# DESIGN AND CONSTRUCTION OF A SIMPLE AUTOMATIC ROOM HEATER WITH REGULATOR

A PROJECT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

BY

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# DECLERATION

I hereby declare this project work was wholly and solely conducted by me. Under the supervision of Engineer Ahmed Shehu department of Electrical and computer engineering.

Federal university of technology, Minna.

06/10/05

Saidu B. Usman

## CERTIFICATION

This is to certify that this work titled DESIGN AND CONSTRUCTION OF A SIMPLE AUTOMATIC ROOM HEATER WITH REGULATOR was carried out by SAIDU B. USMAN under the supervision of Engineer M.S Ahmed for the award of Bachelor of Engineering in Electrical/Computer Engineering of the F.U.T Minna.

Sign ............................ 7/12/2005 ............................

ENGR. M.S AHMED
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DATE

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ENGR. M.D ABDULLAHI
(H.O.D)

DATE

Sign ............................ ............................

NAME: ............................

DATE

EXTERNAL EXAMINER

# DEDICATION

Dedicated to my parents

## ACKNOWLEDGEMENT

I wish to express my profound gratitude to the Almighty Allah for sparing my life to be able to do this project work and for his strength that sustained me throughout the period of my study in F.U.T. Minna

I also wish to thank my supervisor, Engineer Ahmed Shehu for his assistance, constructive criticism, kindness, patience and understanding, who despite numerous tasks has found much time to supervise every step of this work. Also to my H.O.D, Engineer M.D. Abdullahi, and the entire staff of the department o Electrical computer Engineering. I remain ever grateful for your indefatigable effort.

I attributed this success to my parent whom I owe a lot, I cannot cease thanking you for the rest of my life because you have placed in my hands and etched on my heart what will always keep me above.

Due acknowledgment to my siblings for their moral support and encouragement

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Finally my special thanks to Ahlaji M M Usman of Nigeria custom service Apapa Lagos Branch for his contribution towards my education

# ABSTRACT

The design and construction of Automatic room heating system is described in this project. The project is intended to heat, being regulated at a specified critical temperature.

The switching depends on the geographical spread of the temperature range. This project report is intended to produce outputs which solely depend on the temperature of the sensor device (thermistor) according to the resistance change of the device, As the temperature of the thermistor. The thermistor here is fully immersed in water (hot water), as the temperature increases, to approach the set trip value of the variable resistor, when the thermistor resistance becomes less the set value of the variable resistor, the comparator output switches to a high output state and use to drive the transducer. This is used to switch ON and OFF the relay which in turn switch on/off the heating element of the circuit

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## CHAPTER ONE

### 1.1 GENERAL INTRODUCTION

In many developing countries the desire for warmth and comfort may well have motivated the people first use of fire. Proves shows that man used wood and charcoal in open fares to produce warmth, as well as to prepare food in the cave or shelter such simple open fires were used as late as the 19th century where horts and tepees were built allowing the smoke to escape through an opening.

The use of stoves provides a new local way to heat rooms as an alternative to open fire in an earlier used. The fire was contained a combustion chamber usually made of ceramic or iron sections, it heated the stove walls, which in turn heated the room, mainly by convection of the room air over the hot surface. As technology advanced, individual room stoves were superseded by central heating for the entire building. The general public expects public and commercial buildings to be maintained at a comfortable temperature and humidity year-round and to be free from objectionable drafts dust, pollen and noise. In such buildings complex heating and summer conditioning system must be designed to satisfy the comfort requirements of an average person. Unfortunately there is considerable variation in the physiological response of people to their atmospheric environment, and mans people developed a feeling of frustration in public building and work space where conditions are not to the liking but still are beyond their control. To complicate the problem further, show melting system and other building service often are fired into the heating system.

## 1.2 HOME HEATING SYSTEMS.

In a home, the individual has a heating under his direct control, consequently he should be familiar with the type of system that are available. Most home heating system obtained their heat by burning coal. Gas or oil. When any of this fuel is burnt with a deficiency of combustion air or with improperly adjusted burns, it can produce carbon monoxide, a deadly gas that is unsafe to breath in any concentrations greater than 1 part in 10,000 parts of air. For this reasons one should recognize the use of electricity as the source of energy for the heating element. Electricity is a high-grade energy source that can be used for heating by sending current through resistance elements located in the room or building. Electric heat can be provided in many different ways in systems for the home the operation and control of these systems are very simple. In building or heating system, many factors should be considered before one select the type of heating systems for the home. There are considered variance in fuel availability, comparative cost and the competence of contractors in stalling the equipment. The efficiency in using energy source is 80% for gas and 100% for electricity.

To melt the challenges presented by the applications, engineering design complex system with sophisticated control system and special heating units provide for commercial or industrial use. All these units are supplied with warm air, hot water or stream.

One of the best devices for preventing excessive cold discomfort and inconveniencing to human being is by the use of AUTHOMATIC ROOM HEATER" (temperature monitoring equipment) that will switch on automatically as the critical

## MOTIVATION

Design of this type of system is very useful in our homes in order to keep the room to be conducive and maintain the human temperature in other for the body to function properly.

It can also be used in both tertiary and secondary institution (i e boys and girls hostel where the temperature of a room must not be too hot to a certain level in order to avoid causalities among student such as meningitis, body imitation e t.c

## AIMS AND OBJECTIVES

The aim and objective of this project is to show that a room can be kept warm by mare electricity circuit and using electrical energy, which is more cheaper (Economical) than using any other form of energy to generate heater. The dangers associated with burning coal, fuel etc that produces the dangerous gases for human in haling has been taken care off by this project

# CHAPTER TWO

## 2.1 LITERATURE REVIEW

Heat in physics, is transfer of energy from one part of a substance to another, or from one body by another by virtue of a temperature difference. Heat is energy in transit; it always flows from a substance at a higher temperature to the substance at a lower temperature, raising the temperature of the latter and lowering that of the former substance provided the volume of the bodies remains constant. Heat does not flow from a lower to a higher temperature unless another form of energy transfer, work is also present. Until the $19^{th}$ century, the effect of heat on the temperature of a body was explained by postulating the existence of an invisible substance or form of matter termed caloric. According to the caloric theory of heat, a body caloric than one of a lower temperature; the former body loss some caloric to the latter body on contact, increasing that body temperature while lowering its own. Although the caloric theory successfully explained some phenomena of heat transfer, experimental. Evidence was presented by the American- born British physicist Benjamin Thompson (later known as count Von Rumford) in 1778 and the by the British chemist sir Humphry Davy in 1799 suggested that heat, like work is a form of energy in transit. Between 1840 and 1849 the British physicist names Prescott Joules, in a series of highly accurate experiments, provided conclusive evidence that heat is a form of energy in transit and that it can cause the same charges in a body as work heat is measured in terms of the caloric defined as the amount of heat necessary to rise the temperature of 1g of water at pressure of 1 atom from 15oC to 16oC. This unit is called the small or gram to distinguish it from the large caloric, or kilocaloric, equal to 1000 cal, which is used in nutrition studies. In mechanical engineering practice in the united states and great Britain, heat is measured in British thermal units, of Btu one Btu is the quantity of heat required to rise the temperature of 1 lb of water 1of and equal to 252cal. Mechanical energy can be converted into heat by friction, and the mechanical work necessary to provide 1 cal is known as the mechanical equipments of heat. It is equal to 4.1855x107 crys/cal or 778ft - lb Btu. According to the law of conservation of energy, all the mechanical energy expended to produce heat by friction. Appears as energy in the objects on which the work is performed this facts was first conclusively proven in a classic experiment performed by double, who heated water in a closed vessel by means of rotating paddle wheels and found that the rise in water temperature was proportional to the work expanded in turning the wheels. If heat is converted into mechanical energy also applies as in an internal-combustion engine, the law of conservation of energy also applies. In any engine, how ever, sore energy is always lost or dissipated in the form of heat because no engine is perfects efficient.

## 2.2 HISTORICAL BACK GROUND

The physical methods by energy in the form of heat can be transferred between bodies are conduction and radiation, a third method, which also involves the motion of matter is called CONVECTION. Conduction requires physical contact between the bodies or portion of bodies exchanging heat but radiation does not require contact or the presence of any matter between the bodies. Convention occurs when a required or gas is in contact with a solid body at a different temperature and is always compared by the motion of the liquid or gas. The science dealing with the transfer of heat between bodies is called heat transfer.

A number of physical changes are associated with the change of temperature of a substance almost all substance expand in volume when heated and contract when cooled The behaviour of water between 0° and 4°C (32°F and 39°F) constitutes an important exception to this rule. The phase of a substance refer to its occurrence as a solid liquid, or gas, and phase changes in pure substance occur at a definite temperature and pressure The process of changing from solid to gas is referred as sublimation from solid to liquid as melting, and from liquid to vapor as vaporization. If the pressure is constant, these processes occur at constant temperature. The amount of heat required to produce a change of phase is called latent heat of vaporization. If the pressure is constant this processes occur constant temperature. The amount of heat required to produce a change of phase of sublimation, melting, and vaporization exists. If water is boiled in an open vessel at a pressure of 1 atom, the temperature does not rise above 100°C (212°F), no matter now much heat is added. The heat absorbed without changing the water to steam and is then stored as energy in the steam; it is again released when the steam is condensed to form water similarly, if a mixture of water and ice in a glass is heated, its temperature will not charge until all the ice is melted. The latent heat absorbed is used up In overcoming the forces holding the particles of ice together and is stored as energy in the water. To melt 1g of ice, 79.7cal are needed, and to convert 1g of water to steam at 100°c, 541cal are needed.

The heating process may be direct, as from a fireplace or stove in an individual room or indirect, as in a central system in when steam, heated water or heated air passing through pipes or other ducts transports thermal energy to all rooms of a building. The earlier heating system was fire (open) with which people warmed their dwellings. Stove developed by the ancient Romans are still employed in some parts of energy wet if not properly utilized, controlled and maintained, at a certain point in time its disastrous to anyone who comes in contact with it.

That is what bring about the designing if this particle device so has to put HEAT under control and still keep the room warmth and conducive for human

## 2.3 TYPES OF ROOM HEATER

Basically, there are other temperature monitoring devices that uses almost the same time of principle but different types of input and output units through there are some, whose principle is drastically different from that used in this system. Some are designed based on the principle of thermocouple- a device that uses the voltage developed by the junction of two dissimilar metals to measure temperature difference. One denotation called the sensing junction is placed at the point of interest (ROOM), while the other called "the reference junction" is place at a known reference temperature. The voltage developed across the two junctions is proportional to the difference between the including a suitable voltmeter in the circuit.

Other systems uses alloying to digital converters to convert the sensed analog voltage produced by the transducer to (say a thermistor or a semi condition hence which is then fed into a display unit from where the temperature variation may be read. But finding an analogue to digital converter (A/D) in the market might not be too easy.

Hence, the system used in this project is very simple and efficient. It is also economical and automatic, once there is power supply

## 2.4 MAIN SECTION OF THE PROJECT

The circuit used in this project is made up of five main units, namely the temperature transducer unit, the comparator, the regulator, the timer and the heating resistance elements unit

The transducer unit is placed in an oven to the equivalent electrical signal, which then fed and compared with a fixed signal at the comparator. The comparator output is connected in series with the thiner and regulator and the output used to control the heating. Element resistance circuit

When the temperature in the room is below the critical temperature the comparator output is zero and hence cannot power the comparator output heating resistance element circuit. But when above the critical temperature the comparator. Out is above zero and hence can power the heath resistance element while the fan continues to push out the hot air.

# CHAPTER 3

## 3.0 SYSTEM DESIGN

## 3.10 POWER SUPPLY UNIT

The main parts of power supply unit are; the transformer, the bridge rectifier and the reservior capacitor.

## 3.2 TRANSFORMER

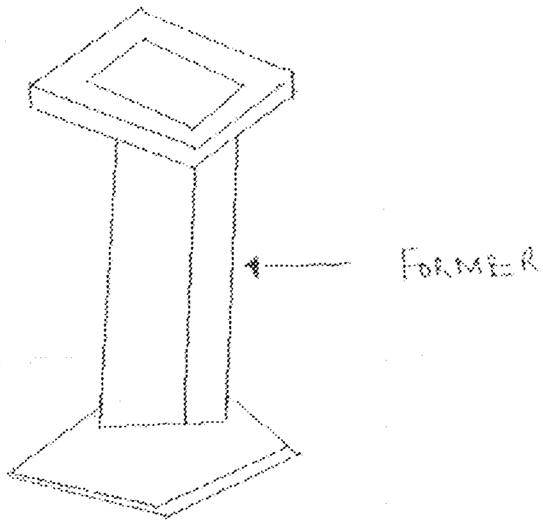
Basically, a transformer is a static electrical machine made up of magnetic core and several copper windings. The windings were divided into primary and secondary windings.

The ability to receive power at one voltage or current level and deliver it at some other voltage or current level is the most unique features of transformer. That is transformers can be used to either step-up or step-down voltages and they can also be used to power the circuit that are isolated from the main power supply. They can are used in electrical engineering for impedance matching.

The essential parts of transformer are primary windings, which energized the coil from an external voltage in secondary winding, which is used to deliver power to an external load. The magnetic core is made up of laminated metal sheets stamped together to provide a high performance (i.e. good magnetic path) So as to link the magnetic fields developed in primary windings with the secondary windings.

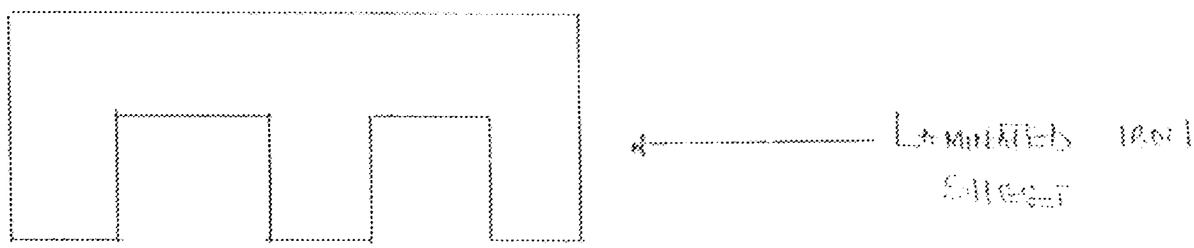
## 3.3 THE FORMER

This is the insulated material used in winding the coils it is normally a plastic that can withstand a fairly high temperature.

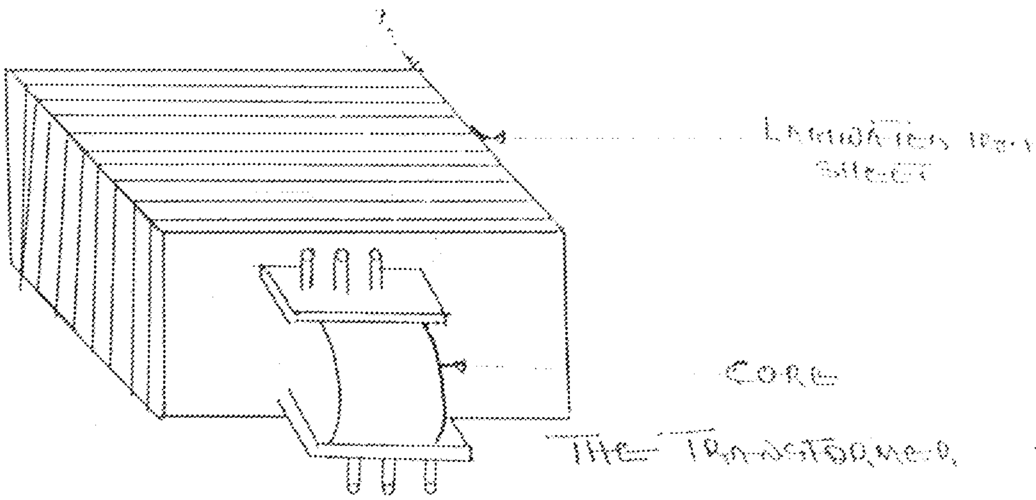



## 3.4 LAMINATED IRON CORE

This is made up of small amount of carbon steel and iron stamped together Theses laminated steels are insulated from one another to reduce eddy current.




The common method used to minimize the effect involves building core of thin sheets of iron alloy called laminations. Iron oxide or special coatings insulate the sheets from each other. The core structures are stack of thin laminations and the laminated nature of transformer core is evident. In a transformer, the coils of the magnetic flux is directed through the iron laminations and is not required to cross through insulation separating them




## 3.5 LOSSES IN TRANSFORMER

The transformer loses may be summarized as follows

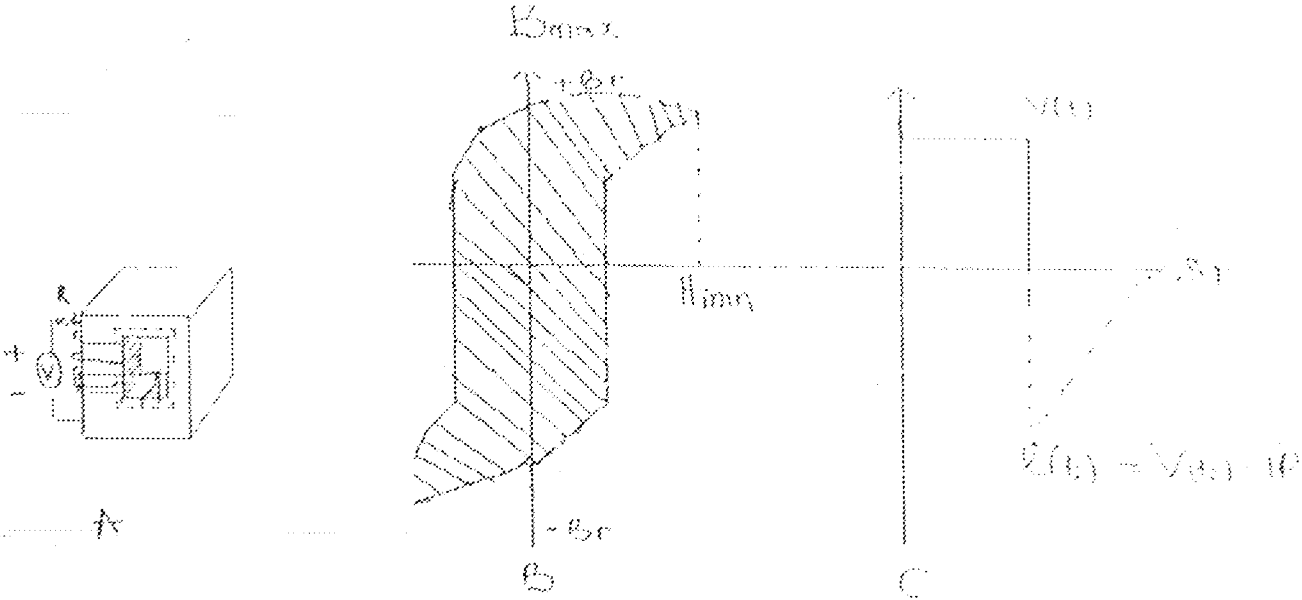
i. Electrical: copper losses = total $I^2 R$ in windings

ii. Magnetic: core losses = Histerisis loss + eddy current loss

iii. Mechanical: cooling and ventilating losses.

## 3.6 HYSTERISIS LOSS:

This denotes a non-linear phenomenon in which the response to a driving force in one direction different from the response to a force in the opposite direction.




They are enclosed by the loop represents the energy lost per cubic meter of iron during the complete cycle of flux variation (joules per m3 per cycle)

To illustrate this point, suppose that the given loop is characteristic of the iron sample being excited by a coil of N turns in the circuit of the figure above, the remnant flux density (in teslas) is Br, obviously, if Br is large, the material would make a good permanent magnet, but the energy loss in a core of such material would be large. A god core material should have a small Br (flux density) and a "skinny" hysterisis loop to keep the lose low. Where A is the cross sectional area of the sample and B is the instantaneous internal flux density ane efe be the average length of the path traversed by the flux flowing.

## 3.7 EDDY CURRENT LOSS:

This is the result of electric current in iron magnetic cores which circulate in closed path like eddies in a creek. To induce a voltage in the winding of a transformer, the magnetic flux threading the windings must be alternating, and this required alternating flux to flow in the core structure.

In this case, voltage are induced in the iron in a direction to oppose the flux alternations, and these voltages derives eddy current. The eddy current produces $I^2R$ losses and heating in the iron and their effect are to be minimized

## 3.8 TRANSFORMER DESIGN:

Power rating of the transformer = 500VA

Primary current = $\frac{\text{power rated}}{\text{Primary voltage}}$ = $\frac{500VA}{240V}$ = 2.174A

Input voltage 250

Secondary current = $\frac{\text{power rate}}{\text{Secondary voltage}}$ = $\frac{500VA}{12V}$ = 41.6A

A = cross sectional area

J = current density

I = maximum current of the conductor

The current density of the copper (J)

J = 257 $A/M^2$

Im = I/J = 2.174/257 = $8.46 \times 10^{-3}\ cm^2$

To determine the diameter of the conductor

A = Πr2.................................... 1

D = 2r.................................... 2

R = D/2.................................... 3

By finding the value in terms of KVA and substitute into equation (1) above

Consider a factor r = Ø/IN = $\frac{\text{magnetic loading}}{\text{Electrical loading}}$

KVA = E X I X $10^{-3}$

= 4.44 F ØN/V X $10^{-3}$

Kva = 4.44 F $Ø^2$ /V X $10^{-3}$

Ø2 = 4.44 F X $10^{-3}$ KVA

Since IN = Ø/r

$$Ø = \sqrt{\frac{}{4.44 FX \; 10^{-3}}} \times \sqrt{KVA}$$

By substituting this into equation (1) above, we have

$$Vt = 4.44f \times \sqrt{\frac{r}{4.44 \times 10^{-3}}} \times \sqrt{KVA}$$

Vt2 = 4.44f2 x 10-3 x KVA

$$Vt2 = \frac{4.44Fr \times}{10-3} KVA \sqrt{}$$

Vt = 4.44Fr x10 KVA

Vt = C √KVA

Vt C 4.44Fr x $10^{-3}$

The following average value of a factor of C may be adopted. 0.35 to 0.45 for core type distribution transformer and 1 to 1.25 for shell type power transformer

To derive the e.m.f. Equation for transformer, one has to consider a coil drive "N" turns wound over a core, flux that is sinusoidally varying as per the equation

Sin (Ft) (i.e sin 2Π ft) where Ø = maximum flux when a coil with "N" turns links a flux which is varying sanusoiladally it induces a voltage, whose instanteous value is given by

Eb = - Nd/dt (Øsin 2Π ft

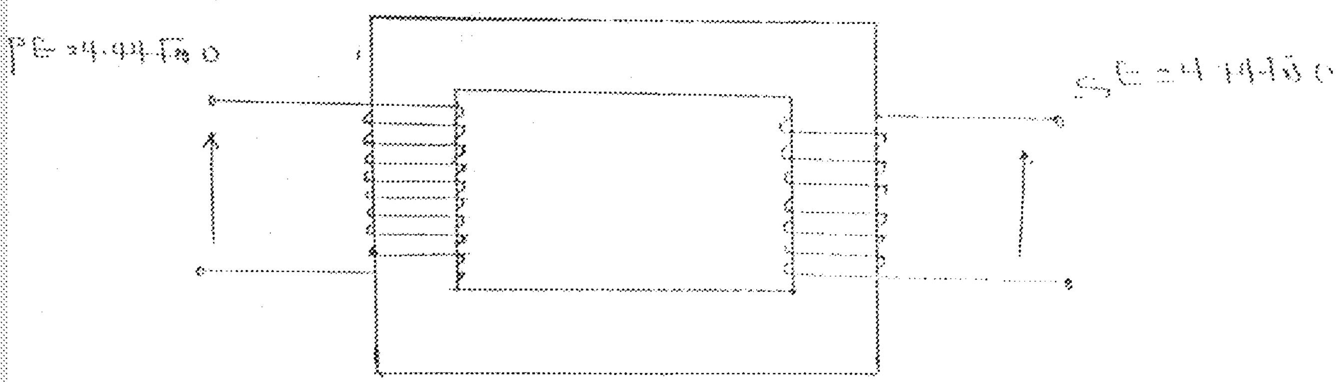
Neglecting voltage drop due to no- load current, applied voltage "e" will be equal and opposite to "e".

E =Nd/dt (Ø sin2 Π ft) = N2Π FØ Cos 2Π ft

= N x (2Π F) x Cos 2Π ft

Comparing 2Π F N Ø Cos 2Π ft with Cos 2Π ft or sin 2Π ft, the maximum value of "e" is 2Π FØN

R.M.S. value of E is



From E r.m.s. = 4.44FN we have voltage per turn as

$$Vt = \frac{Er.m.s.}{N} = \frac{4.44FØ}{N} = 4.44FØ \ldots\ldots \quad \ldots\ldots$$

## 3.9 DETERMINATION OF VOLT/TURN (VIT)

Volt/turn in a transformer is obtained by dividing the number of turns in a winding by the voltage across that winding.

V/T = k√S

Where K is constant that varies between 1.1 and 1.2 ans is S is the KVA rating of the transformer. We shall assume a K of 1.1 for our transformer and with S (KvA) of 0.5

$V/T = 1.1\sqrt{0.5} = 0.778V$

$Vt = 0.778v$

## i. PRIMARY WINDING

Number of primary winding = $\frac{\text{primary voltage}}{\text{Volt/turn}}$

$= \frac{230}{0.778} = 295.699$ turns

Three (3) more turns would be allowed for winding tolerance thus bringing the number of primary winding turns to 299 turns

## ii. SECONDARY WINDING

Number of secondary windings = $\frac{\text{secondary voltage}}{\text{Volt/turn}}$

$= \frac{12}{0.778} = 21.85$ turns

Also, three (3) more than would be allowed for winding tolerance, thus bringing the number of secondary turns to 25 turns. The standard wire gauge (SWG) for primary is 21 while that of secondary is 17.

## TRASNFORMER EQUATIONS

$$\frac{V1}{V2} = \frac{N1}{N2} = \frac{I2}{I1}$$

The power developed in the primary winding is equal to that developed in the secondary winding.

P = V1 = V2I2 = constant

Where p = power input or power output

V1 = primary voltage

V2 = secondary voltage

$I_1$ = primary current

$I_2$ = secondary current

$N_1$ = primary turns

$N_2$ = secondary turns

### 3.9.1 RECTIFIER CIRCUIT

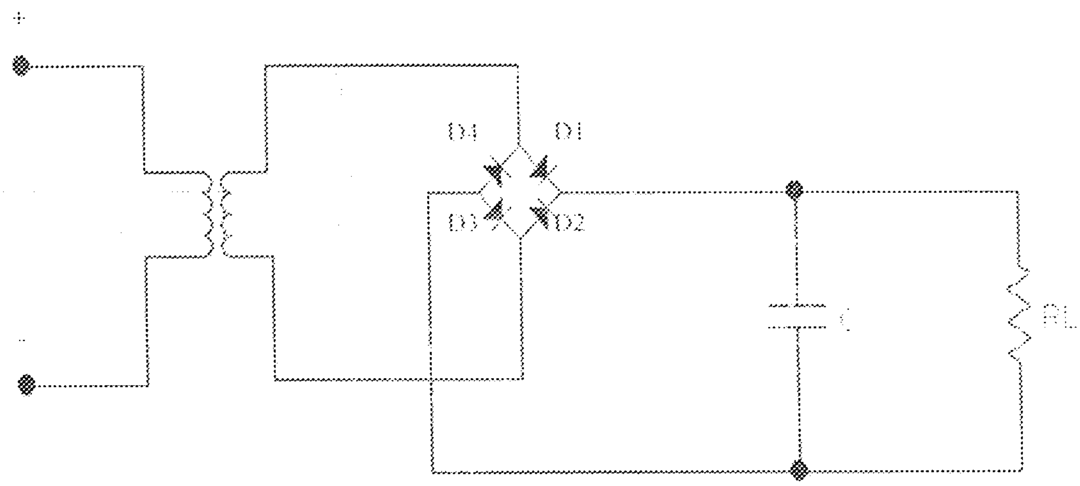



FIG 3.6 THE BRIDGE RECTIFIER

The bridge rectifier circuit can be used in transformer-type power supplies as well as line-operated power supplies to give fall wave output voltages and currents. Fair diodes or rectifying are required for bridge circuit.

The figure above shows a bridge rectifying circuit using a power transformer to produce full wave rectification. The transformer produce high output voltages and isolates the secondary windings from the primary.

During the positive half cycle, input voltage in the primary induces a voltage in the secondary windings in opposite direction. The output current flows A through the load ($R_L$) to B causing a positive output.

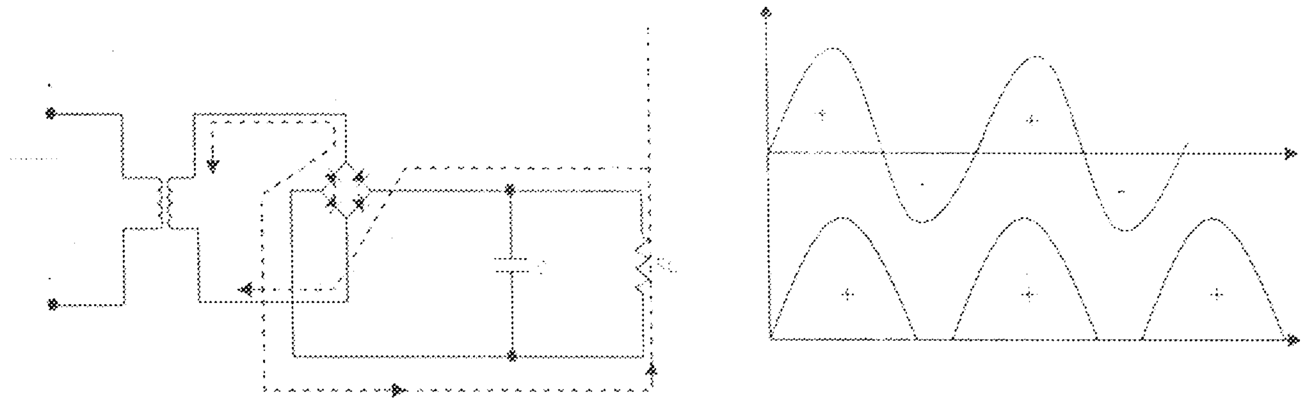


FIG. 3.7

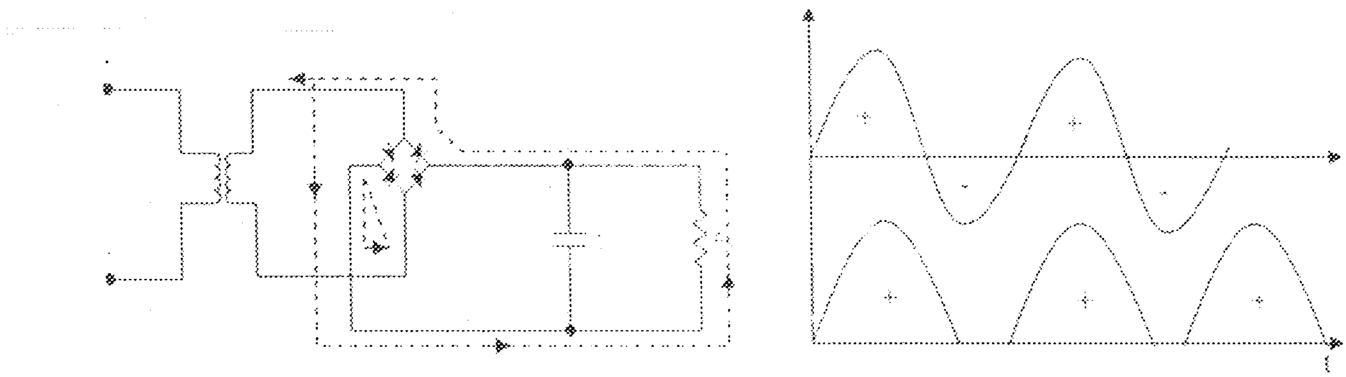
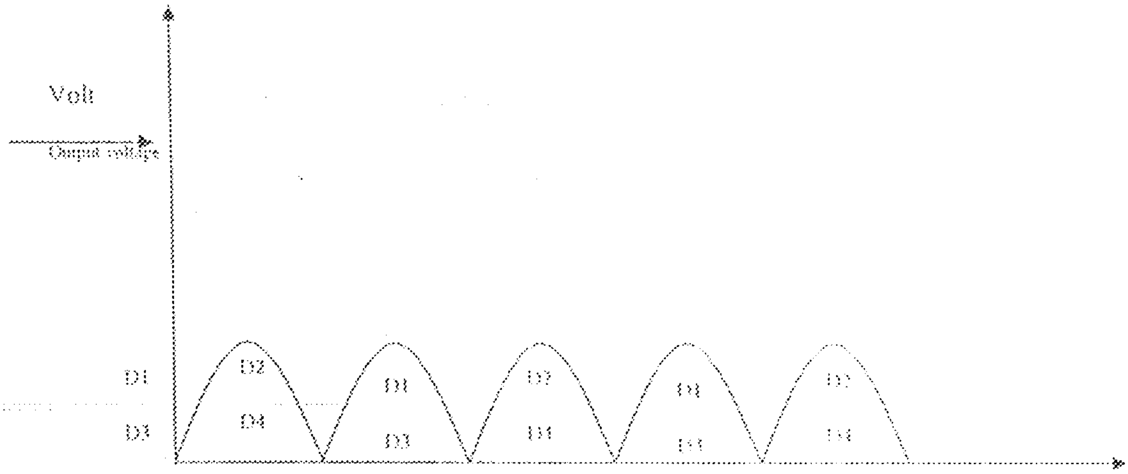


FIG 3.8

During the negative half cycle, the current reverse direction in the primary winding. This causes a reversal of voltage across the secondary winding. The current path through the bridge rectifier circuit is different. However, the output current still flows through $R_L$ in the same direction from A to B causing positive output.

According to the figure, the $V_{in}$ is the input voltage from the secondary winding of the transformer and it is alternating voltage. Vo (A) is the output of the two diodes conducting during the positive half cycle. Vo (B) is the output voltage of the remaining two diodes conducting during the negative half cycle. While Vo(T) is the output voltage of a bridge rectifier circuit.




PULSATING OUTPUT-FULLWAVE BRIDGE RECTIFIER OUTPUT REACTION

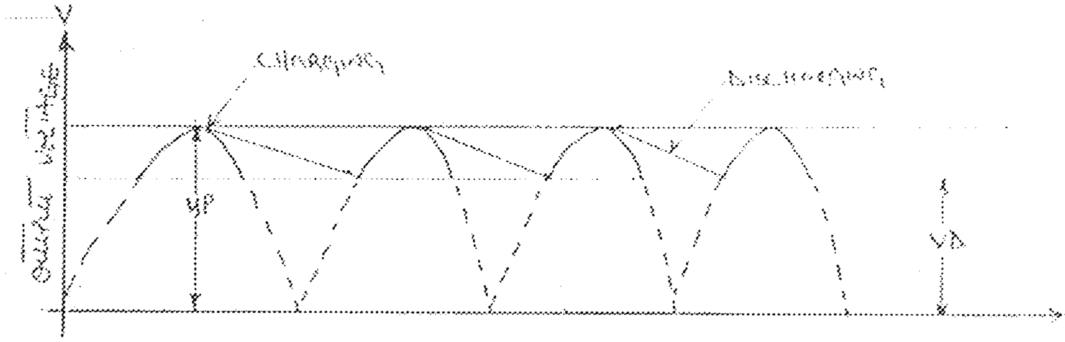
FIG. 3.9

### 3.9.2 FILTER AND SMOOTHING CIRCUIT

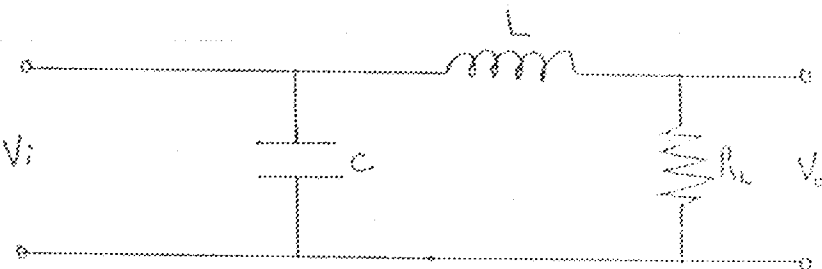
The term filter means to eliminate, separate or limit to a certain kind of item. A power supply filter changes pulsating DC to pore DC.

If the input wave from the rectifier circuits full wave, the filter will provide an output DC voltage that is cve smoother. That is even smoother. This is because the full wave is pulsating at 120 pulses per second, twice as fast as half waves DC. As a result, the filter capacitor will not have to hold a charge for so long with full wave DC as it would with half wave. This causes less ripples because the pulses are closer.

## WAVE FORM BRIDGE RECTIFIER WITH CAPACITOR.



## 3.9.3 SMOOTHIGING CIRCUIT.




With just one capacitor as a filter, the ripple voltage is usually too great for use in most applications. Therefore, a LC (i.e. capacitor and inductor) is a better filter than the capacitor filter. The capacitor provides part of the filtering action to pulsating DC and inductor (or choke) provided the rest. Since the inductor has little pure DC opposition, it passes the pure DC to the output or load.

One of the reasons for using a choke-input filter is because it protects the rectifier devices and is therefore suitable for heavy applications

### 3.9.4 THERMISTOR CHARACTERISTICS

A thermistor made basically of sintered oxides of nickel and manganese, is a device that undergoes a large change of resistance with temperature. Most of the type has a negative temperature coefficient (NTC), i.e. their resistance falls an increase in the temperature of their surrounding but some positive temperature coefficient (PTC) varieties exist whose resistance increase with an increase in temperature.

**TABLE1.1....**

**TEMPERATURE SENSORS (POPULAR TYPES)**

| SENSOR | FEATURES | TYPICAL UESFUL |
|---|---|---|
| 1.THERMISTOR | | TEMPERATURE RANGE |
| (Negative coefficient) | Resistance falls with temperature | -80°c TO +300°C |
| (Positive coefficient) | Resistance rise with temperature | 0°c TO 100°C |
| 2. THERMOCOUPLE | Voltage output rise with temperature | -50°c TO +500°C |
| | Resistance rise with temperature | -50°C TO +150°C |

| | | | |
|---|---|---|---|
| | temperature | | |
| 3. PLATINUM | Voltage for pn junction falls | | |
| 4. SEMICONDUCTOR TYPES | | | |

## CONTROLS AND SWITCHING UNIT

### 3.9.6 THE COMPARATOR

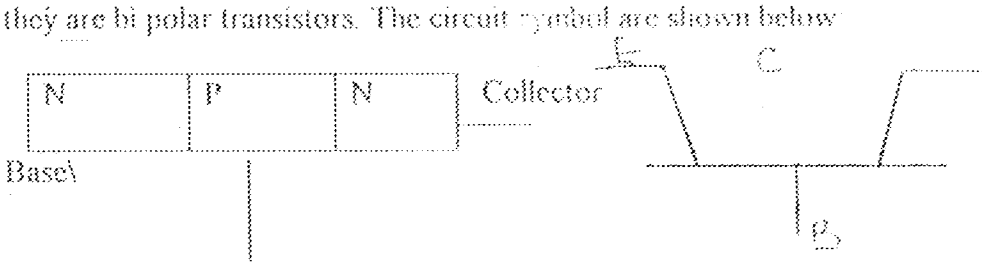
This comparator is an integrated circuit. Its value is (UA 741 CN) and it is a voltage comparator. Basically, corresponding to input conditions that are below or above certain voltage limits. The primary use of comparator is as level voltage limits. The primary use of comparator is as level detector that provides a change in the output voltage when the input has exceeded or fallen below a certain level present by the reference voltage.

The voltage to be compared with the reference is applied to the other input as indicated in figure below.

The figure above, show a different amplifier comparator (-ve) with a reference voltage applied to the non-inverting input, the output is saturated at the positive supply voltage as long as the input voltage applied to the inverting input is lower than the reference voltage. As soon as the input exceeds the reference voltage the output is driven to saturate at the negative supply voltage.

### 3.9.7 TRANSISTOR SWITCHING

The transistors used in this project are NPN. They have values as follows, 2N 3055 and D 313. they have 3 terminals namely, base, collector and Emitter and they are bi polar transistors. The circuit symbol are shown below




CIRCUIT SYMBOL

The collectors of the transistors are connected to the supply + Vcc. When the base current is supplied from the out of the comparator, when the collector currents flow in the transistor D 313 to the emitter. The emitter of transistor D 313 supplies the necessary current to the base of power transistor 2N3055, for the collector current to flow. When the collector current of the transistor 2N3055 flows, then there is out put from the battery charger.

Therefore without the base current to the transistor they wouldn't conduct and a power supply must be applied to the collector of the transistor.

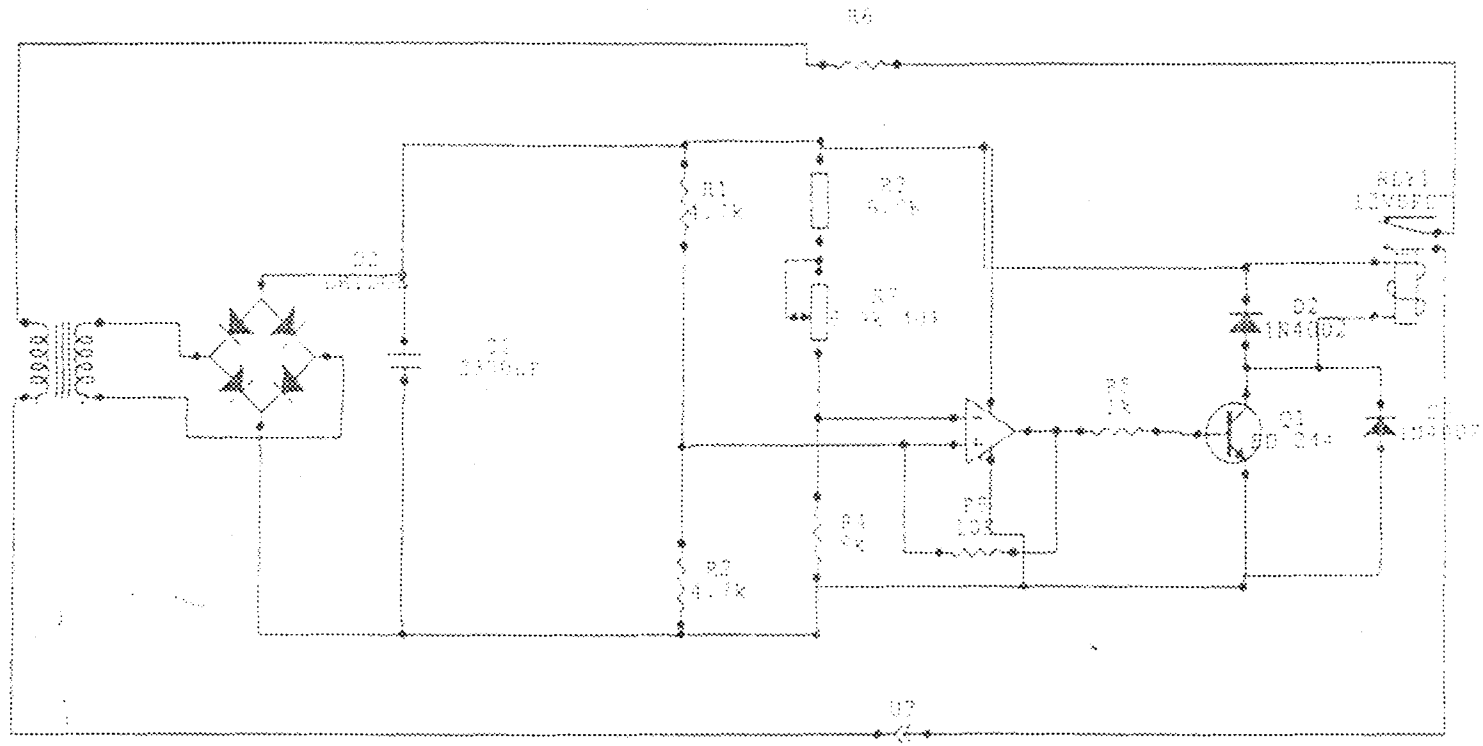



Fig. 3.1: Complete circuit diagram of a simple Automatic Room Heater.

# CHAPTER FOUR

## 4.0 CONSTRUCTION AND TESTING OF RESULT

## 4.1 COMPONENT TESTING

Component testing is very important designing and construction of a project. One of the instruments used in carrying out the component testing is the OHMMETER Ohmmeter is used in detecting which of the terminal of the diode is the anode and which is cathode. This test offered a useful help in determining the polarities of the various components used in this project. Resistors, diodes and transistors were tested with ohmmeter before incorporating them on the designed circuit.

Diodes were tested for conduction in one direction and no conduction in the other.

Transistors were tested in several stages; such stages are stated below.

1. Test for leakage from collector to emitter and Base/Collector
2. Test for leakage from collector to emitter (should be negligible for signal transistor but possibly large on power transistor). It is always advisable to practice this test on a known good transistor because a bad one will give wrong result.

Electrolytic capacitor was also tested with millimeters on ohm range. The meter indicates a sudden rise and fall for a good electrolyte capacitor

Integrated circuit, Lm, can as well be tested with millimeters on ohm range. The meter indicates continuity to each and every pin except pin 5

## 4.2 COMPONENT ARRANGEMENT

Component arrangement is one of the preliminary aspect require in the projects This may rough sketch or arrangement given provision for eventual corrections either by omission or commission. This involved the arrangement of the various components on the breadboard, so that the operation of the designed circuit can be carried out before final mounting of these components on the verroboard.

This enables us to estimate the size of vero-board to be used.

## 4.3 SOLDERING AND PRECAUTIONS

In soldering the components to be soldered has to be cleaned thoroughly to prevent poor soldering and the tip of the soldering iron itself has to be clean or field as well. All these were carried out perfectly before starting the soldering

The precautions taken while the soldering is on are as follows:

i. The soldering iron was always heated properly before used

ii. Component were not overheated

iii. Correct polarities identification of the component were ensured

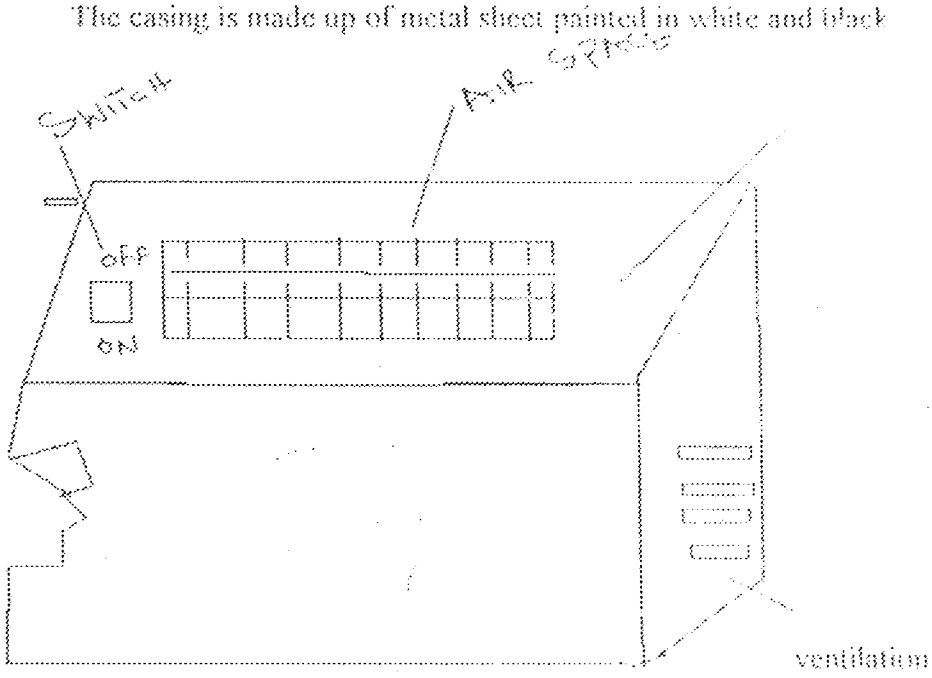
iv. Extra care was exercised during soldering, sorplos lead were removed

v. Finally, the entire component used in this project was carefully mounted with correct polarity.

## 4.4 CONSTRUCTION OF THE CASING

The case size is chosen such that it can contain the transformer and the verobaord. which contains all the components. The case is designed and constructed in such a way that there is a means of ventilation. The cross sectional view of the casing is shown figure below.

The casing is made up of metal sheet painted in white and black




## 4.5 FINAL COUPLING/ASSEMBLING

The final coupling involved the transferring of the transformer and the veroboard into the casing. The transformer was strongly tight on the seat made for it in the casing. The veroboard was also placed on the seat made for it, and was tight with a screw and all other connections were made, such as connection to the switches, indicating lamp and the output terminals as shown in the figure above.

## 4.6 TESTING AND RESULTS

The circuit first mounted on breadboard for testing. This gave the chance to be sure, whether the circuit will not. When the circuit works perfectly on the breadboard, the entire component is properly connected on this vero-board and powered.

## 4.7 OVERALL TESTING

After the construction of the casing, the circuit on the vero-board was then transferred into it and the necessary connections were made. Such as the connection of the thermiestor the main device switch and the two output terminals. The device was then energized and fortunately there was an expected output at the output terminal of the room warmer.

## 5.2 RECOMMENDATION

Sophisticated signal processing techniques using analogue to digital converters and microprocessor based system is recommended to bring this work toward better temperature monitoring in a large room and for monitoring temperature variation inside.

For a more sensitive and reliable system, a temperature transducer that is more sensitive than the thermistor whose resistance of factors of variation with temperature is linear should be used e.g. a diode transducer.

This design is relatively simple and to a certain extent automated hence it can be conveniently used in many applications where overheating at particular temperature is dangerous, such as in bathroom heaters, tea kettles, boilers, automatic fan regular e.t.c. It can be used for much application within the range of 0 to 100 degree centigrade.

Finally it can be said that the desired output at the thermistor (temperature transducer) where satisfactory obtained.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATION

## 5.1 CONCLUSION

The design and construction of a functioning simple automatic room heater for a room was successfully carried out and described. The demonstration of detection of temperature variation is via resistance element means. Hence the main aim of design work which was to produce a system that can detect temperature variation in an oven and produce a signal at an unfavorable or critical temperature ($t_c$) has been fulfilled.

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