

Development and Implementation of a Fuel-Less Power Generator with an Initial Alternating Current Start Up

Emmanuel I. Okhueigbe¹ and Patrick O. Oshevire¹

¹Department of Electrical and Electronics Engineering, Federal University of Petroleum Resources, Effurun, Nigeria
Email: okhueigbe.emmanuel@fupre.edu.ng, oshevire.patrick@fupre.edu.ng
Phone Number: +2348038062904

Abstract:

The erratic power outages have become a great challenge to the power engineers as it limits developmental growth of every country. It is of a greater challenge to supply energy in a country where the population is far beyond the generated energy due to increase in energy demand and this has led to various method of load shedding of energy supply to the load centers by utility supplies in a bit to see how the available energy can be distributed for all to have a fill of it. The non-environmentally friendly pollutant from the generating stations is also a very important issue to be investigated. This paper discusses the use of fuel less generator in addressing the inadequately of power supply by utility. Suppliers to its customers and addressing the challenges associated from pollution generated in the course of generating electricity by the use of a primer mover to generate electrical energy from an alternator. The prime move, shaft, gear box was connected directly with the alternator to generate electricity when the start bottom is turned on to generate an output supply of 220v.

Keywords: Alternator, gear box, prime mover, shaft, voltage level.

1. Introduction

In view of the development and advancement in the power sector and with billions of dollars spent on power project little or nothing is being showed for it which has led to a lot of persons not to be able to access electricity, in Nigeria after the national crisis that occurred in the year 2000, a situation where the generating capacity was bellow 2000MW (Okhueigbe, 2016) The pace of industrial revolution and developmental activities was at its lowest point upon the inability of the utility company to provide electricity to drive the economy which further led to the formal President Goodluck Jonathan in his inaugural speech on 29th May, 2011 placed the power sector in his transformation agenda, it is very clear that the power sector in Nigeria has been struggling to meet the load demand despite the bounty of sustainable power source to

meet the rising demand of energy at various load centers. (Osuide, 1990) (Shanban, 2014) (Sambo, 2012) (Kaygusuz, 2011) (Oyekola et al. 2019). This research work presents one of the alternative means of power general which will cost the nation nothing to maintain and sustain, ecofriendly (SDG compliant) and durable.

2. Methodology

The methodology used in the design and construction of a 5KVA fuel less generator include prime mover, alternator, coupling, charging circuit, capacitor bank and frame. The frame structure was constructed using H-channel steel and 16MM rod for brazing. The prime mover, gear box and alternator, were fixed to the frame structure by drilling holes on the frame structure and installing a damper made of rubber between the frame structure and the

main component of the fuel less generator mounted on the structure to reduce vibration to its nearest minimum. The design of the fuel less generator is made up of six basic component which include supply source, coupler, prime mover, gear box, coupler and alternator. The supply source help in supply of the energy to start

up the generator, first coupler is used in connecting the power supply to the prime mover, why the gear box help in the speed control of the generator system again. The second coupler is used in coupling the gear box to the alternator which finally produce a 220volts output.

Below is the block diagram for the fuel less generator.

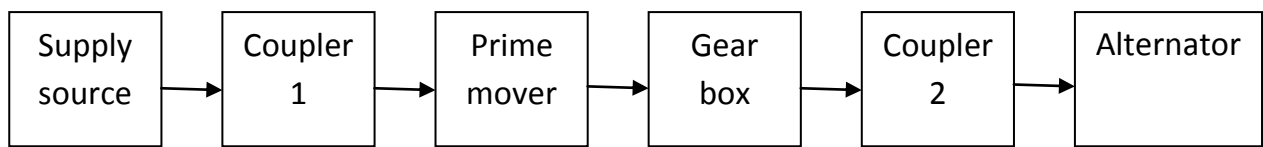


Figure 1. block diagram

The circuit diagram was simulated on a proteus environment in other to see the workability of the research before it was

constructed physically as shown on figure 3

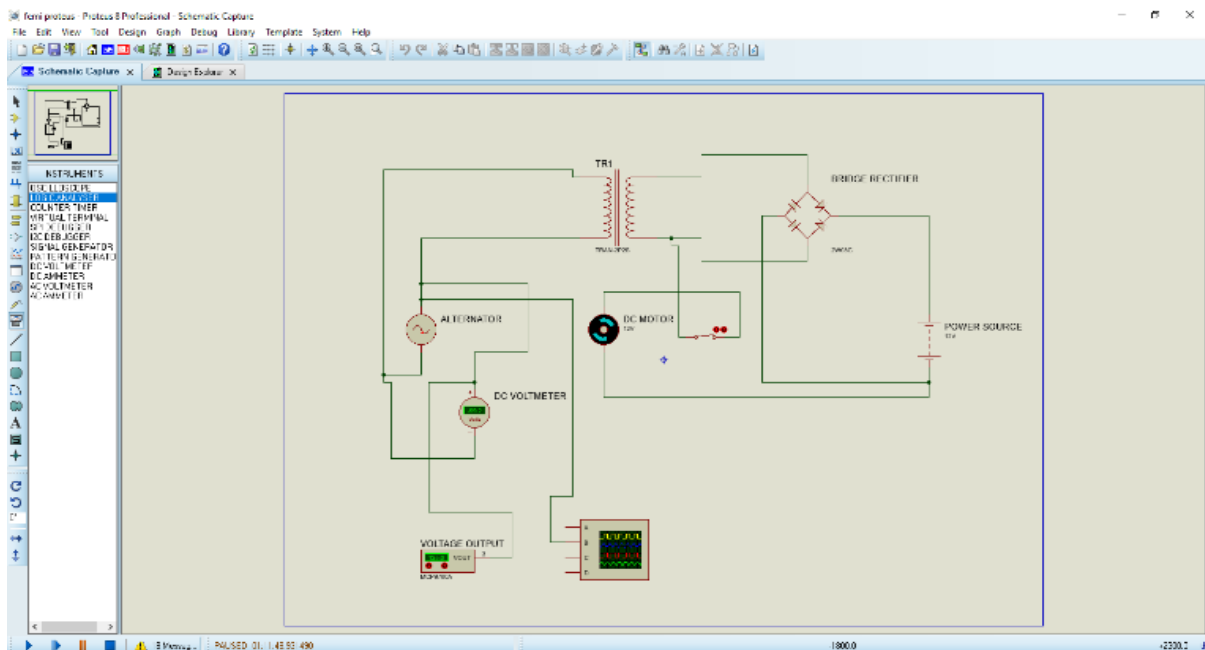


Figure 2. Fuelless Generator Circuit Diagram

Mathematical Model: An alternator operates using the principle of Faraday’s laws of electromagnetic induction to generate an induced electromotive force (EMF) (Oyakola et. al, 2019). The rotor in the magnetic field in the stator which is been linked together by the magnetic flux, the rotational force is applied to the rotor

by the prime mover represented mathematically

$$\text{Induced e.m.f} = \frac{N\phi_2 - N\phi_1}{t} \quad (1)$$

$N\phi_1$ = Initial flux leakage

$N\phi_2$ = Final flux leakage

N = Coil Number of turns

T = Time



Figure3: Pictorial View of the Fuel less Generator

3. Results and Discussion

Direct coupling technique was used in the actualization of this fuel less generator and energy saving bulbs were used at the load point with a stopwatch which was used for timing purpose in an interval of 30 seconds for five occurrence and a digital multi meter was utilized to get the voltage, current and mean voltage.

The output efficiency was determined using the obtained data collected after the

test on the generator was carried out and various load was connected ranging from 1 watt to 1000 watts.

$$\text{Efficiency} = \frac{\text{output Power}}{\text{Input Power}} \times 100 \quad (2)$$

The input supply and the output supply to the load was used in performance evaluation. However, it was observed while the load is varied gradually from a no-load point to a 1000watts with an incremental load variation of 50watts as shown in the figure below.

Table 1: Input Data Against Change in Load

Data	Input current (A)	Load (W)	Input Voltage (V)	Input Power (W)
1	1	1	1	1
2	1	50	2	50
3	1	100	2	80
4	1	150	2	50
5	1	200	2	70
6	1	250	2	50
7	1	300	2	80
8	1	350	2	60
9	1	400	2	50
10	1	450	2	50

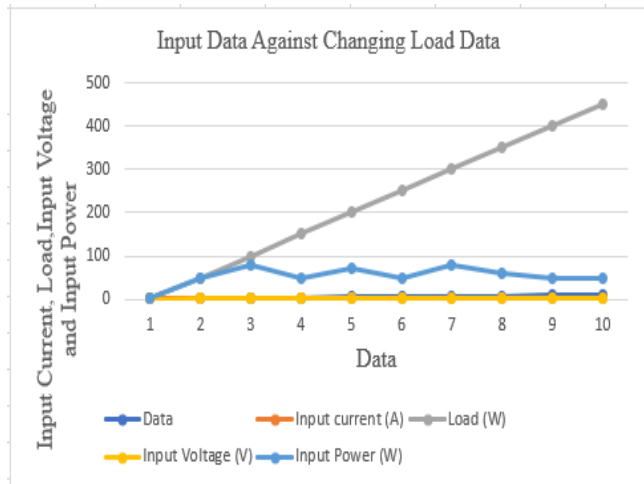


Figure 4. Graph of an Input Data Against Change in Load

Table 2: Output Data Against Load Changing

Data	Load (w)	Efficiency (%)	Output Power (w)
1	20	90	65
2	50	85	63
3	100	83	62
4	150	82	61
5	170	78	55
6	200	72	52
7	250	68	51
8	280	60	50
9	320	55	45
10	400	50	40

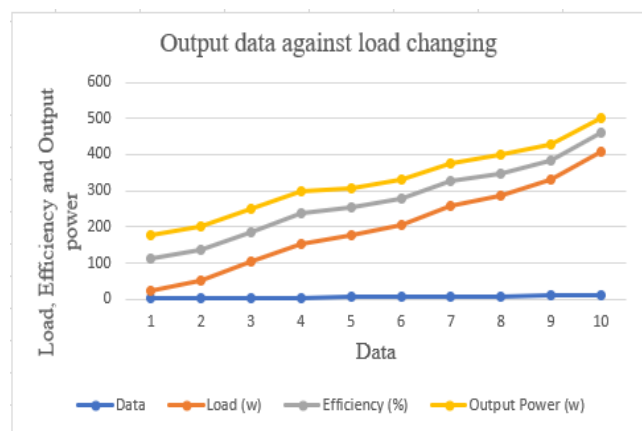


Figure 5. Graph of an Output Data Against Load Changin

Table 3: Input Data Against Changing Load

Data	Load (W)	Output Power (W)	Output Voltage (V)	Efficiency (%)
1	10	10	200	90
2	30	100	180	88
3	50	3	160	86
4	70	70	161	82
5	100	75	158	80
6	150	65	155	78
7	200	63	152	75
8	250	62	150	72
9	300	58	145	70
10	400	55	140	69

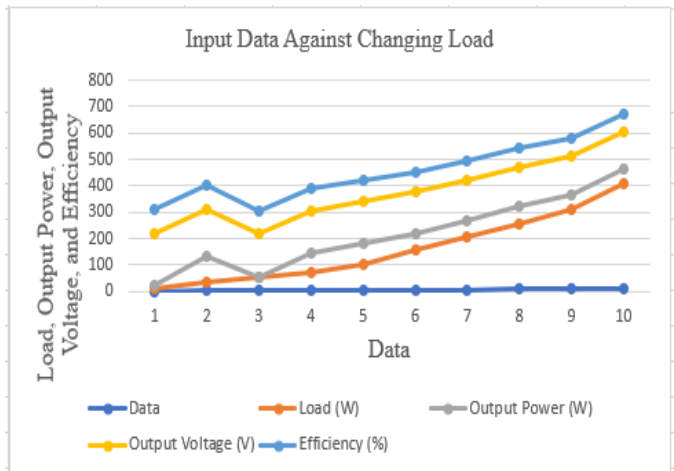


Figure 6. Graph of an Input Data Against Changing Load

Conclusion

With the input of an alternating current supply for the initial startup, the fuel less generator can operate on its own after the system has overcome initial, this research has presented a typical power generating set which does not make use of fuel or other source of renewable power supply during its operation, thereby making the

generating unit economically friendly and also environmentally friendly as it does not pollute the environment. As obtained in other source of power (Fuel and Diesel) generating set, also the fuel less generator has very minimum noise level as the dampers helps in absolving vibrations that may occur during operation of the fuel less generator.

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