DESIGN AND CONSTRUCTION OF AN ALARM INCORPORATED ELECTRIC STOVE

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BY

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A thesis submitted to the Department of Electrical and Computer Engineering, Federal University of Technology, Minna.

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DEDICATION

This work is dedicated to Almighty Allah, who has been the source of my inspiration. ay His peace and blessings be upon His noble prophet Muhammad, whose words of wisdom s being the guiding principles of my life. Also to my late father Alhaji Usman Shaba Chado d my loving mother whose moral and financial contribution can not be overestimated. May nighty Allah reward them both with Jannatul Firdausi ameen.

DECLARATION

I, Adamu Usman Shaba, declare that this work was done by me and has never been sented elsewhere for the award of a degree. I also hereby relinquish the copy right to the leral University of Technology, Minna.

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ABSTRACT

It is not longer news that there is an increase in the demand for energy which has resulted in an alarming rising cost of energy. There is thus the need for efficient utilization of available energy resources.

An alarm incorporated electric stove is a kitchen appliance designed for cooking using electrical energy and at the same time alerts the user that power is restored. This prevents fire outbreak due to forgetfulness of the user. Serves as an alternative to firewood and coal there by reducing the cutting down of trees which causes deforestation.

It is a device made of Hot plate, Alarm unit and Hot plate auto disable unit with manual trigger switch. When the plug is connected to a voltage source, the auto disable unit disables the hot plate and activates the alarm, which indicates that power is in the circuit but hot plate is not active. To activate the hot plate the trigger button needs to be pressed once which activates the relay that completes the circuit of the hot plate and disables the alarm unit. The relay remains in that state until the mains goes low. This process repeats itself upon power high again.

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CHAPTER ONE

INTRODUCTION

The choice of the topic Designing and Construction of an alarm incorporated electric stove though looks simple, however, with the depletion of available sources of energy, increase in the demand for energy and alarming rising cost of energy, there is need for efficient utilization of available energy resources, thus making the choice of the topic highly essential.

Use of electrical energy in cooking is highly efficient and safe in the sense that most heating systems obtain their heat by burning of coal, gas or oil. When any of this fuel is burnt with a deficiency of combustion of air or with improperly adjusted burners can produce carbon monoxide (CO), a deadly gas that is unsafe to breath in any concentration greater than one (1) in 10,000 parts of air. Unlike electricity, the use of coal or firewood is dangerous, inefficient because no proper control and produces a lot of smoke. This prompted the earlier inventors to look for improvements. More so, the use of gas or oil is very expensive and not reliable because sometimes are not readily available in the market. In view of the above mentioned disadvantages, one should recognize the use of electricity as the best source of energy for the heating element.

1.1 AIMS OF THE STUDY

It is not longer news that there is an increase in the demand for energy which has resulted in an alarming rising cost of energy. There is thus the need for efficient utilization of available energy resources. The choice of the topic Designing and Construction of an alarm incorporated electric stove was made with the following aims;

1. To provide a cheap means of cooking with higher efficiency.

2. To reduce the falling down of trees for firewood.

3. To reduce the burning of falling trees on the ground for coal that kills the micro organisms and

4. To produce a means of cooking that alerts the user that power is restored after its failure.

1.2. ALARM INCORPORATED ELECTRIC STOVE

This is a device designed for cooking using electrical energy and at the same time alerts the user during restoration of power after its failure. This prevents fire outbreak due to forgetfulness of the user.

It is a device made of Hot plate, Alarm unit and Hot plate auto disable unit with manual trigger switch. When the plug is connected to a voltage source, the auto disable unit disables the hot plate and activates the alarm, which indicates that power is in the circuit but hot plate is not active. To activate the hot plate the trigger button needs to be pressed once which activates the relay that completes the circuit of the hot plate and disables the alarm unit. The relay remains in that state until the mains goes low. This process repeats itself upon power high again.

1.3. HEAT TRANSFER

Electric stoves rely on the application of direct heat for cooking. Hence, it is necessary to know how heat can be transferred or transmitted from one body to another. This can happen in three ways: Conduction, Convention and Radiation.

1.4. CONDUCTION

In this mode of heat transfer, heat energy supplied to one end of solid causes the molecules there to vibrate with increasing speed. These increased vibrations are then passed on to the neighboring molecules, which begin to vibrate faster and in turn affect the vibration of those molecules still further away from the flame. Hence, all the molecules in the solid eventually vibrate more rapidly about their fixed positions and this gain in kinetic energy is shown as a rise in temperature. The solid is said to be a conductor of heat.

1.5. CONVENTION

In this process, heat is transferred by the flow of hot and cold air currents. Unlike conduction, a process by which heat energy is transferred from molecule to molecule; convention involves the transfer of heat by the actual movement of the heated molecules from the hot parts to the colder parts of the fluid. When a fluid is heated, the heated portion of the fluid moves away from the source of heat, its place is taken by more of the substance which in turn is heated. Since such movement is possible in solids, convention does not take place in them.

1.6. RADIATION

It is the transfer of heat from a hot body to a cold body in a straight line without affecting the intervening medium. The transfer of heat by conduction and convention is done through a material substance (solid, liquid or gas). Yet heat energy is transferred from the sun to the earth even though the space between the sun and the earth is practically a vacuum. This transmission is made possible by another mode of heat transfer termed radiation which takes place even when there is nothing between the hot body and its surroundings.

When the temperature of an object is higher than its surroundings, it radiates more heat than it receives; when the object is at a temperature lower than that of its surroundings, it receives more heat than it radiates. When the temperature of a body is raised, the heat radiated by it increases rapidly.

CHAPTER TWO

LITERATURE REVIEW

The chapter is intended to provide a sound theoretical framework for the study. To achieve this, the principles of various ovens stoves and alarms are reviewed.

2.1. BRIEF HISTORY OF STOVES AND OVENS

There have been historical records of the existence of cooking devices like stoves and ovens many centuries ago. These devices served their purpose and solved the problems of cooking in their times. The first historical record of a stove being built refers to a stove built in 1490, in Alsace, France. This stove was made entirely of bricks and tiles. Just after this invention, cast iron stove was invented and used mostly in America. Around 1728, cast iron stoves really began to be made in quantity. These first stoves of German design are called fire-plate. Not too long from then, Benjamin Franklin (1706-1790) invented the iron furnace stove or 'Franklin stove' whereas Frans Wilhelm Lindqvist designed the first sootless kerosene stove. Jordan Mott invented the first practical coal stove in 1833. Mott stove was called the baseburner. The stove had ventilation to burn the coal efficiently. British inventor, James Sharp patented a gas stove in 1826, the first successful gas stove to appear on the market.

As time went by, further inventions were made due to the shortcomings of already existing inventions and the increasing advances in technology. On June 30, 1896, William Hadaway went on to design the first toaster made by Wetinghouse, a horizontal combination toaster cooker. Perhaps, one of the greatest discoveries of cooking devices was the invention of microwave oven. The history of microwave oven is of great interest to us because the project design and implementation under consideration will be a reliable substitute for these ovens especially for industrial applications.

Like many of today's great inventions, the microwave oven was a by-product of another technology. It was during a radar-related project around 1946 that Dr Percy Spencer, a self thought engineer with the Raytheon Corporation, while testing a new vacuum tube called a magnetron, discovered that the candy bar in his pocket had melted. This intrigued Dr. Spencer, so he tried another experiment. This time he placed a popcorn kernels near the tube and, perhaps standing a little farther away, he watched with an inventive sparkle in his eyes as the popcorn cracked and popped all over his lab.

Dr. Spencer fashioned a metal box with an opening into which he fed microwave power. The energy entering the box was unable to escape, thereby creating a higher density electromagnetic field. When food was placed in the box and microwave energy fed in, the temperature of the food rose rapidly. Dr. Spencer had invented what was to revolutionize cooking, and forms the basis of a multimillion dollar industry, the microwave oven.

2.1. TYPES OF OVENS

An oven is the most important equipment for baking foods in the baking and confectionery industry. They include;

- Hearth Ovens: This kind of oven includes 1-4 levels with about 2-3 trays thick. Each level is an independent oven since it is equipped with industrial steam producer, temperature regulator, timer and lighting.

- Convention Ovens: Conventional ovens apply heat from the bottom and as the heat rises, it creates different temperature areas or zones within the oven. Hence, they are often referred to as zoned ovens. When operational, the hottest area is at the top, the centre is moderate while the coolest part is at its bottom.
- Fan Assisted Ovens: This type of oven operates like a conventional oven with the addition of a fan at the rear. As the heat rises from the bottom, it is circulated by the fan to create a more even temperature distribution.

2.2. DEFICIENCIES OF MODERN OVENS

The theoretical and practical framework on which this work was conceptualized is based on providing a means of cooking and heating foods that is much better than using microwave oven as one of the most widely known modern ovens. Although modern ovens include both electrical and microwave ovens and other types of oven previously mentioned, we shall in this section refer to modern ovens strictly as microwave oven. As such, the deficiencies to be discussed here are with regards to microwave oven, which historians say is the greatest discovery since fire. The identifiable deficiencies of the microwave oven are discussed below:

Uneven Heating: In a microwave oven, food is heated for so short a time that it is often cooked unevenly. Microwave ovens are frequently used for reheating previously cooked food, and bacterial contamination may not be killed by the reheating resulting in food borne illness. The uneven heating is partly due to the uneven distribution of microwave energy inside the oven, and partly due to the different rates of energy absorption in different parts of the food.

The first problem is reduced by a stirrer, a type of fan that reflects microwave energy to different parts of the oven as it rotates, and by a turntable or carousel that turns the food. It is also important not to place food or a container in the centre of a microwave's turntable. That actually defeats its purpose. Rather, it should be placed a bit off-centre so that the items travel all around the area of oven's cooking cavity, thus assuring even heating.

The second problem must be addressed by the cook, who should arrange the food so that it absorbs energy and periodically test and shield any part of the food that overheats. However much these techniques are employed, the problem of uneven heating cannot be completely solved in microwave ovens.

- In some materials with low thermal conductivity where dielectric constant increases with temperature, microwave heating can cause localized thermal runaway.
- Many microwave ovens performance drops after about 15 minutes of continuous usage, which means food takes longer time to cook. When heating several meals, the last meal to be cooked may not be heated properly as a result.
- Defrosting is another common weakness, as many microwave ovens may start to cook the edges of the frozen food, while the inside of the food remains frozen.

2.3. PROVEN DANGERS OF MICROWAVE OVENS

i. Liquids when heated in a microwave oven in a container with a smooth surface can superheat. The boiling process can start explosively when the liquid is disturbed, such as when the operator grabs hold of the container to take it out of the oven, which can result in severe burns.

ii. Tin foil, aluminum foil, ceramics decorated with metals, and products containing other metals can cause sparks when they are used in a microwave. This is because any metal or conductive object placed into the microwave will act as an antenna, absorbing microwave radiation. If the object is pointed, for example metal pork, the pointed ends will act to concentrate the electric field formed at the tips. This has the effect of exceeding the dielectric breakdown of air, about 3×10^{6}v/m causing sparks to form.

Perhaps the most controversial hazard of microwave foods is the health implications. Research operations conducted by German and Russian researchers reveal three main categories of this hazard.

Category 1: Cancer-causing effects.

Category 2: Nutritive destruction of foods.

Category 3: Biological effects of exposure.

2.4. HISTORICAL DEVELOPMENT OF ALARM SYSTEMS

An alarm system is a system which operates as a warning device or signal for alerting or informing people of danger or problem. An alarm system is thus a security system that produces a form of sound to warn people of a particular danger. The development of alarm systems started with the creation of man. Man required given alert, information etc and adopted a form of signaling, exclamation and shouting. This was later replaced by clapping of hands and beating of gongs by town criers to alert the community in order to disseminate information in the early African society. All these methods of raising alert were crude, unreliable and inefficient.

With the advancement of science and technology, these crude methods of generating alarm were replaced by electronic alarm systems in the late eighteenth century. These electronic alarm systems operate without any human effort, once it senses a particular signal; it gives an indication in form of loud sound or noise depending on its design.

The security industry is constantly evolving to come up with new and innovative techniques to warn people of a particular danger. Today we have the new generation of electronic alarm system which comes in various levels of complexities and sophistication. These are usually called the modern electronic alarm system.

2.6. MODERN ELECTRONIC ALARM SYSTEMS

With the recent increase in crime rates, it has become important to protect our buildings and properties with adequate safety devices with increased level of sophistications.

The cost of these safety devices depend on the equipment technology and the application requirement. These safety devices are called the modern electronic alarm system.

Some of the modern alarm systems commonly used these days are burglar alarms, duress alarms industrial alarms, speed limit alarms and anti theft car alarms.

The alarm sensor technology employed in this project work is the anti theft car alarm system. This type of alarm system in the case of a car is usually mounted within the car where it will be practically inaccessible to intruders. When the switch is not triggered or turned on, the electrical system of the car seizes to function or fuel supply is cut off.

In the case of electric stove when connected to the mains, the alarm alerts the user that there is current in the circuit but the hot plate is disabled until the trigger button is pressed which deactivates the alarm unit and completes the circuit of the hot plate. This prevents fire outbreak when left ON in the socket during power restoration after its failure.

CHAPTER THREE

DESIGN AND IMPLEMENTATION

3.1. CIRCUIT AND ANALYSIS

In order to meet the objective of this project, the entire system design is divided into the following units:

1. The power supply unit.
2. Hot Plate Auto-Disable Unit.
3. Alarm Unit.
4. Hot Plate.

The block diagram is shown in the figure below:

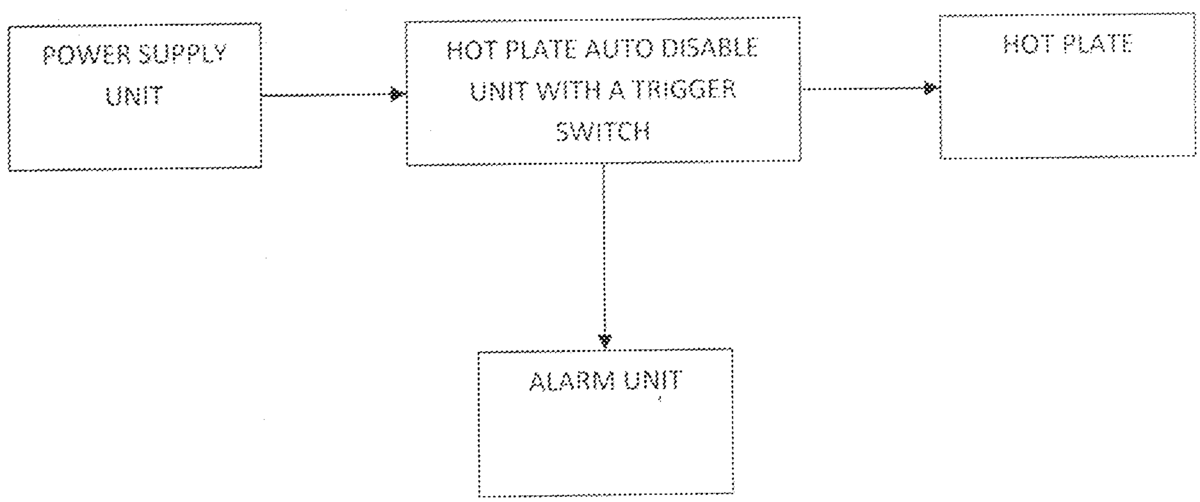


Fig. 3.1 the block diagram of an alarm incorporated electric stove

3.2. THE POWER SUPPLY UNIT

The power supply unit consists of a transformer, four diodes and a capacitor. The power supply unit is meant to take an ac power from the mains, step down the voltage, rectifies the ac and regulates the dc to enable the power drives the circuit.

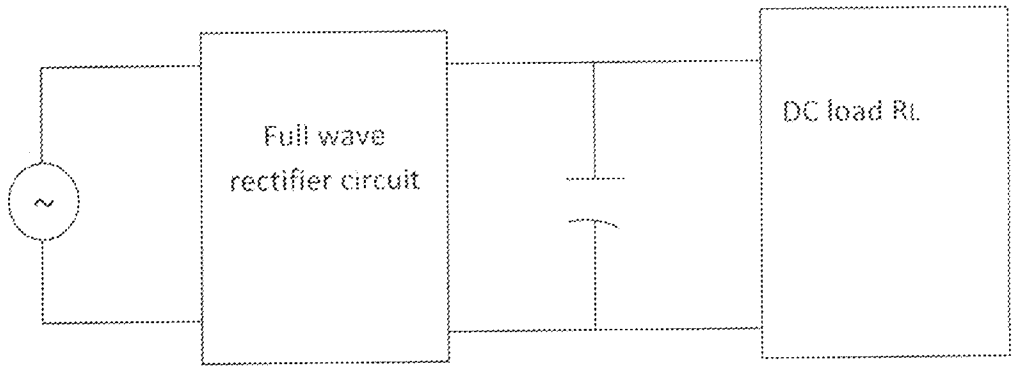


Fig. 3.2 Power supply circuit.

3.2. OPERATION OF THE POWER SUPPLY UNIT

The operation of each stage of the power supply unit can be described below:

3.2.1. VOLTAGE TRANSFORMATION

The voltage transformation was achieved using a step down transformer.

A transformer is a static piece of apparatus by means of witch electric power in one circuit is transformed into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current. The physical basis of a transformer is mutual induction between two circuits linked by a common magnetic flux.

Transformers have two coils in which the input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core in fig. b.

In the case of this project work step down transformer is used. The ratio of the number of turns o n each coil, called the turn's ratio, determines the ratio of the voltages. A step down transformer has a large number of turns in the primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

$$Turns\ ratio = \frac{Vp}{Vs} = \frac{Np}{Ns} and$$

Power output = Power input

$$Vs \times Is = Vp \times Ip$$

$$Where\ Vp\ =\ primary\ (input)\ voltage$$

$$Np\ =\ number\ of\ turns\ on\ primary\ coil$$

$$Ip\ =\ primary\ input\ current$$

$$Vs\ =\ secondary\ (output)\ voltage$$

$$Ns = number\ of\ turns\ on\ secondary\ coil$$

$$Is = secondary\ (output)\ current$$

The transformation was achieved using the specifications given below:

$$Vp = 230v\ rms,$$

$$Vs = 12v\ rms$$

$$Is = 300mA = 0.3A\ rms$$

Using the transformation equation

$$\frac{Vp}{Vs} = \frac{Is}{Ip}$$

$$Ip = \frac{(Vs \times Is)}{Vp}$$

$$Ip = \frac{(12 \times 0.3)}{230}$$

$$Ip = 0.0157A$$

$$= 15.7mA\ rms$$

$$Also,$$

$$Vpeak = \sqrt{2}xVrms$$

$$= \sqrt{2}x12 \qquad = 16.97v$$

$$Ipeak = \sqrt{2} \times Irms$$

$$= \sqrt{2} \times 0.3$$

$= 0.424$ A

3.2.2. VOLTAGE RECTIFICATION

Voltage rectification is the process of converting ac voltage into dc voltage. Most of the electronic devices and circuits require a dc source for their operation. Dry cells and batteries are one form of dc source. They have the advantage of being portable and ripple-free. However their voltages are low, they need frequent replacement and are expensive as compared to conventional dc power supplies. Since the most convenient and economical source of power is the domestic ac supply. It is advantageous to convert this alternating voltage (usually 220v rms) to dc voltage (usually smaller in value).

In this case full wave bridge rectification is used: it requires four diodes connected in bridge circuit as shown below:

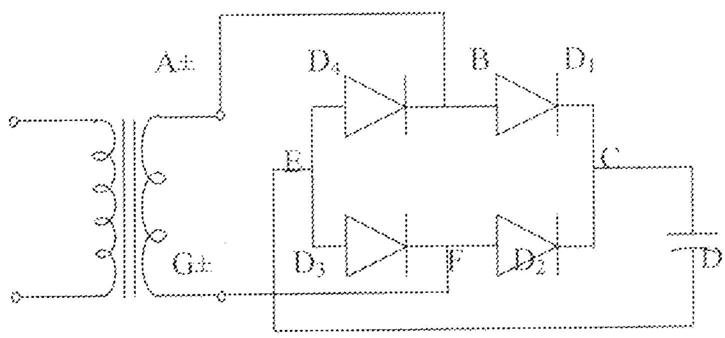


Fig.3.3 Full wave bridge rectifier.

3.2.3. WORKING PRINCIPLE

During the positive input half-cycle, terminal M of the secondary is positive and N is negative as shown in figure (c) above. Diode D_1 and D_3 become forward-biased (ON) where as D_2 and D_4 are reversed-biased (OFF). Hence current flow along 'ABCDEFG' as shown in figure (c) above. During the negative input half-cycle, secondary terminal N becomes positive and M negative. Now D_2 and D_4 are forward-biased. Circuit current flows along GFCDEBA as shown in figure (c). Hence, we find that current keeps flowing through the load resistance R_L in the bridge rectifier always act as an anode and point C as cathode. The output voltage across R_L is as shown in the figure (d) below:

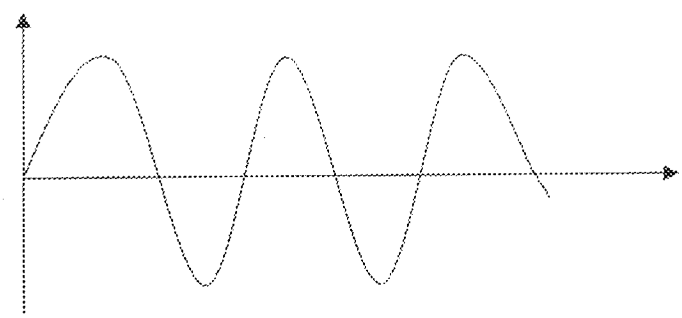


Fig.3.4 Sinusoidal voltage wave forms.

3.2.4. JUSTIFICATION OF COMPONENTS AND METHOD OF RECTIFICATION

Full wave bridge rectification is used because;

1. The components (diodes) used have low cost, small size and are highly reliable.
2. Much smaller transformer is required because it utilizes the transformer secondary continuously.

3. It is suitable for high voltage applications

4. No centre-tap is required on the transformer.

3.2.5 AVERAGE DC VOLTAGE

The average DC voltage can be calculated using the following formula

$$V_{dc} = 1/\pi \int_0^\pi (Em \sin\theta)\, d\theta$$

$$= -1/\pi \left[Em \cos\theta \right]_0^\pi$$

$$= -Em/\pi [\cos\pi - \cos 0]$$

$$V_{dc} = \frac{2Em}{\pi} = 0.636Em$$

Where $Em = rms\ value\ of\ the\ AC\ voltage$

And $Em = Erms \times \sqrt{2}$

Therefore

$$V_{dc} = \frac{2\sqrt{2}Erms}{\pi}$$

$$V_{dc} = 0.9\,Erms$$

$$V_{dc} = 0.9 \times 12v = 10.8v$$

3.2.6 RIPPLE FACTOR OF RECTIFIED SIGNAL

Although the rectified voltage is not a filtered voltage, it nevertheless contains a dc component and a ripple component.[EDCT]

Recall D.C value of the Rectified voltage $V_{dc} = \frac{2}{\pi} V_m = 0.636 V_m$ $V_m = ak\ voltage$

Where $V_m = V_{peak}$

$$V_{dc} = 0.636 V_m$$

$$= 0.636 \times 16.97$$

$$= 10.79v$$

Rms value of the a.c output rectified signal $V_{r(rms)} = 0.308 V_m$

$$= 0.308 \times 16.97$$

$$= 5.23v$$

% ripple of the Full wave rectified signal $r = \frac{Ripple\ voltage\ (rms)}{dc\ voltage} = \frac{V_{r(rms)}}{V_{dc}} \times 100\%$

$$r = \frac{0.308 V_m}{0.636 V_m} \times 100\%$$

$$= 48.5\%$$

3.2.7 FILTERING

A circuit that converts a pulsating output from a rectifier into a very steady dc level is known as filter. This is because it filters out or smoothens out the pulsations in the output.

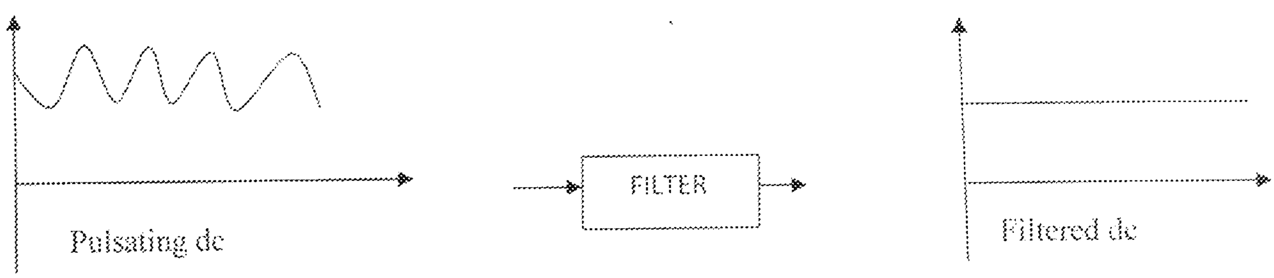


Fig.3.5 DC wave form

As seen, output of various rectifiers is pulsating. It as a dc value and some ac components called ripples. This type of output is not useful for driving sophisticated electronic circuits/

devices. In fact these circuits require a very steady dc output that approaches the smoothness of a battery's output.

In this project work, a suitable single capacitor C is connected across the rectifier and in parallel with the load R_L to achieve filtering action. This type of filter is known as capacitor input filter. This filter circuit depends on the property of a capacitor to charge up during conducting half-cycle and to discharge during the non-conducting half-cycle. In simple words, a capacitor opposes any change in voltage. When connected across a pulsating dc voltage, it tends to smoothen out or filter out the voltage pulsations.

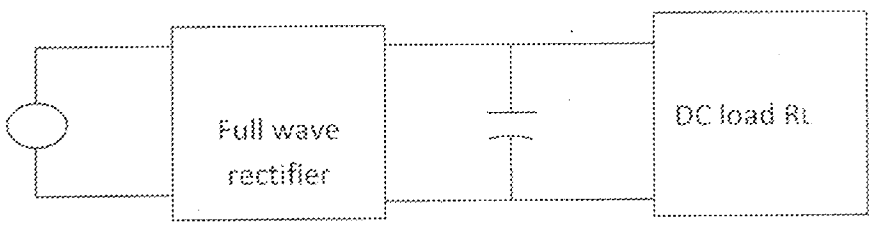


Fig.3.6 Rectifier and filter circuit.

3.2.8 WORKING PRINCIPLE.

When positive half-cycle of the ac input is applied, the diode is forward-biased and hence is turned ON. This allows capacitor to quickly charge up to peak value of input voltage V_{ip}, because charging time constant is almost zero. It is so because there is no resistance in the charging path except diode forward resistance is negligible. After being fully charged, the capacitor holds the charge till input ac supply to the rectifier goes negative. Since the negative is also being utilized in full wave rectifier, the process above repeats itself. Except that before it changes to negative the capacitor tries to discharge. The filtering action of this simple capacitor on a full wave rectifier is shown in figure below;

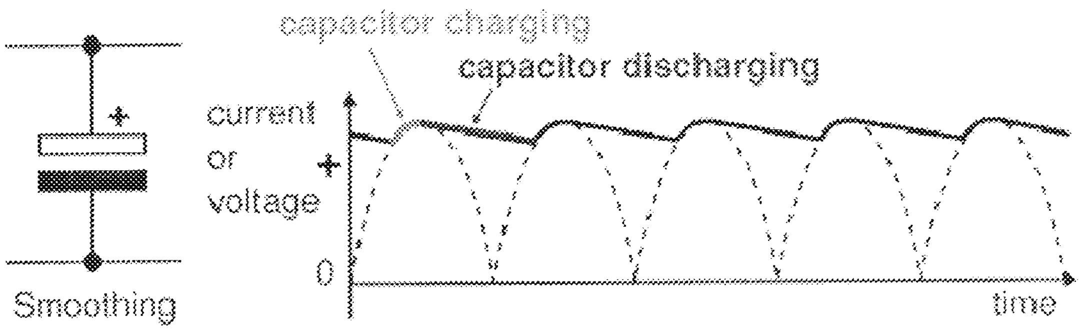


Fig.3.7 the output waveform of a full wave rectifier.

It will be seen that the dc load voltage increases slightly towards V_{ip} and also the ripple is voltage has been reduced by half. The decreased ripple is because of shorter discharge time before the capacitor is reenergized by another pulse of current.

In order to perform smoothing a large capacitor (470μF) was connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling, see fig below. The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.[web]

Capacitor Filter

Capacitor ripple voltage is given by $Vr(rms) = \frac{2.4I_{dc}}{c}$

$$Idc = load\ current = \frac{Vdc}{limiting\ resistor\ value}$$

$$= \frac{10.70}{2.7}$$

$$= 4.0\ mA$$

C = capacitance value of the capacitor = 470μF

$$Vr(rms) = \frac{2.4x4}{470} = 0.020v$$

DC Voltage of the Capacitor Ripple Voltage V_{dc} is given by

$$V_{dc} = Vm - \frac{4.17I_{dc}}{C}$$

$$But\ peak\ rectified\ voltage\ Vm\ =\ \sqrt{2} \times Vr(rms)$$

$$= \sqrt{2}x5.23 = 7.40v$$

NB $Vr(rms) = rms\ value\ of\ rectified\ output\ signal$

and $$Vdc = 7.40 - \frac{4.17 \times 5.77}{470}$$

$$Vdc = 16.92v$$

Capacitor ripple r

$$r = \frac{Vr(rms)}{V_{dc}} \times 100\%$$

$$r = \frac{0.0295}{16.92} x100\% = 0.17\%$$

3.3. HOT PLATE AUTO-DISABLE UNIT

Hot Plate Auto-Disable Unit is a circuit designed to disable the Hot Plate and activate the Alarm upon power high. To activate the Hot Plate, the trigger button needs to be pressed once. This is done in order to alert the user of the presence of power in the circuit. This unit consists of the 555 Timer, Relays and the manual trigger switch.

3.3.1 RELAYS

A **relay** is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts.

Since relays are switches, the terminology applied to switches is also applied to relays. A relay will switch one or more *poles*, each of whose contacts can be *thrown* by energizing the coil in one of three ways:

- Normally-open (**NO**) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. It is also called a **Form A** contact or "make" contact.
- Normally-closed (**NC**) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. It is also called a **Form B** contact or "break" contact.
- Change-over (**CO**), or double-throw (**DT**), contacts control two circuits: one normally-open contact and one normally-closed contact with a common terminal. It is also called a **Form C** contact or "transfer" contact ("break before make"). If this type of contact utilizes a "make before break" functionality, then it is called a **Form D** contact

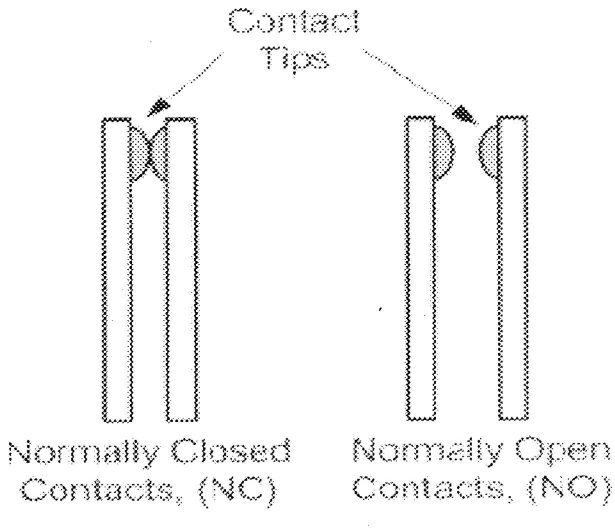


Fig.3.8 Relay contacts

3.3.2. 555 TIMER CIRCUIT

The 8-pin 555 Timer is one of the most useful ICs ever made. With just a few external components it can be used to build many circuits. The circuit diagram below shows a 555 Timer symbol

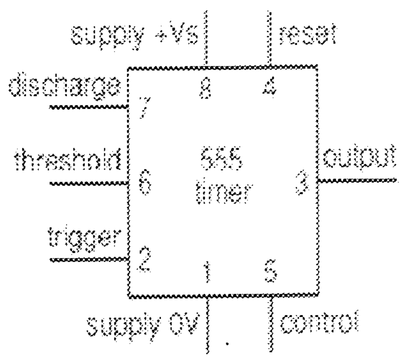


Fig.3.9 Symbol of a 555 timer

In the case of this project, the Monostable 555 timer is used which is a circuit that produces a single output pulse when triggered. It is called a Monostable because it is stable in just one state: 'output low'. The 'output high' state is temporary. The duration of the pulse is called the time period (T) and this is determined by resistor R_1 and capacitor C_1.

Time period, $\mathbf{T = 1.1 \times R_1 \times C_1}$

T = time period in seconds (s)

R_1 = resistance in ohms (Ω)

C_1 = capacitance in farads (F)

The timing period is triggered (started) when the trigger input (555 pin 2) is less than ⅓V_s this makes the output high and the capacitor C_1starts to charge through R_1. Once the time period has started further trigger pulses are ignored. The threshold input (555 pin 6) monitors the voltage across C_1 and when this reaches ⅔V_s the time period is over and the output becomes low. At the same time discharge (555 pin 7) is connected to 0V, discharging the capacitor ready for the next trigger.

Trigger is useful to ensure that a monostable circuit is reset or triggered automatically when the power supply is connected or switched on. This is achieved by using a capacitor instead of (or in addition to) a push switch. The capacitor takes a short time to charge, briefly holding the input close to 0V when the circuit is switched on. A switch is connected in parallel with the capacitor since manual operation is required.

3.4 THE ALARM UNIT.

The alarm unit consists of the buzzer which is an output transducer that converts electrical energy into sound. It contains an internal oscillator to produce the sound which is set at about

400HZ. Buzzers have a voltage rating but it is only approximate, for example 6V and 12V buzzers can be used with a 9V supply. Their typical current is about 25mA.

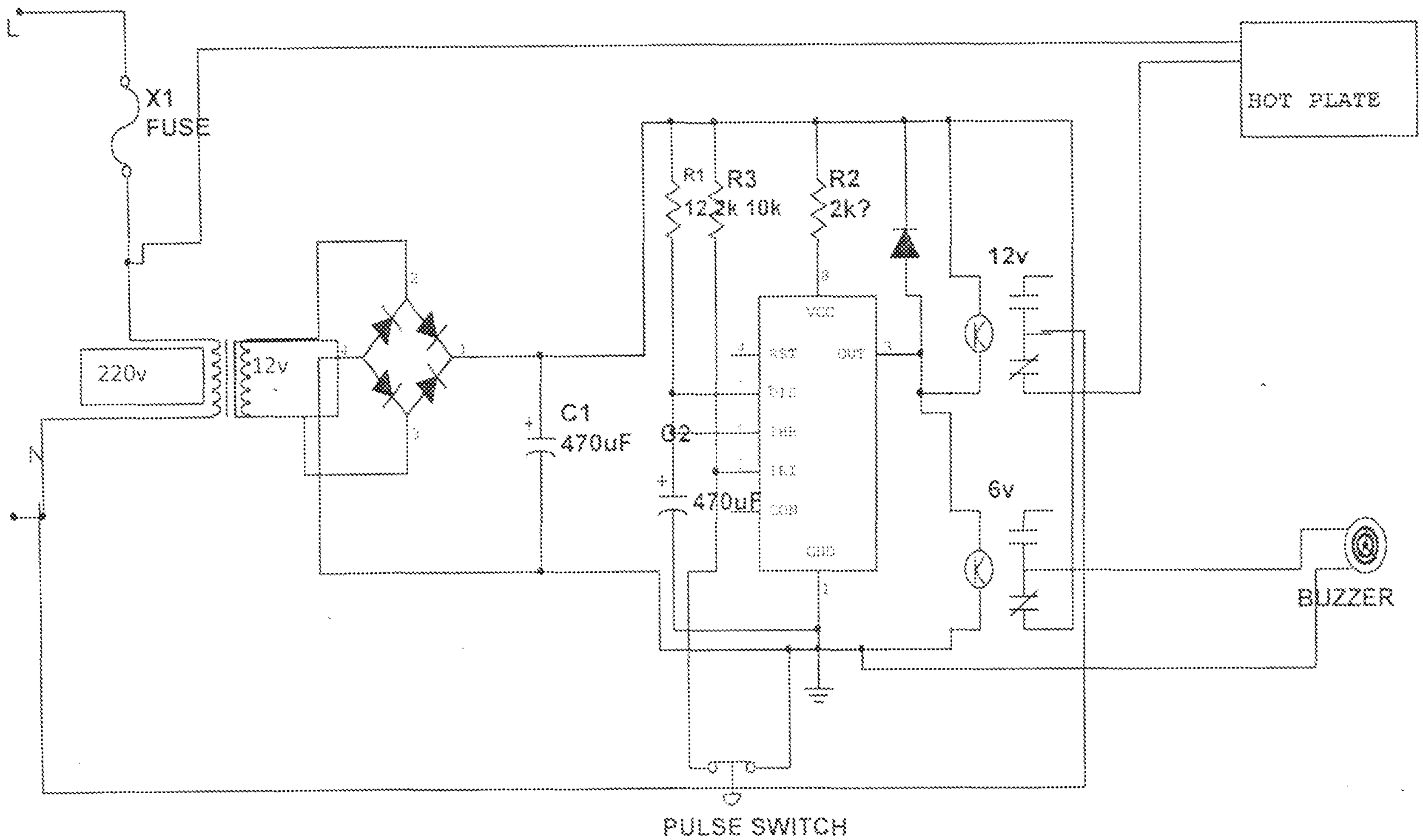
3.5 THE HOTPLATE

Electric heating is extensively used for both domestic and industrial applications. Domestic application include: Immersion heaters for water heating, Electric heating, Electric iron, Hotplates for cooking etc.

In the case of this project work, hotplate was used. It is a round plate made from cast iron with a stainless plate reflector beneath it. It has a voltage rating of 220-240v with a frequency of 50HZ. Its power rating is 1KW

Appendix

Complete Circuit Diagram



CHAPTER FOUR

TESTS, RESULTS AND DISCUSSION OF RESULTS

After completing any engineering design and construction, as in this project work, testing the resulting device plays a vital role in ascertaining the functionality of the system. It also helps to ensure whether the resulting device is functioning satisfactorily within design specifications as to achieve objectives.

4.1 TESTING AND RESULT OBTAINED

In this project work, testing of the device was carried out in four basic steps. These steps are sequentially listed below:

Step 1: To ensure that all the components to be used are functionally operating, they were first tested with digital multi-meter in which some failed and were replaced before finally soldering them on the veroboard.

Step 2: To ensure that there was no breakage in the circuit path, immediately after soldering on the veroboard, the circuit path was tested using the digital multi-meter. This was done to also ensure continuity of circuit on the veroboard.

Step 3: The period of time for the stove to stop was manually tested. This was achieved using Digital Stop Watch and the result obtained was found to be 2:04 hours. The value obtained from the manual testing closely agrees with that obtained in the design specifications i.e. 2:00 hours.

Step 4: After completing the construction and casing the stove was finally tested by boiling water with it to ensure that the circuit is still in good shape.

4.2 DICUSSION OF RESULT.

The sole reason of testing all the components before they were soldered on the veroboard is to avoid the painstaking effort it will take to remove faulty components at the end of the day. From the continuity test carried out on the veroboard to check the circuit path, it was discovered that the circuit was in a perfect working condition as continuity was ensured.

Simulation of the circuit design was also done as mentioned earlier, with the sole objective of comparing the results obtained from design calculations to that obtained from simulation. The two results when compared closely correspond with only a very slight discrepancy in values.

4.3 PROBLEMS ENCOUNTERED

It should be noted at this juncture, that the realization of the final project work was not without problems. The various problems encountered include:

1. Some basic components to be used for the project work were not within reach as it was not available in town.
2. The biggest problem encountered was that of component damages in the course of soldering on the veroboard. This was due to the heat generated by the soldering iron.

CHAPTER FIVE

CONCLUSION AND RECOMENDATION

5.1 CONCLUSION

It can be concluded that the sole of carrying out the design and construction of an Alarm Incorporated Electric Stove was achieved. in that the aim was to develop a cheap, affordable, reliable and efficient stove with security system, which was successfully realized at the end of the project work. One factor that accounts for the cheapness of the project was the proper choice of components. Those that were readily available were used and close substitutes were found for those that were not readily available. The reliability of the entire electric stove was ensured by the integration of an alarm into the circuit which will work when power is restored after its failure. The system was tested and found to be working to specifications and predictions.

Summarily, a cheap and reliable way of checking fire outbreak due to frequent power failure when using electric stove has been achieved, which is the aim of the project. We can conclusively say therefore, that the benefits of having this alarm incorporated electric stove cannot be overemphasized.

5.2 RECOMENDATIONS

I strongly believe that a lot of improvement can be done on this prototype design to enhance its efficiency, flexibility and performance. For these reasons, I which to recommend the followings:

1. This design does not include a means of cooling within the system. It only provided a means of reflecting the heat generated by the Hotplate from damaging whatever is below it by including stainless plate beneath the Hotplate. It is therefore recommended that

future designers should attempt to incorporate effective means of cooling to reduce the Hotplate temperature.

2. Also the design does not include timing circuit that will allow the user to select the desired cooking period.

3. Furthermore, an alternative source of power supply needs to be provided to serve as back-up to the erratic power supply by Power Holding Company of Nigeria (PHCN) e.g. solar cells.

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