International Journal of Engineering Innovation & Research
Volume 5, Issue 4, ISSN: 2277 – 5668

Development of Energy Saver Safety Switch

Engr Dr Arinze W.Nwosu, Ifreke U. Eyo, Chukwu N.Nelson
Corresponding Author: ifrekeeyo@yahoo.com

***Abstract* – This paper educates on the energy saving safety switch as an innovative device in the family of switches. It is made to: Cut off supply from any electrical lighting appliances whenever power goes off, thereby keeping the power supply to the appliance automatically off even when power has been restored. As a result of this, it saves energy and guards against danger of fire outbreak. Material selections, design parameters and operations were discussed.**

***Keyword* – Energy Saving, Electric Power, Electromagnetism, Relay, Safety.**

I. INTRODUCTION

In developing countries, public power instability is rampant. Most times people forget to turn off their appliances, when power supply goes off. When power is brought back, often in abnormal condition it damages appliances. At the same time this results to waste of energy and creates unsafe conditions if the appliances are heat generating ones. This device was created to solve this problem. By turning off power to the appliance and turns off itself when power goes off automatically, stops the flow of current to the appliance even when power is restored.

Most of the domestic appliances that are commonly used are plugged into wall socket, example television, fridge and iron. And, some are control by wall switch, example wall fan and lighting. These switches are always manually turned on and turned off. And if the switch is toggled on when power goes off, when power is brought back it goes to appliance direct which is dangerous. It has been noted from research and finding that most damage to domestic appliance are caused by introduction of sudden power which is always accompanied with excess abnormal voltage to the appliances which make it unsafe.

In most developing and developed country today, energy consumed knowingly or unknowingly is paid for because of the use of prepaid meter. Here, charges are strictly based on consumption, and for this reason it becomes necessary to save energy as much as possible, hence this device is made to reduce energy wastage as wall switch.

II. METHODOLOGY

Design Development and Consideration

As an electrical related project the primary concern for Material selection were safety, strength, reliability conductivity, resistivity to, corrosion, wear resistance weight shape and size, cost of production, and human factor.

Principle and Analysis

The Energy saver switch is composed of the relay which is the main component. It operates based on the theory of electromagnetism; the principle is called ***faraday's law of electromagnetic induction, which states that the magnitude of induced electromotive force (e.m.f.) is equal to the rate of change of magnetic flux*[1]**. It is known that when an electric current flow through a conductor, a magnetic field is immediately induced to existence in the space surrounding the conductor. It can also be said that when electron are in motion they produce a magnetic field. Most importantly, the magnitude of the magnetic field strength which is proportional to the electromotive force is influenced by the number of turns and the size of laminated core. These factors are considered for the design of varying capacity of the device.

Design Analysis

Explanation: Suppose the coil of a relay has N turn and flux density through it changes from an initial value of $N\varphi_1$webers to the final value $N\varphi_2$ weber in time t seconds when a potential difference is induce. Since flux linkage is the product of number of turn and the flux density of the coil, where Initial flux linkage =$N\varphi_1$,and final flux = $N\varphi_2$

Induce e.m.f. $\mathbf{e} = \frac{N\varphi 2 - N\varphi 1}{t}$wb/s or volt 1

$e = N[\frac{\varphi 2 - \varphi 1}{t}]$ Volt 2

Putting the above expression in its differential form shows that

$e = \frac{d}{dt}(N.\varphi) = N.\frac{d}{dt}$volt3

The induce e.m.f. set up current in such a direction that magnetic effect produced by it opposes the very cause producing it. A minus sign is given to the right hand side[1]. Hence

$e = (-N\frac{d\varphi}{dt})$volt4

e is the amount of e.m.f. established when current passes through a coil of N turn for mechanical manipulation of the relay arm. The e.m.f. determines the strength of the relay.

To get the desired magnetic flux the formula below is applied

Field strength (H)

$H = \frac{NI}{L}$AT/m the unit is A/m because turn has no unit

H is the magnetic field strength
N is number of turn of wire
A is cross sectional area of the core (m^2)
L is length of magnetic path (meter, m)
I is ampere of the coil (A)
AT/m is unit of magnetic field strength, ampere-turn per metre

Flux Density (*B*)

Electromagnetic effect of Material varies base on their permeability for this reason selection of medium was done base on this

μ_0 μ_r = absolute permeability,

$\mu_0 = 4\pi \times 10\wedge(-7)$ $\mu_r = 1$

$B = \mu_0 \mu_r H = \frac{\mu 0\ \mu\ rNI}{L}$ wb/m^2 unit in henry/m

Total flux produce $\varphi = B \times A = \frac{\mu 0\ \mu\ rANI}{L}$ wb

Magnetic flux $\varphi = \frac{NI}{L/\mu 0 \mu rA}$ wb

The numerator NI which produces magnetization in the magnetic circuit is known as magneto motive force (MMT)

The denominator $\frac{L}{\mu 0 \mu rA}$ is called the ***reluctance*** of the electric circuit and is analogous to resistance in electric Circuit

Also *flux*= $\frac{\text{m.m.f}}{\text{reluctance}}$

III. MATERIAL SELECTION

The materials used for this device are commonly sourced. The material components used where chosen based on optimal performance which some include cost consideration, operational parameter and the data available according to product safety commission and standard organisation of Nigeria. These components are efficient and affordable. The device is made up of the following component:

1. Relay
2. Indicator light
3. Push buttons
4. Connector
5. Casing

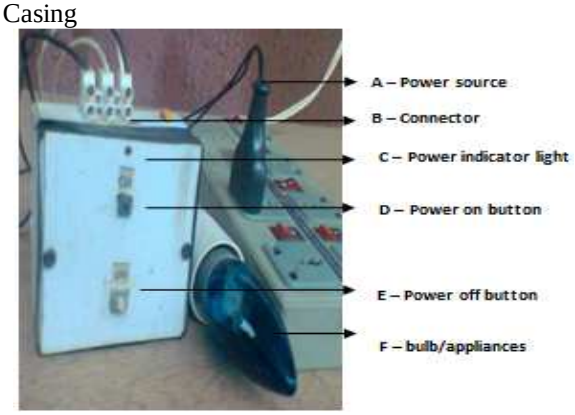

Fig. 1. Energy saver safety switch and testing apparatus

Fig. 2. Test stage 1, power switch is turn on, indicator light on, but no power to the bulb

Fig. 3. Test stage 2: Bulb light up,(c) showing present of power when the on button is triggered

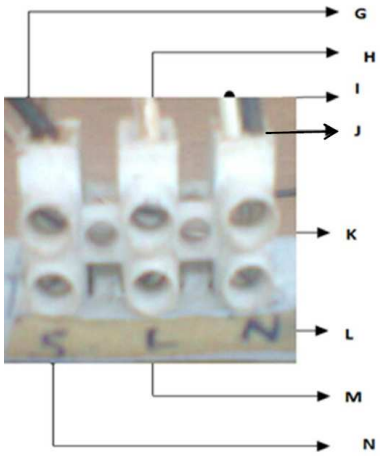

Fig. 4. Showing Connecting port on Connector

G - AC input live.
H - Mains Output to bulb.
I - Neutral output to bulb.
J - AC input neutral
K - Terminal connector
L - Neutral port to the circuit
M - Output from the circuit
N - AC input to circuit

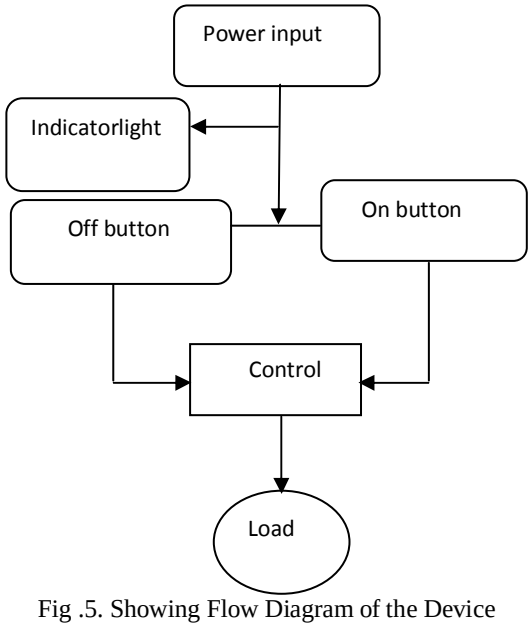

Fig .5. Showing Flow Diagram of the Device

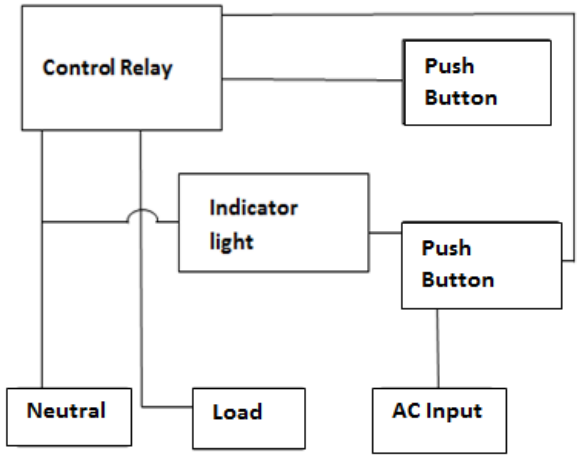

Fig. 6. Showing Block Diagram of the device

Operations

AC flow into the input terminal connector(J and G) which is link with (S and N) respectively where power flow into the device. The power flows to the indicator light(C) then to the stop bottom (E). The stop bottom is link with the start button (D). The stop button has two connections, one goes to the power and the other to control relay. The control is made up of logical connection with relay. When button (B) is activated current flow from the relay to the load terminal. The flow could be cut off with the stop button.

V. OPERATIONAL DESCRIPTION

Fig. 4. Shown the device and it outward nomenclature Connector Terminations

S Represents power input, 220 AC power is connected to the device. Through terminal **G**.

L Represents load output, this where the AC power output is connected to the appliances. Through **H**

N represents neutral which is for terminal **I** and **J**

K is Insulated connector

(From fig 1, A is connected to the load, with operational parameters of 220-250 volt single phase, 50-60Hz.

VI. CONCLUSION

This device presented in this paper intervene for power wastages as a result of human forgetfulness in turning off their electrical appliance when power goes off mostly in developing country were prepare electric meter is use. It also acts as safety devices against power surge, transient and fluctuation.

As a relevance innovative product the demand is expected to be high the device is well structure that the installations procedure for industrial, commercial and domestic building are easy. The component materials are approval by government accredited body in term of safety, quality and durability.

REFERENCE

[1] B L Theraja. 'Electrical technology' basic Electrical Engineering, volume 1, [2005]
[2] I.S. Grant, and W.R.Phillips. Electromagnetism, [1975].
[3] R J fouler. Electricity principle & application, Seventh edition.
[4] T, L Floyd principle of Electric circuit fourth Edition
[5] Michael F. Ashby, Mechanical Selection in Machining Design Third edition
[6] D.J. Griffiths, "Introduction to Electrodynamics" [1989].
[7] Course lecture by Richard Fitzpatrick physic Department University of Texas at Austin "Classical electromagnetism" vol.11997
[8] Microsoft ®Encarta® [DVD]. 2009.