work is a model worthy of emulation.

My indebtedness goes to the entire staff of Electrical/computer Engineering Department who has one way or the other make this project a huge success..

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I also expressed my unalloyed and earnest gratitude to all my friends and relatives both near and far who serve as pipeline to make this project see the light of the day.

Lastly, Another big thank to Mr Jonatha Kolo for his immensed contributions that make this project a huge success. All his kind understanding and advice are appreciated.

DECLARATION

I hereby declare that, this thesis presented in partial fulfilment of the requirement for the award of Bachelor degree in Electrical and computers Engineering (B.Eng) is a complete handwork of Haruna Ndabida Ibrahim under the supervisor of Mr Ahmed Mahmod. During 1997/98 academic session.

CERTIFICATION

I here by certify that I have supervised, read and approved this project work which I found to be adequate in Scope and quality for the partial fulfilment of the award of a Bachelor degree in Electrical and computer Engineering (B.ENG)

SIGN.. *DATE* 23/12/98

ENGR MAHMOOD .S. AHMED

PROJECT SUPERVISOR

SIGN.. *DATE* 8/1/99

HEAD OF THE DEPARTMENT

ENGR .S.N. RUMALA

SIGN.. *DATE*...........................

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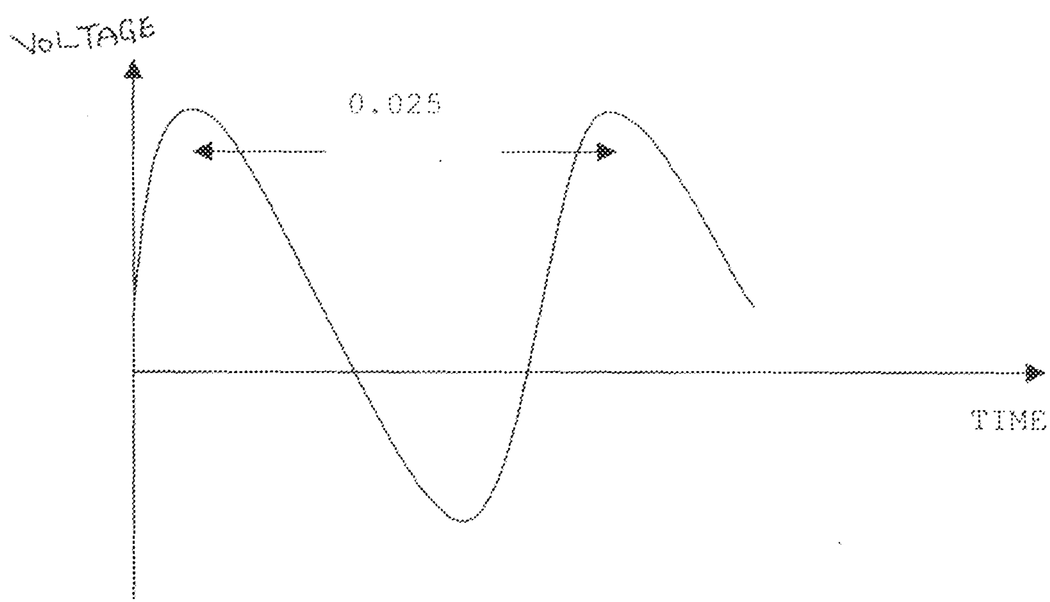
Chapter three contained how components were first connected in breadboard, and tested satisfactory before transferring into vero-board where soldering was done and also tested to confirm correct connections. Chapter four based on project discussion of result from construction.

Finally, chapter five gives the conclusion and offers some recommendations for future advancement on the project.

1.2 PROJECT OUTLINE

The basic electrical power available in any community is usually an alternating supply.

The supply voltage fluctuates, usually sinusoidal as shown below:



The frequency is generally 50 or 60HZ. This can be used unmodified for heating, lighting and some electric motors. But there are many applications where the load being supplied requires a potential differences of fixed polarity to be applied to it, i.e it requires a unidirectional current flow.

forward direction is less than that to the current in the reverse direction.

Basically, it is a unidirectional device whose resistance in the reverse direction is so high that any reverse current is negligible.

An alternating current can be said to rectified if, after passing through the device, its average value, depend over a whole cycle of the applied potential difference, is finite.

The function of all rectifiers are the same regardless of the type of rectifier used. That is, they allow electrons to flow in only one direction.

For single phase (1-0) there are three types of rectifier circuits;

(i) Half wave rectification

(ii) Full wave rectification

(iii)Bridge full wave rectification

HALF WAVE RECTIFICATION

In this type of rectification, only single diode connected in series with the a.c supply and the load. And it conducts on every one half-cycle.

FIG(2.1) illustrate the half wave rectifier with resistive load.

In other to smooth the output of the rectifier, is to connect a capacitor in parallel with a load resistor as shown in Fig.(2.1a). The capacitor becomes charged during conducting half cycles, this discharged current during the non-conducting half cycles, this discharge current flowing only into the resistor because of the reversed characteristic of the rectifier. The current i flows only during the interval of time in which $V1 > v_2$.

The disadvantage of this rectifying circuit, is that is has low efficiency. The d.c output of rectifiers circuit is required to be steady, and this could be achieved if the load voltage could be prevented from falling to zero during alternating half cycles. This could be achieved in connecting a capacitor in parallel with the load resistor as shown below:-

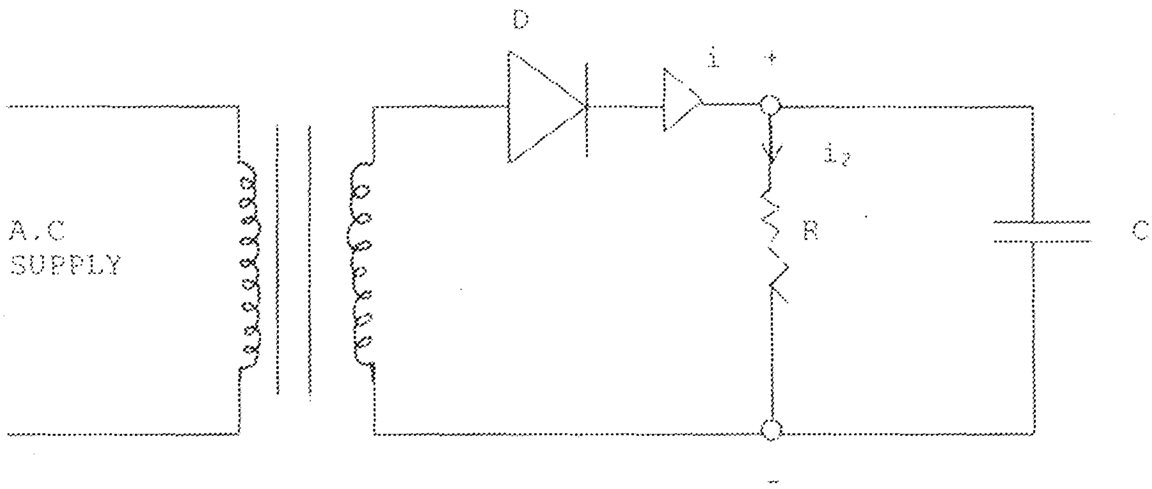
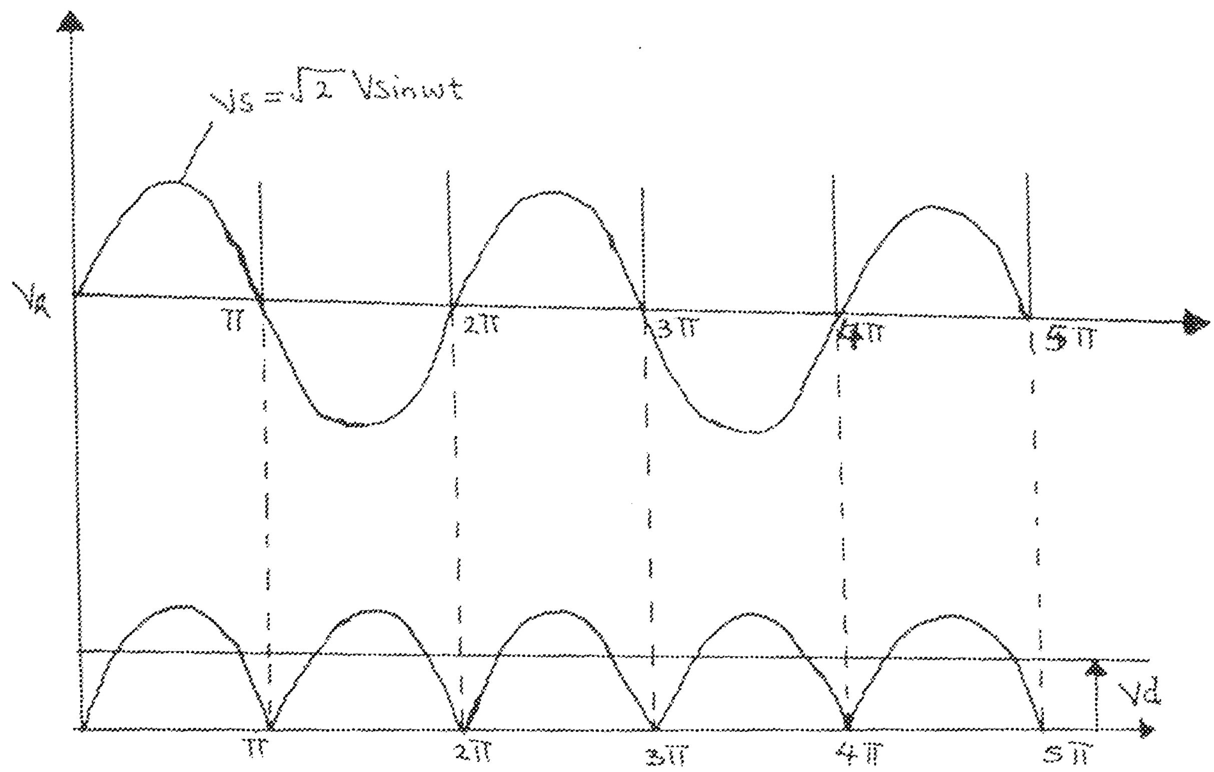


Fig 2.4b The Bridge full-wave rectifier with load voltage, wave form.



The d.c. component of full wave rectifier is given by::

$$Idc = \frac{1}{2\pi}\int_0^{2\pi} Id(\omega t)$$

Where I = instantenous value of current voltage

V = Vm sin wt

$\therefore$ I = V/R = $\frac{Vm\ Sin\ wt}{R}$

Where R = load resistance

2.5 MAINTAINABILITY OF BATTERIES

There are measures to be taken when using secondary cells.

(i) Adding of water from time to time to keep the level of the electrolyte within the limit specified by the manufacturer.

(ii) Keep spark low and flames away from the yent of a cell so that the hydrogen and oxygen gas produced within a cell is not ignited.

(iii) Stop discharge, except in emergency, before the voltage fall tool low for satisfactory operation.

(iv) Never allow any (special solution), powders, jelly, any metal or other foreign matter to get into the cells.

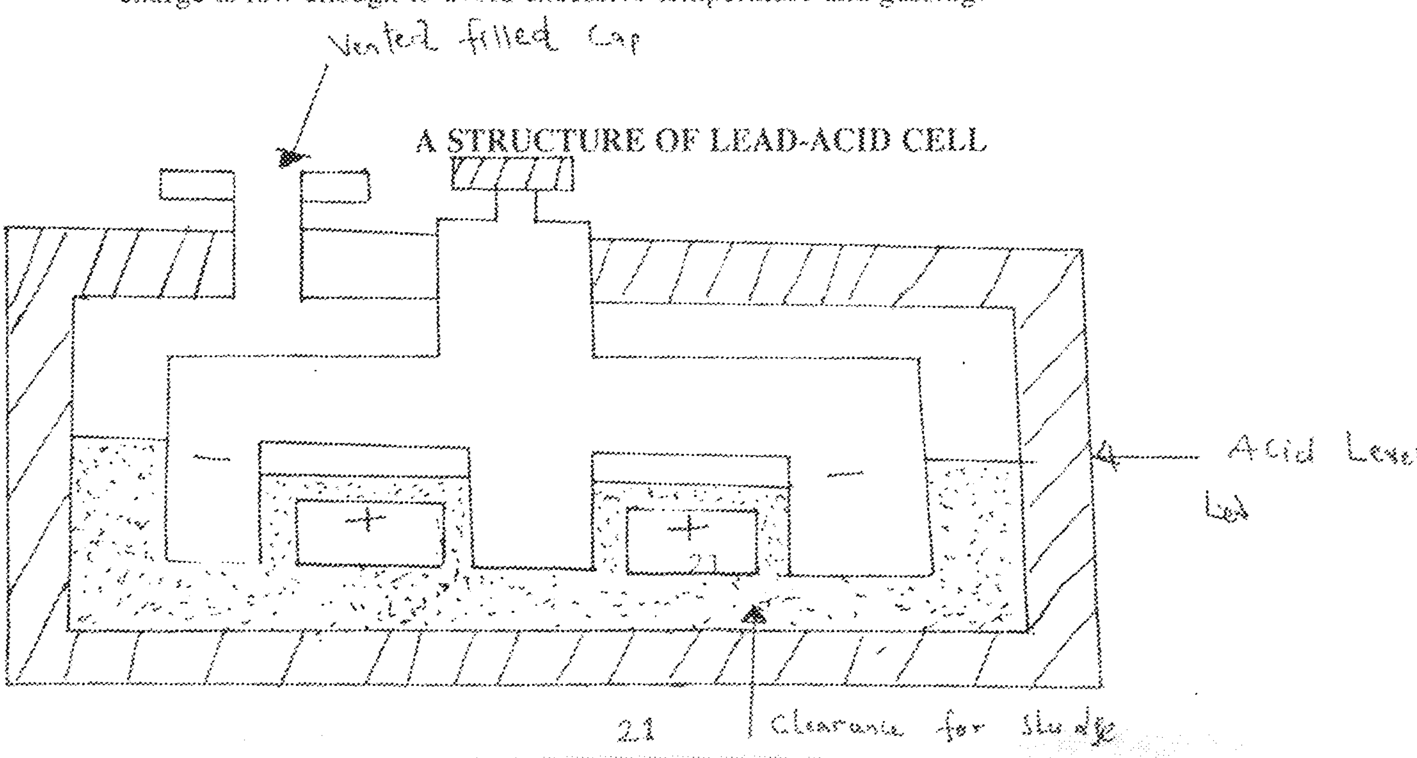
(v) The specific gravity of the battery gives the best indication of its state of charging. a discharged cell will have a specific gravity of 1.150, which will rise to 1.280 when fully charged.

(vi) Never add electrolytic or acid except to replace a loss known to be due to spillage and the added acid should then be of the same specific gravity as that in adjacent cells.

(vii) Always keep the battery clean and dry.

All manufacturers provides information for the care and operation of their different types of batteries. Excessive overcharge in ampere-hours should be avoided, even if the rate of charge is low enough to avoid excessive temperature and gassing.

A STRUCTURE OF LEAD-ACID CELL



2.6 TRANSFORMER STAGE

Transformer is a stationary apparatus for transferring electrical energy from one alternating current to another without change of frequency, through the medium of magnetic field. It serves the purpose of charging the output voltage with respect to input voltages.

The input side of the transformer is referred to as primary, and the output side as the secondary. The transformer is used to either increase (step-up) or decrease(step-down) the voltage level, depending on the requirement of power supply. Let N_P represent the number of the transformer primary turns, and let N_S represent the corresponding number of secondary turns. A transformer is described by its turns ratio, which can be specified as either $\frac{N_P}{N_S}$ or $\frac{N_S}{N_P}$.

Let v_1 and i_1 represent the instantaneous primary voltage and current and let v_2 and i_2 represent the instantaneous secondary voltage and current. The following relationships apply to the transformer: -

$$\frac{V_2}{V_1} = \frac{N_S}{N_P}$$

$$\frac{I_2}{I_1} = \frac{N_P}{N_S}$$

Although stated in terms of instantaneous variables proceeding relationship apply equally well to root-mean square (rms) quantities. Infact, most transformer voltages and current ratings are specified in rms units.

TRANSFORMER

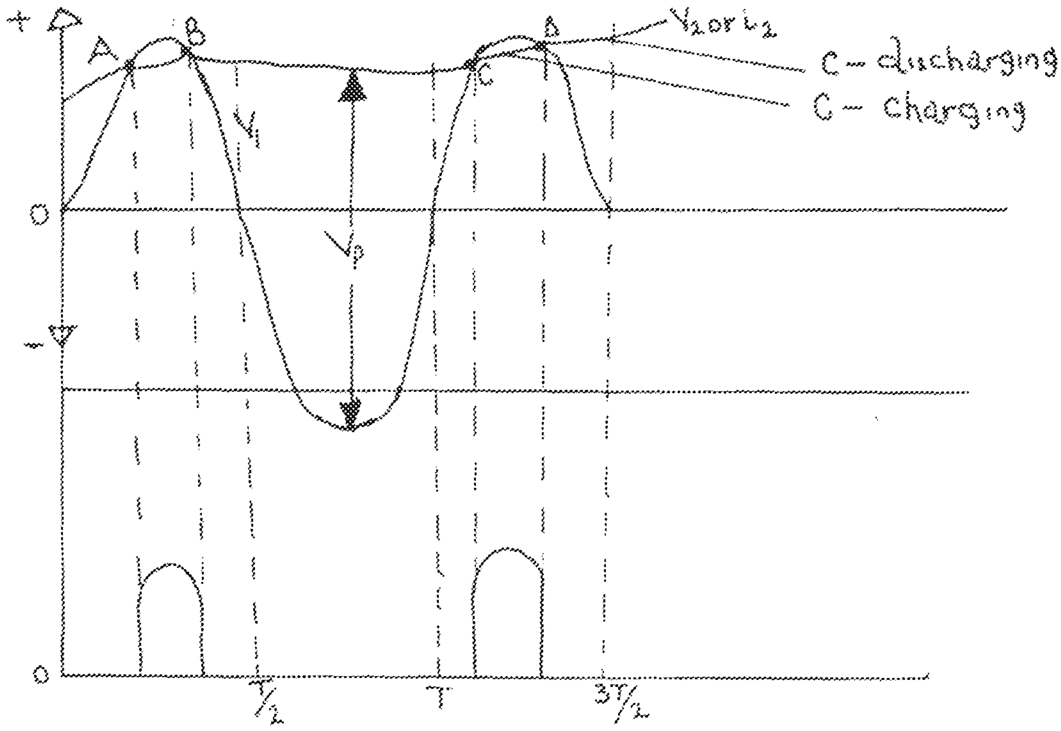


Fig. (2.2) illustrate the half wave rectifier with combined resistive and capacitive loading.

FULL WAVE RECTIFICATION

In full wave rectification, both wave of the cycle of applied potential difference are utilized, it consist of two diodes each conducting an alternative half cycle due to conduction of electrons in the load throughout the cycle which give higher efficiency. However, center tapped transformer with secondary winding most be used. This kind of rectification is employed in this project work, to rectify current flowing into the charging unit.

This is accomplished by taking the negative output terminal to the mid-point of the secondary winding of the supply transformer, and connecting each of the two secondary terminals to separate rectifier, as shown in Fig.2.3

There is an important phenomenon which does not occur with half-wave rectification, that is the reverse voltage to which the non-conducting rectifier is subjected is the arithmetic sum of its own applied p.d and the voltage drop across the resistor.

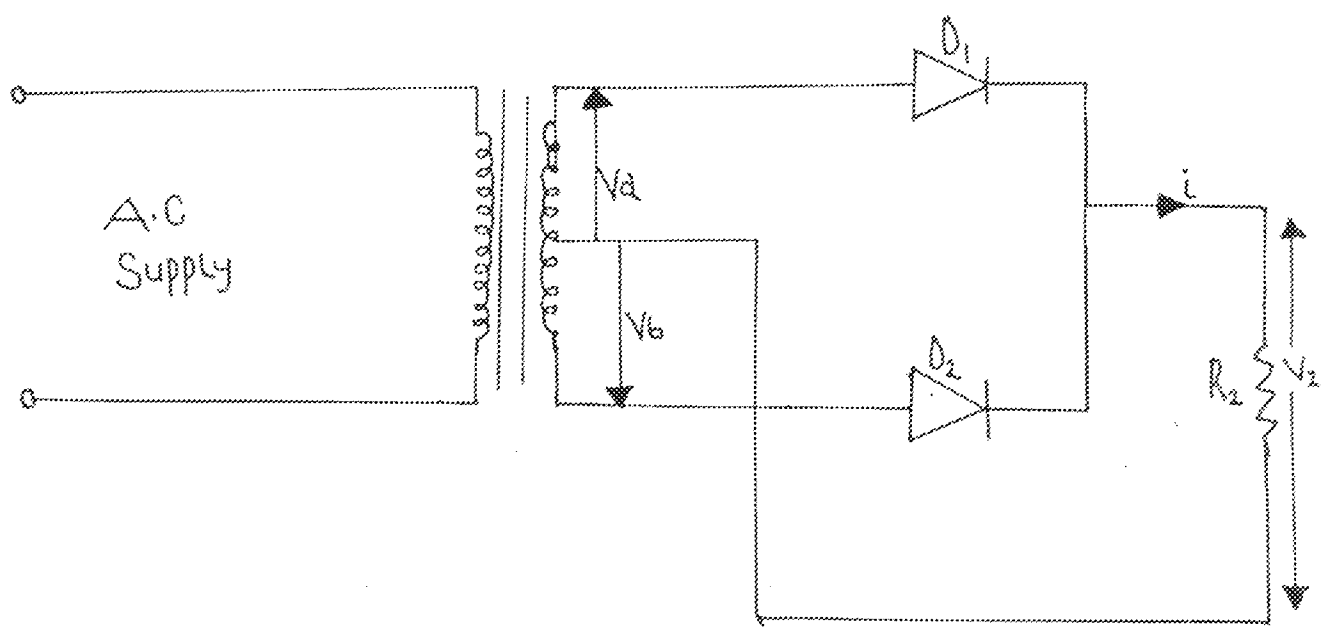
At the normal operation, $R_2 >> R_1$, it follows that this voltage drop is little less than the applied p.d, while the result that peak reverse voltage is very nearly equal to 2Vm.

The full - wave circuit has the following advantages over the half - wave circuit.

(i) Full wave is more efficient

(ii)The ripple voltage is at twice the supply frequency i.e at 100Hz.

The increase in the ripple frequency makes it easier to reduce the percentage rippled to the desired level. The disadvantage of the circuit are the need for a center tapped transformer and for two diodes.



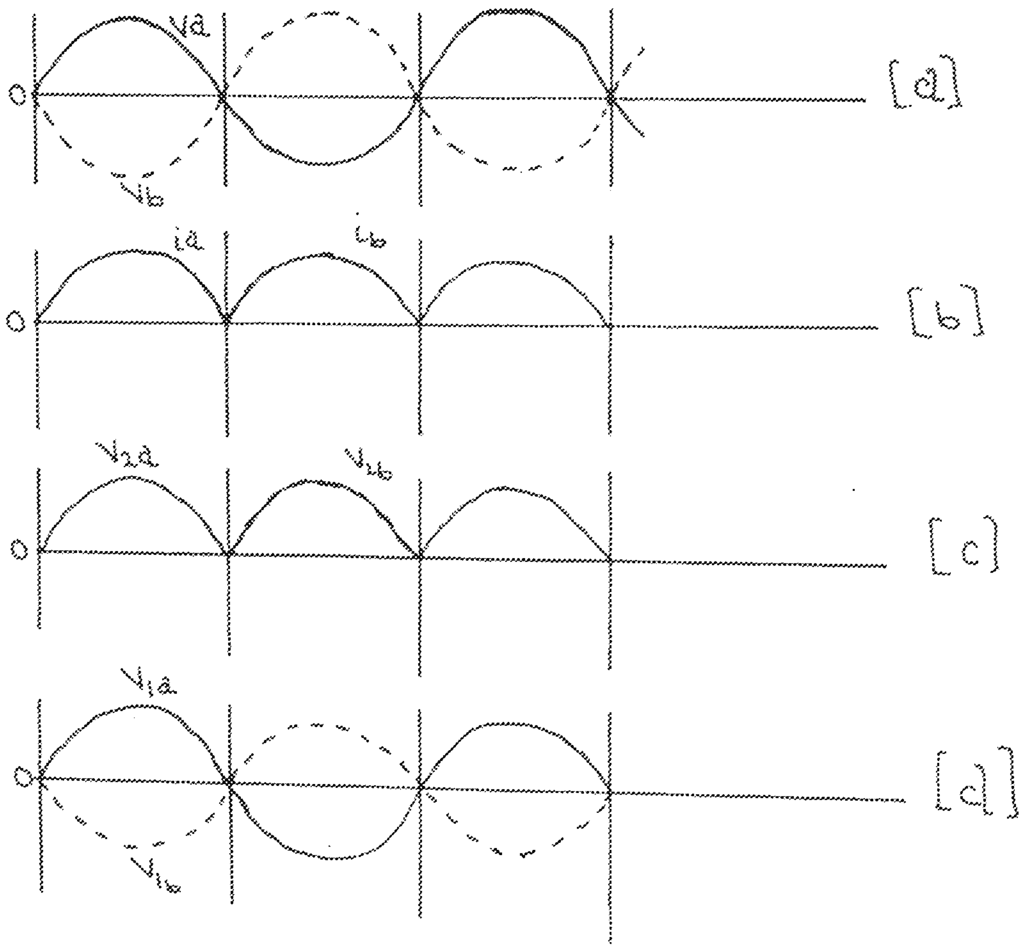


Fig. 2.3 illustrate Full-wave rectification

(a) Applied voltage

(b) Current

(c) Terminal voltage

(d) Voltage drop across rectifier

BRIDGE FULL WAVE RECTIFIER

In the bridge full-wave rectification,four diodes in one encapsulated unit over the whole cycle without center-tapped transformer used. Bridge full-wave rectification was used in this project work to rectify current entering the switching device (relay). The disadvantage of using the circuit full-wave rectifier, is that transformer secondary windings must produce twice the voltage of that used in the half-wave rectifying circuit. Because only half of the winding is used at any one time.

This is why the issue of bridge full-wave rectification arised, to solve that problem, since the bridge rectifier circuit requires four diodes as shown in fig 2.2, instead of two diodes to avoids the need for a center-tapped input transformer.

The variations in the load voltage can be reduced by connection of a capacitor across the load. The load voltage waveform is then that of fig 2.2b

When higher d.c. voltage are required, the bridge circuit has some advantages over the circuit using a center-tapped transformer.The peak inverse voltage (PIV) of each diode is only equal to the peak secondary voltage vs;a center-tapped secondary winding is not required, and the current rating of the transformer is less. This means that a smaller and hence a cheaper transformer can be used.

The current through the load resistance is always in the same direction and d.c. component is twice as large as in fig 2.4a below.

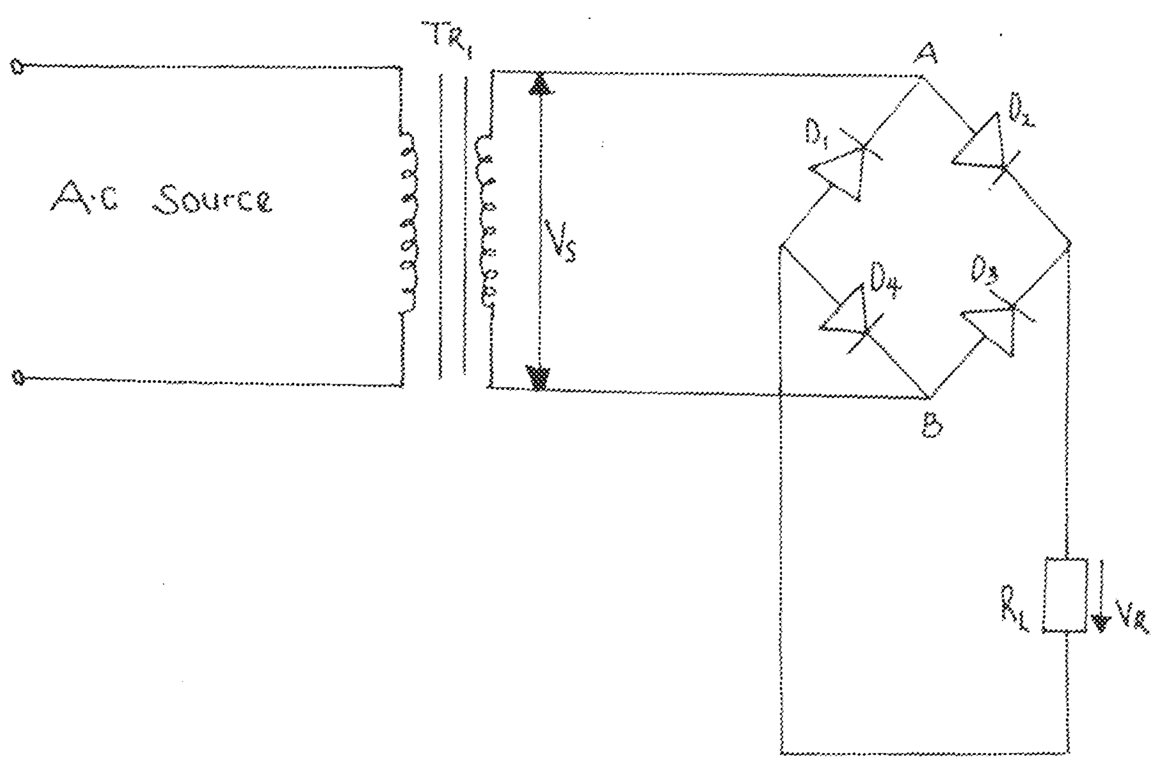
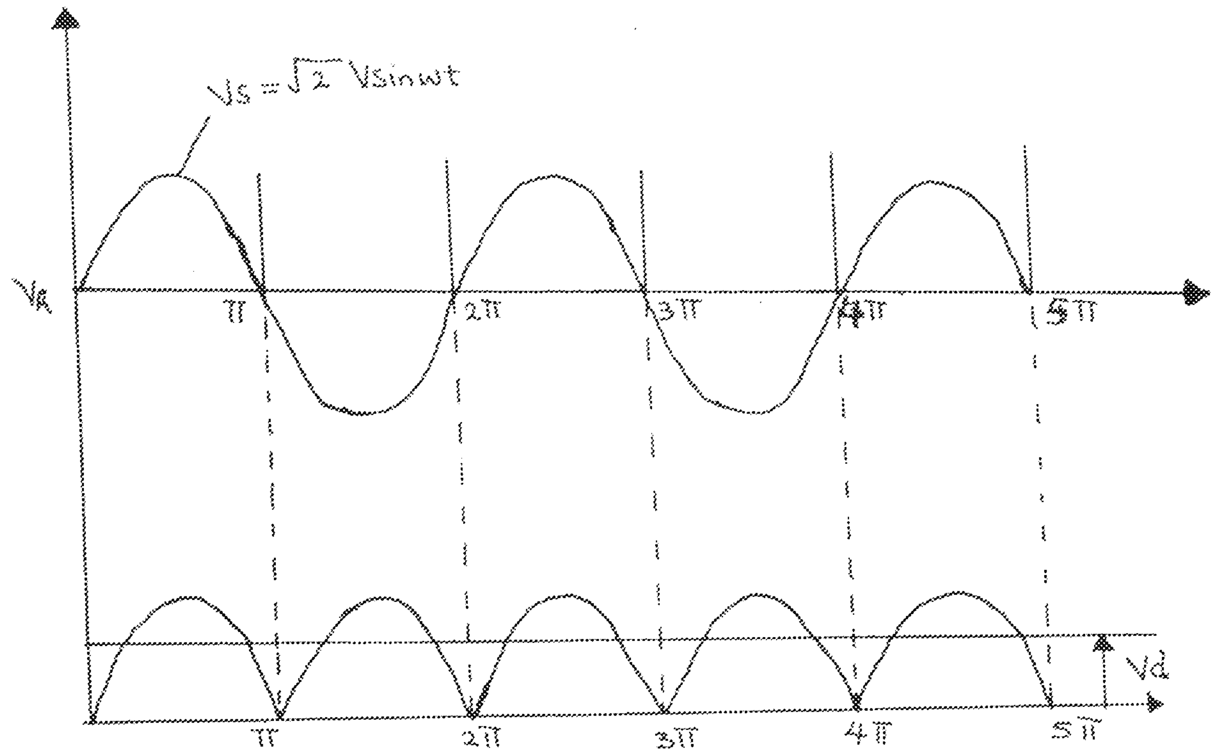


Fig 2.4b The Bridge full-wave rectifier with load voltage, wave form.



The d.c. component of full wave rectifier is given by::

$$Idc = \frac{1}{2\pi}\int_0^{2\pi} Id(\omega t)$$

Where I = instantenous value of current voltage

V = Vm sin wt

$$\therefore \quad I = V/R \quad = \frac{Vm \ Sin \ wt}{R}$$

Where R = load resistance

$$Idc = \frac{1}{2\pi} \int_0^{\pi} Id(\omega t) + \int_{\pi}^{2\pi} Id(\omega t)$$

$$= 1/2\pi \int_0^{\pi} \frac{VmSin\omega td(\omega t)}{R} + \int_{\pi}^{2\pi} VmSin\omega td(wt)$$

$$= \frac{1}{2\pi} \cdot \frac{Vm}{R} [Cos\omega t]_0^{\pi} + \frac{1}{2\pi} [-Cos\omega t]_{\pi}^{2\pi}$$

$$= 1/2\pi \ \frac{Vm}{R} [4]$$

$$= \frac{2Vm}{\pi R}$$

$$= \frac{2I\ max}{\pi}$$

2.3 THE BATTERY

Battery are closed electro-chemical power sources, that convert chemical energy reactants incorporated into the device to electrical energy. A battery is a collection of cells wired in series or parallel. In modern usage, cells are often refered to as batteries. Each cell, has a positive and negative electrode, the positive electrode is in oxidation state while the negative electrode is in reduction state.

When the cell is operating, the negative electrode yields electron to an external circuit and the positive electrode accept electron from this circuit. The electrons flows from negative electrode to positive electrode, the current is carried through the battery by ions of the electrolytic solution.

Two main types of battery exist, known as primary and secondary. Primary batteries can be used once only; when the chemical reactants have been consumed as a result of electrical discharge of the battery. Secondary batteries are based on a reversible chemical reaction, the battery may be recharged by passing electrical current through the device in the opposite direction to the discharge current. Despite their ability to be recharge, secondary batteries have a finite useful life.

When comparing and selecting batteries, we are usually interested in the amount of energy that the battery can supply before it is fully discharged. This quantity is called the capacity of a battery and can be stated in watt-hours(w-h), which is a unit of energy, or in ampere-hours(A-h), which is a unit of electric charge.

The two main types of secondary battery are the lead-acid type used in road vehicles for starting lighting and ignition (SLI) and the nickel-cadmium type used in aircraft and military vehicles. The both batteries are also available in smaller sizes for powering portable equipment.

But for the purpose of this project, 12v lead-acid battery is used.

2.4 BATTERY CHARGING

Methods of charging a battery

There are different methods used for charging battery, the followings are the most commonly used.

(a) Constant current:- Batteries are charged by passing direct current through them from positive to negative terminals. The cells are normally connected in series, so that each cell receives the same charging current. When the cells were connected in parallel, it would be difficult to maintain the current division e.m.f (electromotive force) would tend to discharge into those cells possessing a lower e.m.f. Fig 2.5 shows how this may be done using rheostat in series with the output of the charger. The current flowing through the rheostat depends on its safety and on its setting and on the p.d between its terminals. Thus, p.d is the difference between the output voltage of the rectifier and voltage required to charge the cells. Thus, if the rectifier output voltage is much higher than the ritual charging voltage needed for the cells, the rheostat, as the cells charged up is small and the current remains reasonable constant.

An alternative method is to control the current by using a variable inductor connected in series with the a.c input to the charger as shown below:

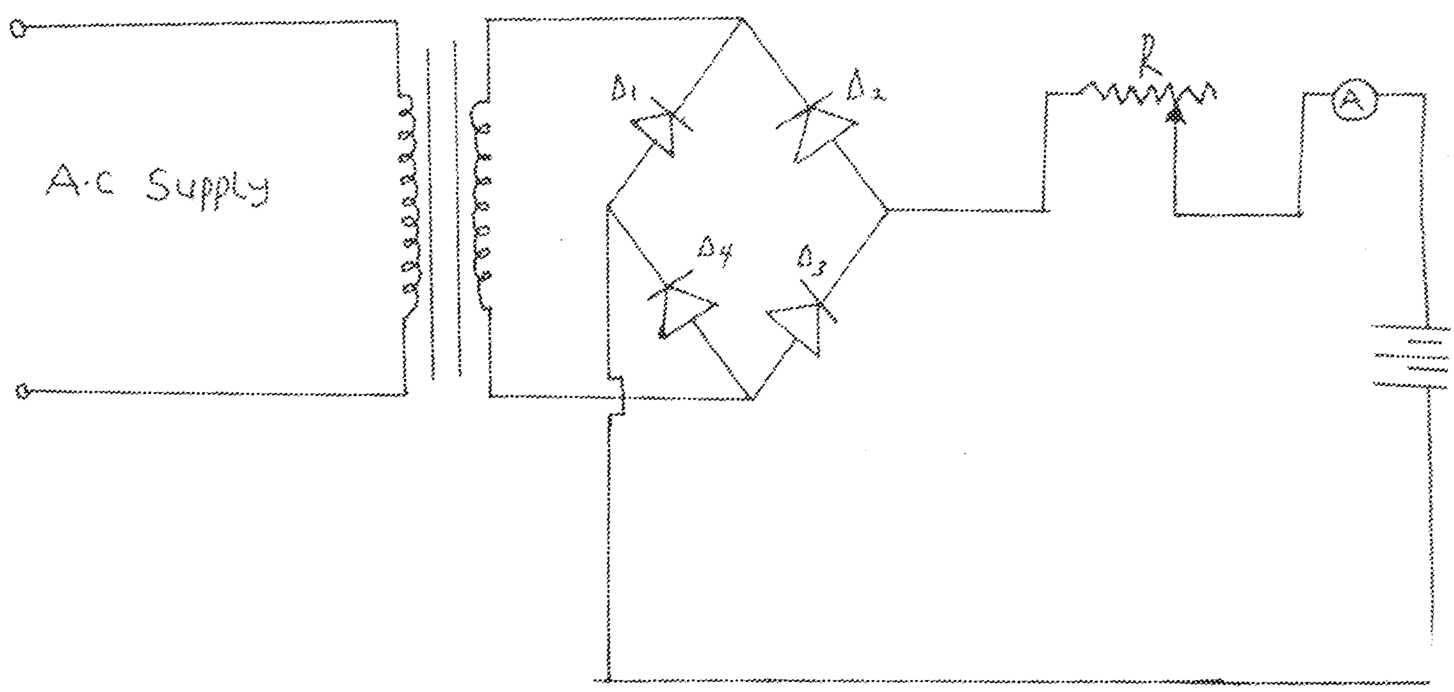


Fig 2.5 shows constant current battery charger.

Fig 2.5 shows constant current battery charger.

(b) Constant voltage method:-When using this method, the charging voltage is maintained constant at a value slightly higher than the e.m.f of the fully charged cell, multiplied by the number of cells connected in series. The charging current using this method depends on the difference between the charging voltage and total e.m.f of the cells. This current may be calculated from the formula:

$$I = \frac{V - E}{R}$$

Where V is the charging voltage

E is the total e.m.f of the cell.

R is the total internal resistance.

The above formula indicates that at the commencement of the charge, when the e.m.f. of the cells is low, the charging current will be large. The charging current will gradually reduces in value when charging is in progress. Fig 2.5 shows the circuit of a constant voltage battery charging, the resistor R, helps to prevent excessive currents flowing at the commencement of the charging.

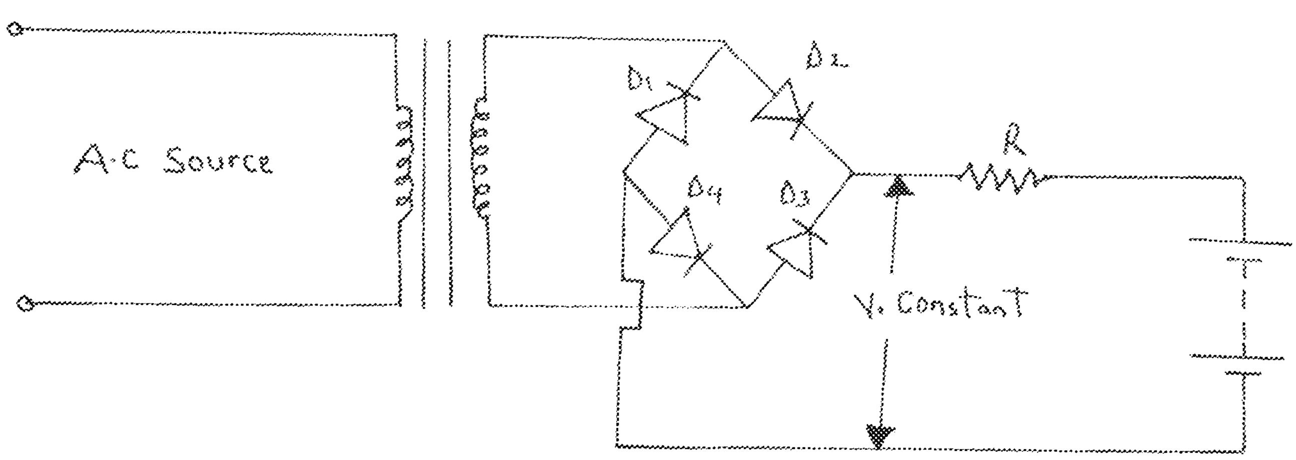
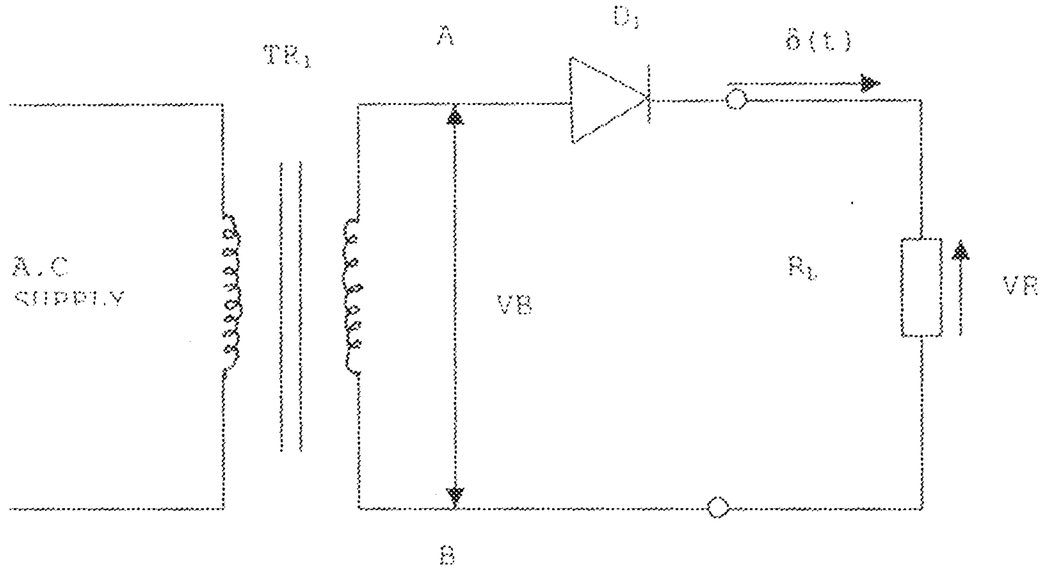
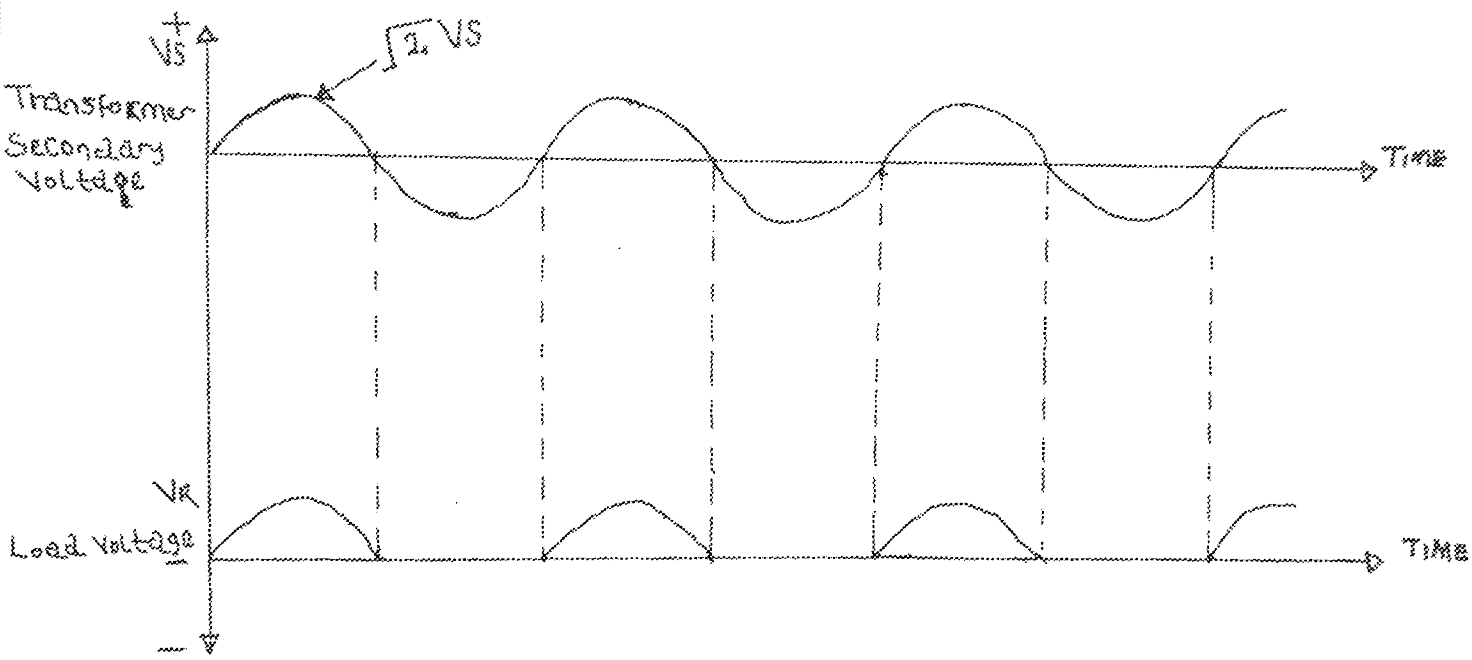
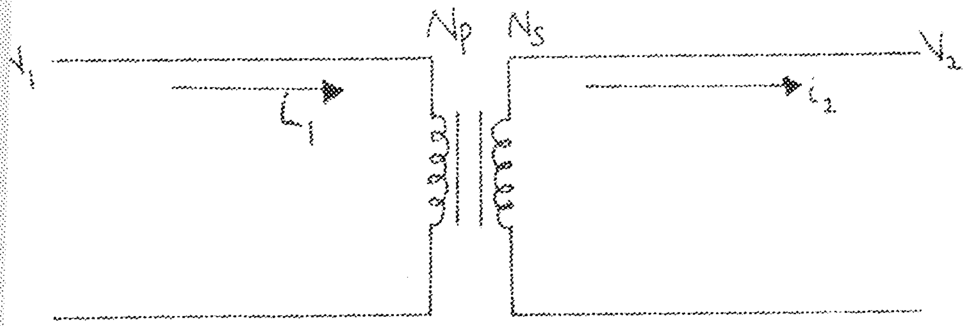


Fig 2.5 constant voltage battery charger.


TR1
A
D1
i(t)
A.C
SUPPLY
VB
RL
VR
B


VS
√2 VS
Transformer
Secondary
Voltage
TIME
VR
Load Voltage
TIME

TRANSFORMER



The steel core consists of laminated sheets about 0.36mm thick, insulated from another from thin layer of vanish. The purpose of laminating the core is to reduce the heat loss due to eddy current induced by alternating magnetic flux. The vertical portions of the core are YORK. The main path of alternating flux circulated in the steel core is represented by dotted lines in the figure below. If the whole of the flux produced by the primary coil passes through secondary coil, the e.m.f induced in each turn is the same for primary and secondary sides.

Hence N_P and N_S are the number of turns of primary and secondary respectively.

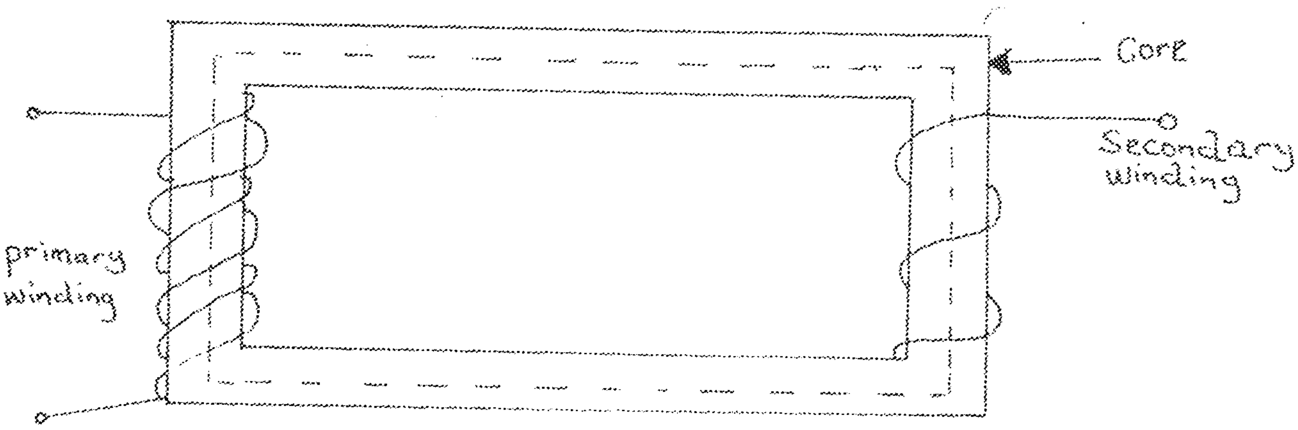
$$\frac{\text{Total e.m.f induced in secondary}}{\text{Total e.m.f induced in primary}} = \frac{N_S \times \text{e.m.f per turn}}{N_P \times \text{e.m.f per turn}} = \frac{N_S}{N_P}$$

When the secondary is open circuit, its terminal voltage is the same as the induced e.m.f. The primary current is then very small so that the applied voltage v_1 is practically equal and opposite to e.m.f induced in primary coil.

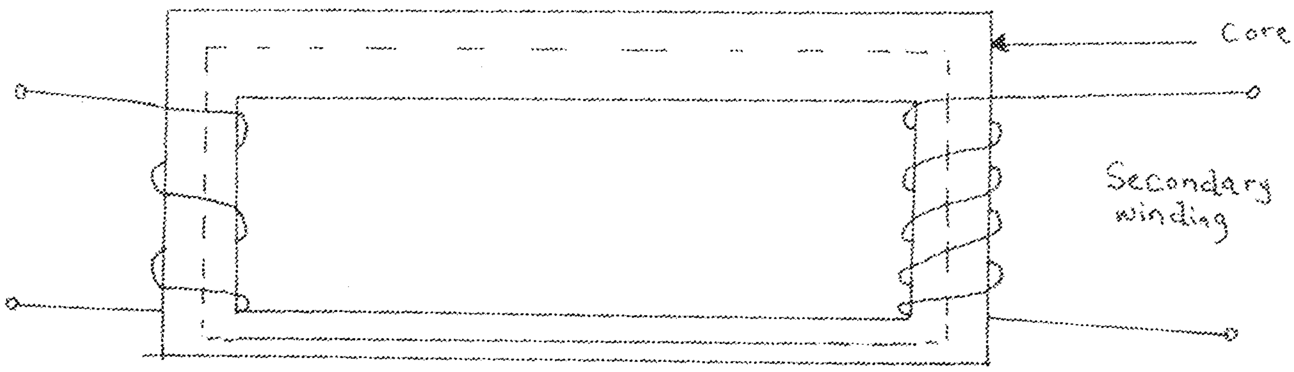
Hence $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

There are basically two major type of transformer used in this project, working on a frequency of 50Hz. The first one is center-tapped and non-center tapped.

The first one, step-down transformer, it steps down the a.c voltage from 220V to 12v (lower d.c voltage) to suit the use of some of the electronic devices like diodes, transistor and others. This is the type of transformer with turns on the primary winding than on the secondary winding and is used to step-down voltage and current.



Structure Of step-down Transformer (a)



Structure Of step-up Transformer (b)

THE MAIN FUNCTION OF TRANSFORMERS IN THIS PROJECT.

(i) The step-down transformer (T_1), isolates the equipment d.c power line from the main supply.

(ii) T_1 also charges the level of a.c main voltage to lower voltage value(12v) required.

(iii) Step-up transformer (T_2), charges the low d.c voltage from T_1 to high voltage value (220v on no-load and 110v on load) required to power the lighting unit.

The primary coil P and secondary coil S are wound on limb coil.

The ratio of secondary voltage to primary voltage N_s / N_p is determined by the numbers of turns in each winding, if the transformer is 100percent efficient at transferring electrical energy from primary to secondary.

This ratio (T = N_s) called "Turn Ratio".

N_p

Secondary p.d = Turns on secondary

Primary p.d = Turns on primary

In symbols

$V_s = N_s$

$V_p = N_p$ respectively.

If N_s is twice N_p, the transformer is step up and V_s will be twice V_p, in step down transformer, V_s is less than V_p

$V_p > V_s$ step down

$V_p < V_s$ step up and

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

$$\frac{V_s}{I_s} = \frac{I_p}{V_p} \text{ and}$$

$$\frac{N_s}{I_s} = \frac{N_p}{I_p}$$

THE INVERTER

2.7 INTRODUCTION

Inverter is a device that does the conversion of direct current (d.c.) to alternating current (a.c.).

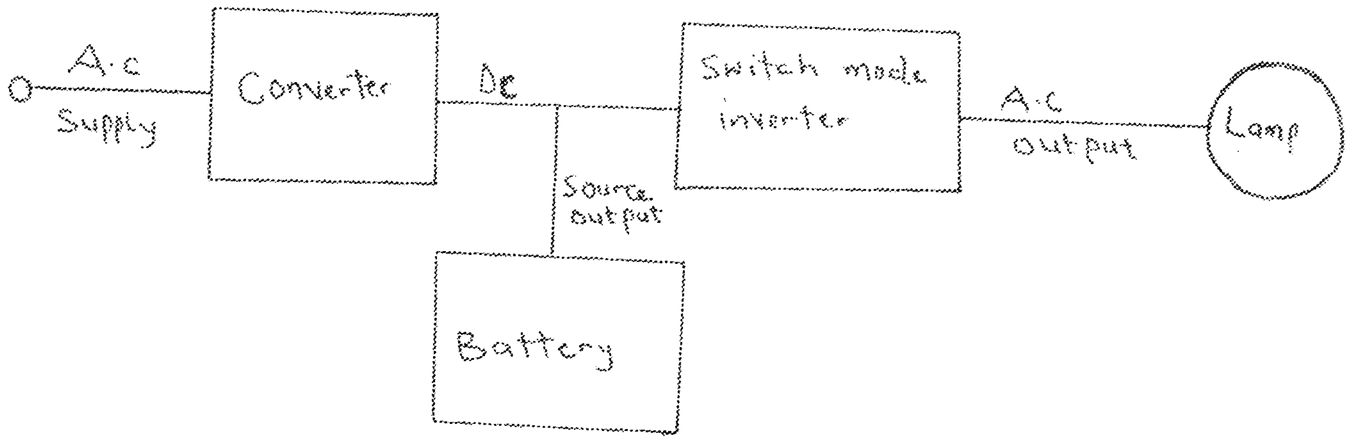
The purpose of inverter is to charge the d.c. Voltage derived from the battery bank to an a.c. voltage in order to power the load. The inverter determines the quantity of power used to drive the load, it is the most important subsystem of emergency lighting system. If the inverter should fail, the system is out of operation.

There are two types of switch mode inverters

(i) Voltage source inverter VSI

(II) Current source inverter CSI.

The block diagram below shows how the conversion was done, from a.c. input to the a.c. output of the lamp.



2.8 BASIC INVERTER TOPOLOGY

There are 3 types of inverter configuration (single phase) Viz.

(i) Full - bridge inverter.

(ii) Half bridge inverter.

(iii) Push- push inverter.

FULL BRIDGE INVERTER

The maximum output voltage of full-bridge inverter is twice that of the half- bridge inverter, with the same d.c input voltage. For this reason, it is preferred over the half-bridge inverter in higher power ratings.

The output current and switch currents are one- half of those of an half bridge inverter for the same power.

HALF BRIDGE INVERTER.

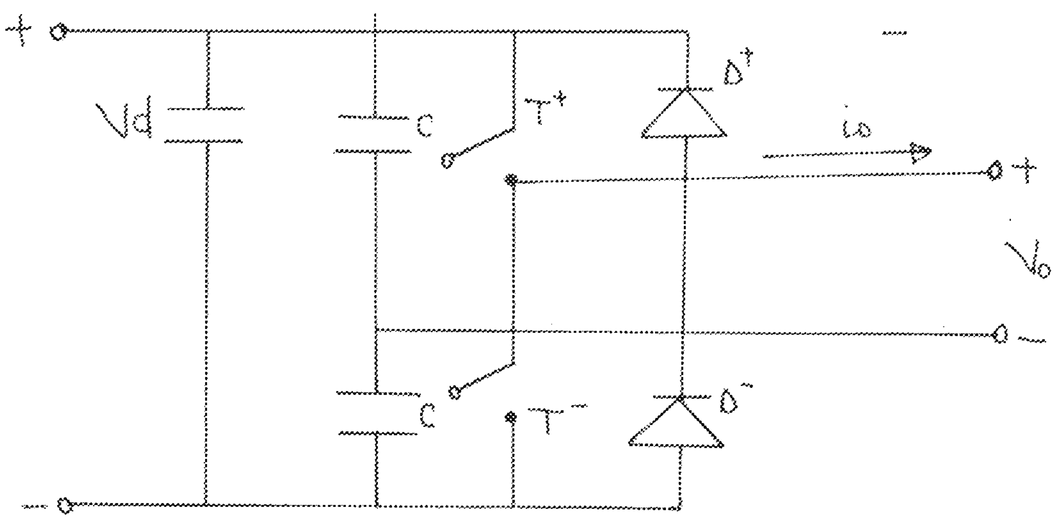
In the half bridge inverter, there are two capacitors of the same size connected in series across the d.c input and their junction is at mid potential, with a voltage of V/2 across each capacitor.

Regardless of the switching states, the current between the capacitors divides equally when T+ is on either T+ or D1, conducts depending on the direction of the output current and it splits equally between the capacitor, C+ and C-. The capacitor C+ and C- are effectively connected in parallel in the path of io and this further explains why junction "o" stays at the mid- potential.

The capacitors block d.c. and eliminate the problem associated with transformer saturation from the primary side where the transformer is used to provide electrical isolation from the output.

The peak voltage and current rating of the switching in half - bridge inverter are as follows:

VT = Vd and IT = i0peak.



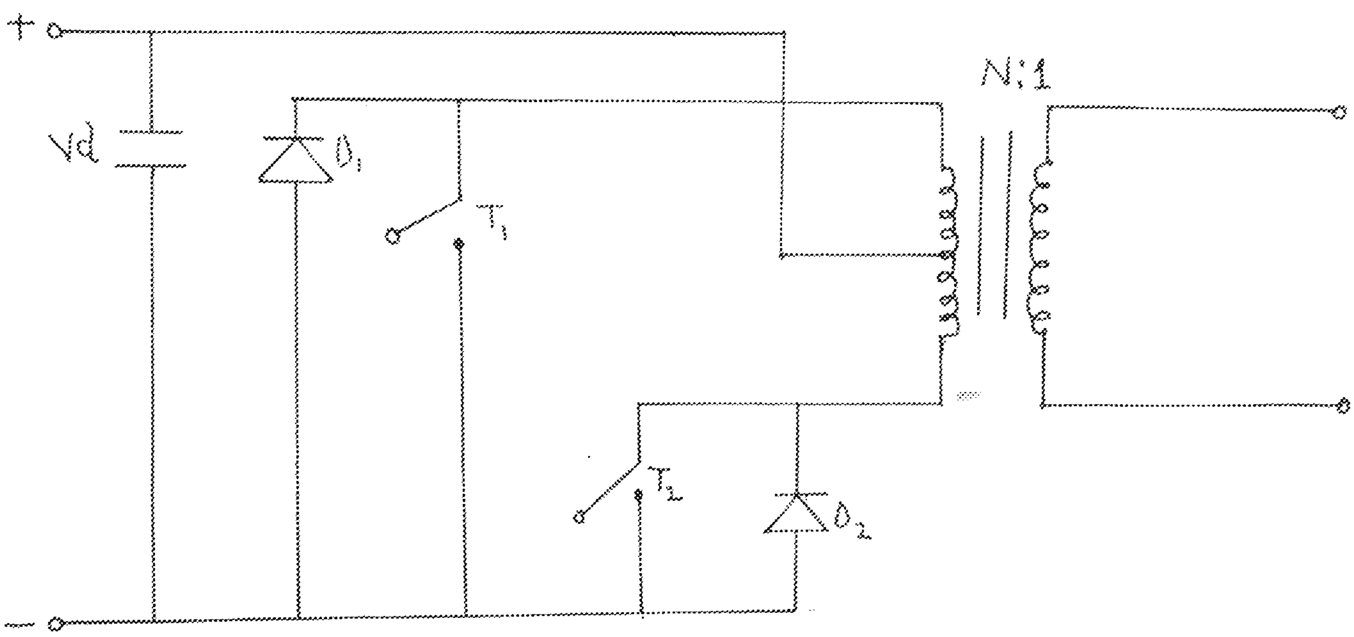
Half- Bridge Inverter.

Half- Bridge Inverter.

PUSH- PULL INVERTER.

A push- pull inverter requires a transformer with a center- tapped primary. A push- pull inverter can be operated in the pulse with modulation or square wave. The main advantage it has is that not more than one time. In push- pull inverter, the peak switch voltage and ratings are:

VT = 2ud and IT = iopeak/n.



CHAPTER THREE

CONSTRUCTION AND TESTING

3.0 INTRODUCTION

This chapter elucidated on how emergency lighting system was constructed. Before the construction of this project, several things were taken into consideration, most especially the theory and design of each stage.

The circuit was first constructed on solder less breadboard, for easy location of bugs and replacement of any damage component when the need arises. It was then transferred onto the vero board, and careful soldering of component was done.

All components lead were kept at a minimum to prevent accidental short circuit. the circuit was carefully planned, minimizing errors and make trouble - shooting. Finally the entire connection was carefully housed in a wooden box (compartment) and the lighting bulb mounted by the side

The principle of operation of the emergency lighting system can be divided into the following parts:

i. The power (main) supply unit.

ii. The battery charging unit

iii. The switching /control unit

iv. The inverter unit

v. The lighting unit

3.1 THE MAIN SUPPLY UNIT

In this section, the main supply from the NEPA gets to the circuit. The main supply source voltage is a single phase i.e. 220v with 50Hz frequency. It was then step-down and rectified before further usage.

The main supply unit consists of the center - tapped step-down transformer, which isolates the d.c Power line equipment from the main supply and also change the level of a.c. main voltage (220v) to the lower d.c. Voltage (12v) as required. The Transformer in this unit was connected to four rectification diodes, which serves as rectifier unit where trace of a.c voltage from the transformer secondary winding is converted into pulses of unidirectional current.

The red light emitting diode connected to this unit, is to indicate when supply is from main source. 1kΩ resistor was connected to the LED to unit the amount of current that goes into it.

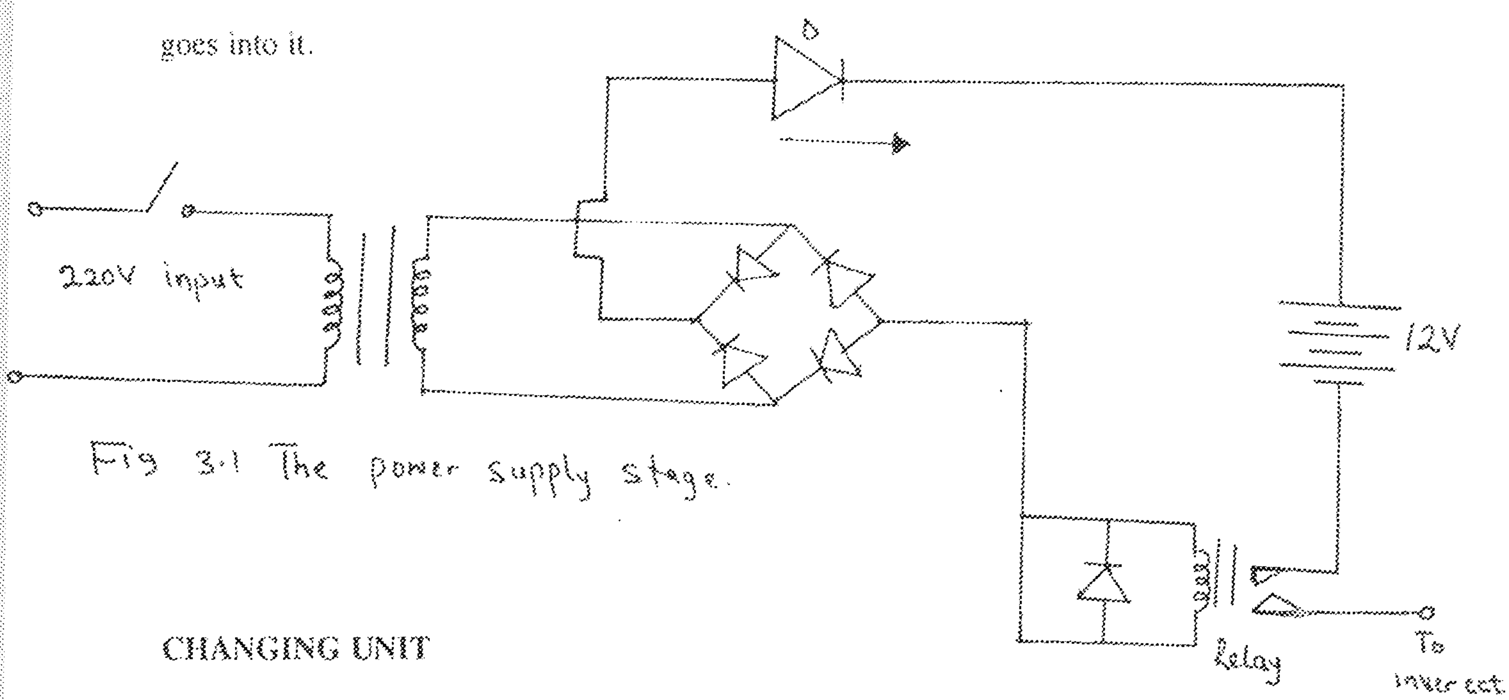


Fig 3.1 The power supply stage.

CHANGING UNIT

3.2 BATTERY

A battery is an energy conversion device, containing one or more cells that generates electrical energy. It is convenient portable source of energy.

Every battery has two important characteristics that determines it's suitability for a particular application, it's voltage and discharge rate.

The voltage of the battery used in this project is 12v-lead acid shortage battery. It positive electrode connected to the inverter that does the conversion of direct current (d.c) to alternating current (a.c) The negative electrode connected to converter section that does the conversion of alternating current (a.c) to direct current (d.c). A lead acid battery is re-charged, by sending direct current of the proper voltage through it, in a direction opposite to current flow on discharge. This reverses the chemical reaction within the cell to regenerate the active chemicals, which can then react to produce an electric current.

CHARGING EFFECT ON BATTERY

This charging unit is essential part of Emergency lighting system due to the fact that it is the source of energy being stored in the battery after the battery must have been discharged. Therefore to make the battery operate it must be charged i.e electric current must be pass through it. When d.c current is supplied by an external power source, flows through the battery, a chemical action takes place inside it. This reverse the chemical reaction within the cell to regenerate the active chemical which can then react to produce an electric current. As a result of which the lead sulphate and plate connected to the positive terminal of the power source gradually changes to lead peroxide. While the lead sulphate on the plate connected to the negative terminal of power source changes to spongy lead gradually, as the acid leaves the plates and returning to electrolyte, thus increasing its density. Initially, a heavy current will flow through the battery when charging an already discharged battery and gradually the current reduces as the battery is being completely charged.

3.3 SWITCHING UNIT/RELAY OPERATION

When the circuit receives it's initial supply from NEPA, it is used to rectified and then connected to an automatic switching device (relay). When the current energizes the relay coil, a magnetic field is set up which magnetize the coil terminal and current flows into the lead acid battery through the battery changer.

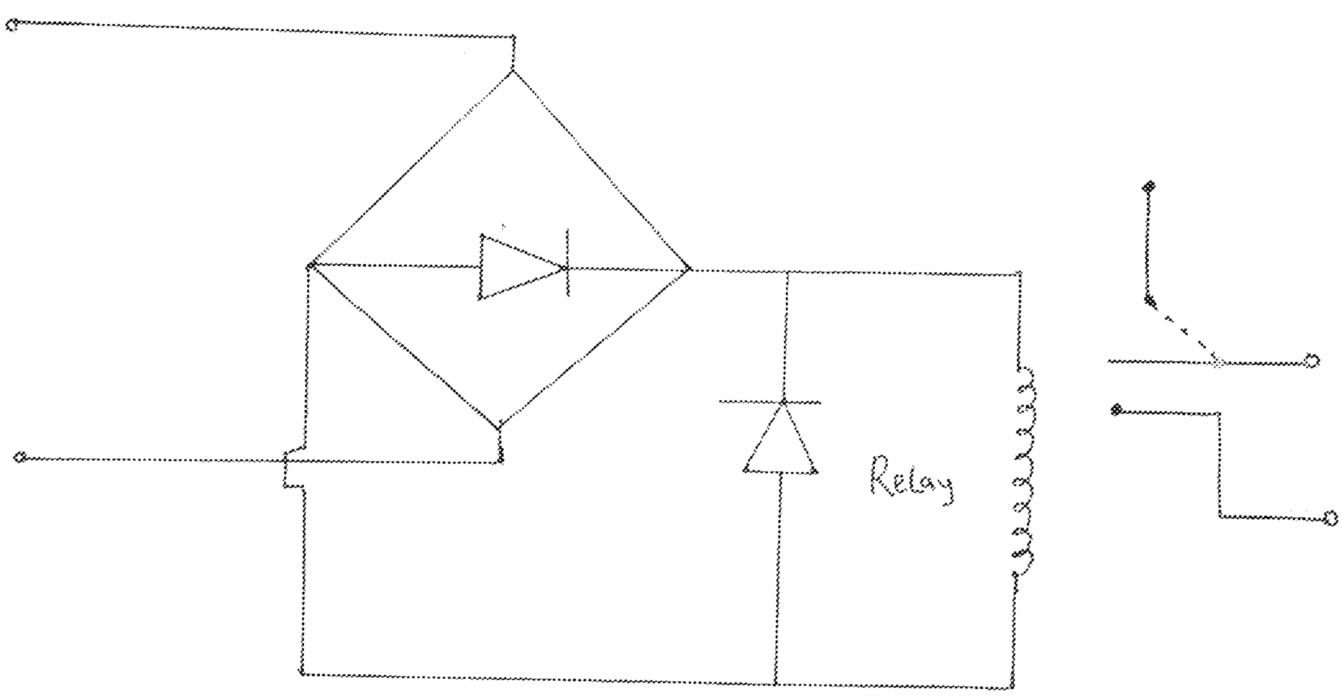


Fig 3.2 Switching unit.

When the power from the main supply fails, the relay de- energizes and thereby change over to the emergency lamp. The battery which was charging before now supply the current to the fluorescent lamp through inverter.

A relay in normally closed positive opens when activated and normally open relay close when energized. When energizing potential is removed, the spring action returns, the amateur return to its original state. Relays can be categorized as an under current and under voltage relays. An over current and over voltage relay operates when the activating quantity (current or voltage) exceeds its operating or pick up values.

An under current and under voltage relay operates when the initial quantity of current or voltage falls below the rest or drop out value.

Relay provides safety for the operation of a device or a system, since relay operating voltage and current can be relatively small when compared to levels required for smooth running of a device.

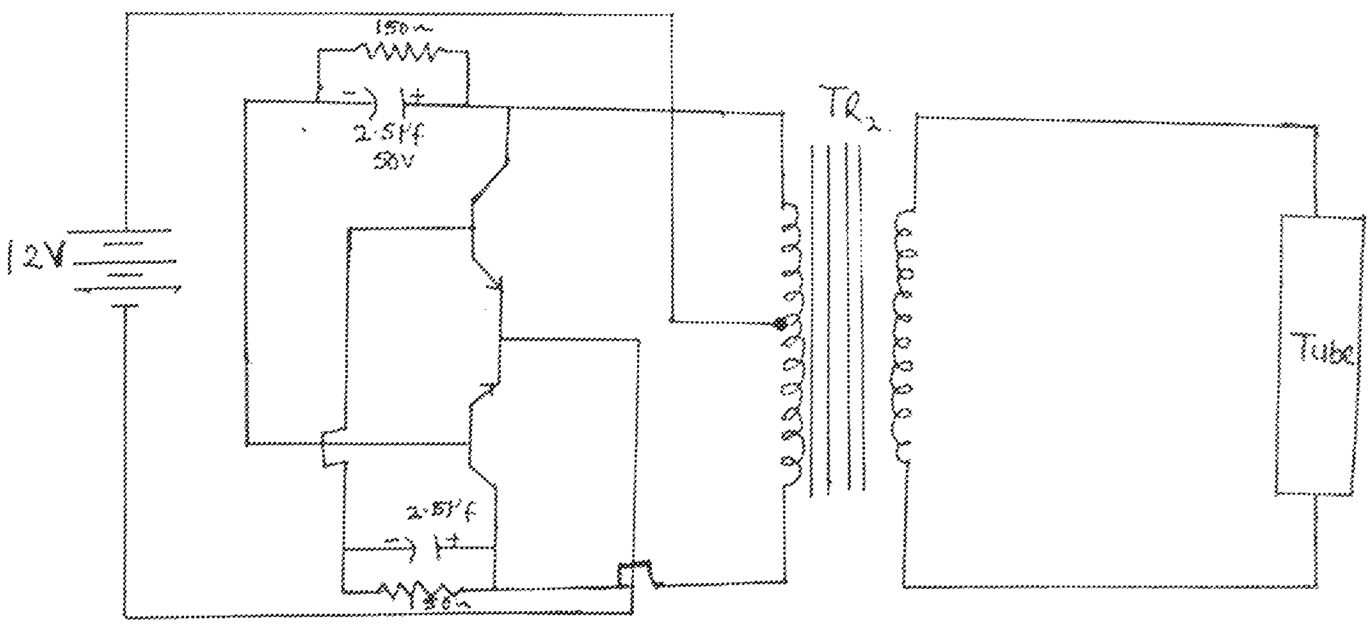
3.4 THE INVERTER UNIT

This is the major determinant of the magnitude and frequency of the output current and voltage. In the event of an output, the battery supply sufficient power to the inverter to maintain its output for specified period of time, depending on the time the battery to discharge to a predetermined minimum voltage or it is turn off.

The inverter is meant to carry out the purpose of conversion of direct current (d.c) to alternating current (a.c). The power transmission in this unit, helps in generating a better substantial amount of electric current through alternating condition and step - up transformer is employed to transform the impedance of the device to optimum impedance required. The connection of the capacitors and inductors forms an oscillator, to produce an alternating e.m.f of known frequency and output Voltage of sinusoidal waveform.

When all the switches are ON, the resulting surge of the d.c. current flows into the inverter circuit through connection point as transistor base current into inductor Li (part of the step-up transformer) and induces an e.m.f at the same frequency into the transformer. This voltage is now applied to the base of the 2N- 3055 transistor. The capacitors helps the transformers in the amplification of oscillator its amplitude is built up until a point is reached the transistor is driven into saturation in one half - cycle, and into off in the other half. The current after 180^0 phase shift flow through L2 to make the second half cycle and e.m.f. is also induced into the transformer.

Fig 3.3 Inverter Unit



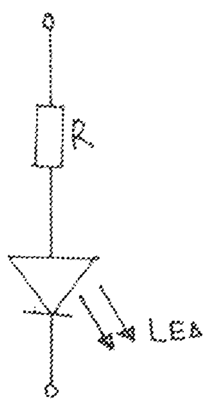
3.5 INDICATOR UNIT

The connection of the indicator circuit in this project is made by connecting light emitting diode in series with a 1k resistor, which serves as current regulator to the L.E.D.

The red LED indicator lamp glows when main supply is ON and OFF for the green LED indicator Lamp to glow as soon as main supply fail and relay call the battery into action (to indicate direct current) supply.

The LEDs are connected in such away that, the red LED takes its source from a.c main supply and green LED takes it's own source from d.c (Battery supply.

Fig 3.4 An Indicator Circuit



When d.c input to the inverter is from a low-voltage source, such as battery where the voltage drops across more than one switch in series result in a significant reduction in energy efficiency.

output power = 500w (assumed)

output voltage = 220volts

frequency = 50Hz

Input voltage = 12v

output current = A

power = voltage x current

P = V X I

$$I = \frac{p}{V} = \frac{500}{200} = 2.27A.$$

Assuming efficiency of 95%, the required effective secondary current:

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 CONCLUSION

Emergency lighting system purely embraces the basic principles of electronics i.e. the use of transistors as amplifiers (BUFFER and POWER). So these projects afforded me the opportunity of really appreciating the world of electronic, and still give me more courage to go inward more into electronics.

The idea embodied in these projects was to use the available component within our environment to achieve our aim. The project is very necessary in daily routine to man. Lighting stops many important functions.

Without light virtually nothing could be achieved. So it is not too much, if federal government could invest on these line.

It is also observed that, at the end of this project work, the gap between the theoretical work and the practical application is however wide.

The charging unit of this system has the ability to start 28W fluorescent lamps whose starting power ranges between 70w-80w. The lighting system can be ON for about sixteen hours when its battery is in good charging condition.

RECOMMENDATION

After the completion of the project work, I hereby make the following recommendation for the project improvement.

(i) The inverter circuit should be improved to give higher power rating for outdoor illumination e.g. 1000watts-halogen lamp.

(ii) The lighting system should be used only for emergency case for its durability.

(iii) The school should arrange for assisting students at least material – wise in future project construction to alleviate financial burden.

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$Ieff = \frac{2.27 \times 100}{95} = 2.39A$

From the transformer relationship

$E_1 = N_1 : I_1N_1 = I_2N_2$

Where E_1 = Input voltage

E_2 = output voltage

I_1 = Input current

I_2 = output current

N_1 = Numbers of turns in primary

N_2 = " " " in secondary

$E_1 = I_2, E_2 = 220, I_2 = 2.39A, I_1 = ?$

$\frac{E1}{E2} = 12/220 = 18.33$

The transformer turns ratio must be 1:18.33 therefore the primary peak current which must be switched is given by

$I_p = N_2XI_2.$

$= 18.33X2.39A$

$= 43.81A.$

3.6 LIGHTING UNIT

Since the output of this project construction is mainly Emergency lighting. Therefore, this unit comprises of only a fluorescent lamp, which has much to share with the inverter circuit, which rendered its use of starter unnecessary, hence behave like an instant starting lamp. This makes the lamp to light instantaneously when the circuit switch is closed. No automatic starter switches is employed due to the amplification work of inverter circuit couple with step-up transformer and heating effect on the lamps cathode electrode. Since cathode is capable of emitting electron especially, when heated like in this case where it is used as a filament in a vacuum tube, it emits radiations called light.

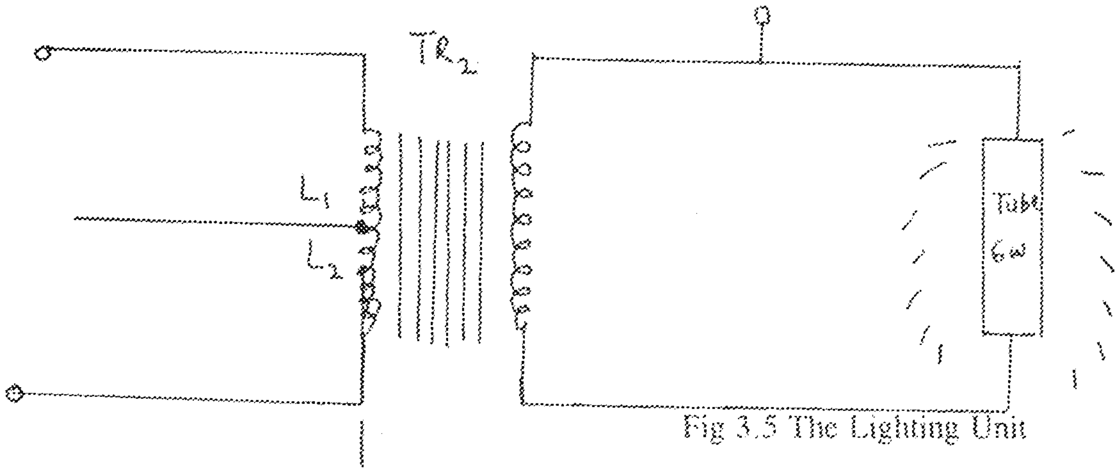


Fig 3.5 The Lighting Unit

3.7 TESTING

During the construction of this project, the components were tested to confirmed their values before used in the construction. The waveform was tested using an oscilloscope after rectification, and the required waveform was given.

Finally, the construction work was connected to the main supply a.c source, which serve as a charging operation to the battery charges. And later switched off the main source i.e. a.c source to serve for sudden power failure. The emergency light then came up immediately, signifying the successful completion of the project construction.

This shows that the aim and objective of the project tittle is achieved.

CHAPTER FOUR

4.0 DISCUSSION OF RESULT

The result of the emergency lighting system can be seen clearly in the circuit construction, most of the functional part analysis have been made in the previous chapter of this write up. Thus, this chapter does not require a more elaborate analysis of it's operation as it would have been needed before.

For the operational circuit diagram of the system in fig ( ). The main supply is 230v a.c 50Hz. This is connected to a step- down transformer which inturn was connected to a bridge rectifier circuit to carry out the function of a battery charger. Both polarity coming from the rectifier circuits were connected to a 12v lead acid battery.

The negative terminal of the battery is connected to the negative end of the inverter circuit. And the other positive end of the inverter is connected to a positive end of a relay. The positive terminal of the Relay which is operated in 12v direct current.

The relay used at the cause of this project as the ability to operate with a very small current and to switch a large current ON and OFF. Also, 230v, 50Hz connected was made on the input terminal of the Relay.

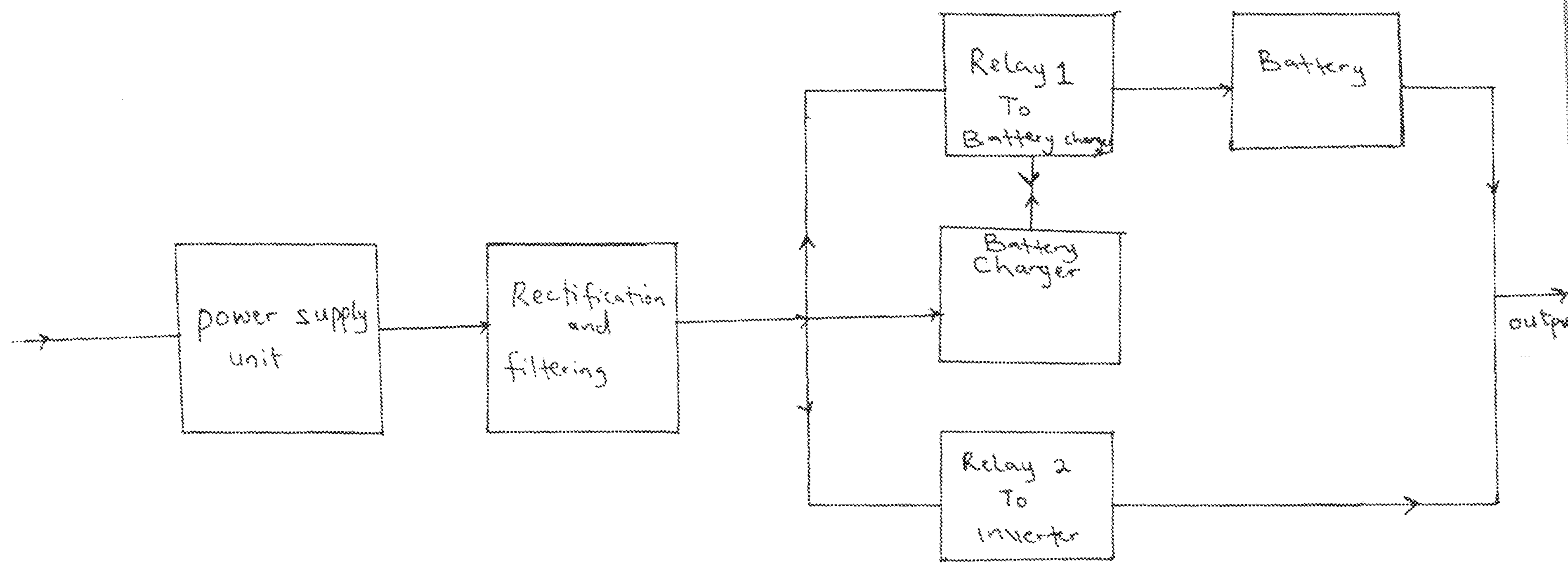
The indication section gives the indication and receives its supply by connecting the live directly from the input a.c supply and the other end to a normally close" terminal of the relay. The indicator circuit is made up of a bridge rectifies for the conversion to d.c current. And 1k resistor is connected with LED on series, so as to enable them share the voltage proportionally.

The analysis of the inverter circuit has been done in previous chapter. It should be noted that this section converts the direct current coming from the 12v battery to alternating current i.e. The amplification of battery d.c. Voltage to a.c voltage which now give power for instant lighting to the fluorescent lamp.

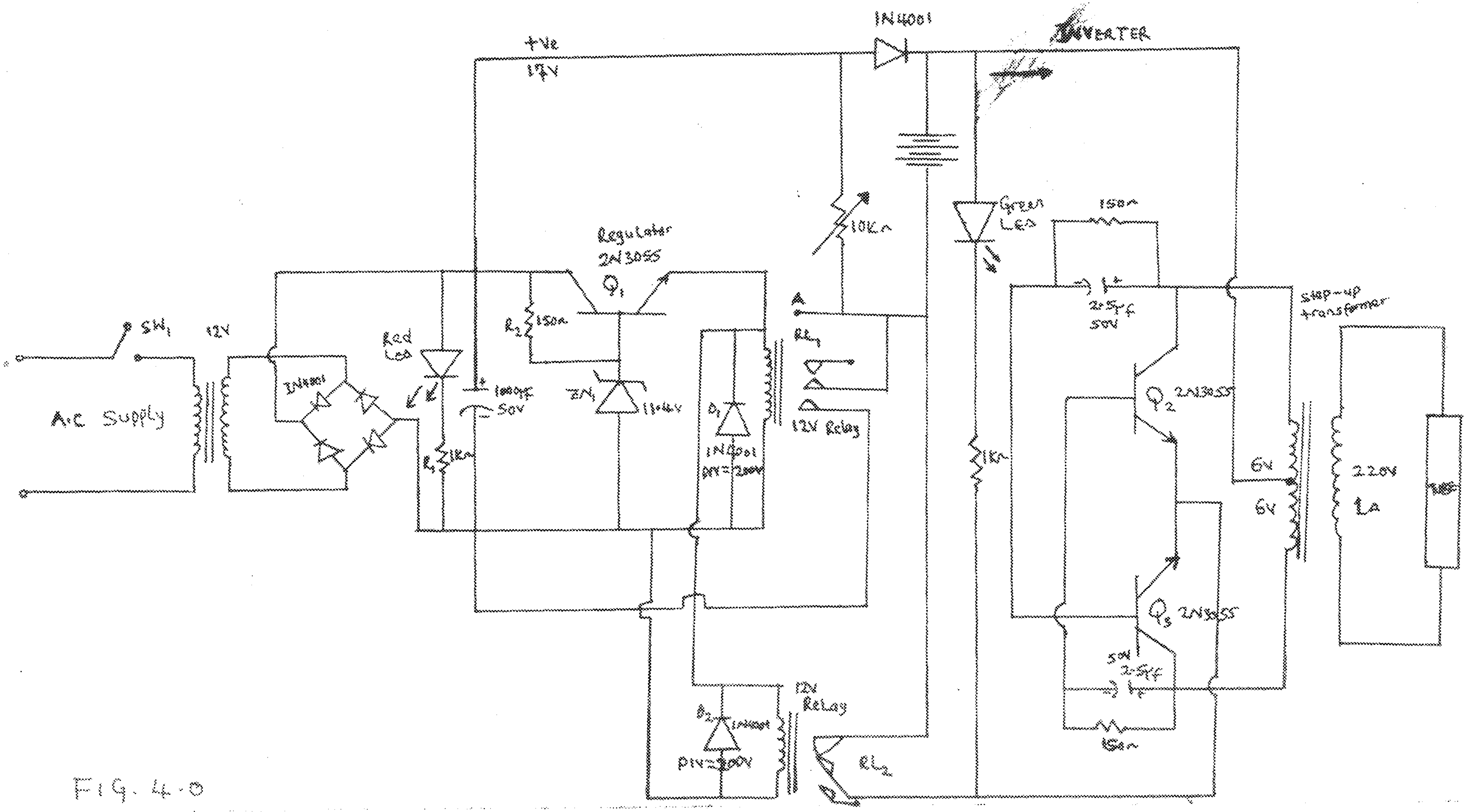
In the inverter section, different operations takes place, such as in the Darlington pair of transistor which act as a driver or switch and power output section serve the purpose of current amplifier in the circuit.

While the Multivibrator Astable serve the purpose of conversion of the pulse signal to sinusoidal waveform. And how it was connected to an autotransformer could be seen clearly in the diagram.

The secondary side of the autotransformer was connected to the fluorescent lighting device, and tested positively by the illumination, that is found in the lamp. It should be noted that this project can only provide illumination for a single fluorescent lighting device or single in cadicent lamp on testing.



Block diagram of Emergency Lighting system.



SW1
12V
A.C Supply
IN4001
Red Led
R1 1KΩ
1000μF 50V
+Ve
17V
Regulator
2N3055
Q1
R2 150Ω
ZN1
11.6V
D1
IN4001
PIV=200V
12V Relay
RL1
A
10KΩ
IN4001
INVERTER
Green LED
1KΩ
150Ω
2.5μF 50V
Q2 2N3055
Q3 2N3055
50V 2.5μF
150Ω
6V
6V
Step-up transformer
220V
1A
D2 IN4001
PIV=200V
12V Relay
RL2

FIG. 4.0