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DESIGN AND CONSTRUCTION OF A FUEL LESS GENERATOR

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ABSTRACT

The global consumption of energy is growing and there is need for new renewable energy sources. A fuel less engine is an engine that produces electricity 24/7 without fuel (petrol, diesel, oil, grease, gas, sun, wind energy). The driving mechanism is the DC motor, which is driven by a battery (12V or more). The battery drives the DC motor, which in turn spins the alternator to produce electricity and at the same time, with the help of the diode, it recharges back the battery. It requires a suitable controller to regulate the voltage due to variation of consumer loads. Fuel less engine has very little impact on the environment, noiseless, pollution free, self-dependent and it can be built to the capacity of the load you want it to carry. The fuel-less power generating set components unit are: the power supply unit, the conversion unit, the control unit, the output unit, and the charging unit. From the performance evaluation report, It can be deduced that the machine (fuel-less power generating set) had the peak efficiency of 89.5% at a load of 180W and the lowest efficiency of 68.7% at a load of 720W.It was also revealed that there is a decrease in the output of the machine when there is a high increase in the load. After proper statistical analysis, the machine is said to have an average efficiency of 56.4%. The input voltage which is usually supplied by the battery ranges from 11.68V at load of 900W to 12.67 at 0W for fuel-less power generating set compare to 10.3V at load of 1000W to 12.63V for power inverter. This can be accounted for due to the fact that fuel-less generating set has self-charging component while the inverter system depends on main source (PHCN or Power Generating Set) for recharging the battery. Furthermore, the voltage output in the power inverter system is more stable than that of fuel-less power generating set as inverter system records output voltage which ranges between 146.8V at 1000W and 241.8V at 0W against the fuel-less generating set that recorded 28.24V at 1000W to 225V at 0W respectively.

KEYWORDS: *global consumption, energy sources, power inverter system, power supply*

1.0 INTRODUCTION

The exert nature of electricity is not known but investigation indicate that it consist of small negative charge called Electron, when this electron are standing still we have static electricity" and when they are forced to traveled a movement of electron they are called "Dynamic electricity. Power generation and distribution has been an indispensable factor in the progress of an economy, ranging from manufacturing, banking, media, health care, aviation, etc. (Atere, 2009). It has however been proved that power skyrocket the productivity of a country. Since power has been defined by Knight as the rate of doing work; this simply means that the productivity of a country will largely depend on the availability of power from different source. Thus, Hassan (1989) cited in Atere (2009) states that majority of the problems of Nigeria is traceable to the erratic power supply nature of the country, where many activities has been paralyzed due to the power outage. Analysis has clearly showed that Nigeria loose up to about N220 Billion annually, due to the unstable nature of the country power supply which has poses a threat, hence, reducing the capacity of industries to increase productivity (James,2005).

Environmental pollution which leads to degradation or depletion of ozone layer is one of the major problems caused by the use of generator with fossil fuels (Ajayi, 2012). Other problem includes land and water pollution, noise pollution, increase in price of fossil fuel year in year out, among others.

According to Occupational Safety and Health Administration (OSHA) Federal Safety regulations (2007) as cited in Adewumi (2015) explained sound as what the human ear hears; noise is simply unwanted sound. Sound is produced by vibrating objects and reaches the listener's ear as pressure waves in the air or other media. Sound is technically a variation in pressure in the region adjacent to the ear. When the amount of sound becomes uncomfortable or annoying, it means that the variations in air pressure near the ear have reached too high amplitude. With maximum noise levels permitted at a property line that range from 52 dB(A) to 72 dB(A), depending on location and zoning, and untreated generator set noise levels that approach 100 dB(A) or more, it is clear that generator set noise mitigation will be a subject of great importance. In order to find other ways of producing energy, a number of alternatives has arises from non- conventional energy sources that are renewable. One of these alternatives is the generation of electricity from a fuel less engine in an isolated power generation system with low maintenance cost (Adewumi 2015). A fuel less engine is an engine that produces electricity 24/7 without fuel (petrol, diesel, oil, grease, gas, sun, wind energy). The driving mechanism is the DC motor, which is driven by a battery (12V or more). The battery drives the DC motor, which in turn spins the alternator to produce electricity and at the same time, with the help of the diode, it recharges back the battery. It requires a suitable controller to regulate the voltage due to variation of consumer loads (Aremu, 2009). There are several different types of engine and all have different uses on the road, in the air, on the water, under the ground, in the hospitals and behind the data centers.

Fuel less engine can replace any of these engines types. Fuel less engine has very little impact on the environment, noiseless, pollution free, self-dependent. It can be built to the capacity of the load you want it to carry.

The global consumption of energy is growing and there is need for new renewable energy sources. Among the following energy sources that could be free from carbon dioxide are wind, wave and tidal of photovoltaic and osmotic power (Adewumi, 2015). But fuel less engine is still most dependable low maintenance cost energy source that provides new renewable solutions. The use of low cost, conventional energy such as fossil fuels will continue to be major source of energy until next decades, despite their adverse effect on environment. The pressure on the environment by human activities compiled with carbon dioxide emissions calls for thorough research on the alternatives (Adewumi, 2015).

2.0 MATERIALS AND METHOD

Our approach to this project is realized through the design and implementation of it components unit.

The fuel-less power generating set components unit.

- The power supply Unit
- Conversion Unit
- Control Unit
- Output Unit
- Charging Unit

2.1 The Power Supply Unit

24 volts battery was used as source of power supply unit to the D.C motor in order to induce electromotive force (E.M.F). Lead acid battery is highly recommended for DC generating system. This serves as storage device for the direct current which is to be induced.

2.2 Conversion Unit

This unit is the unit that distinguished the DC generator from the popular fuelled generating set. The units make use of DC motor, which will be responsible for all voltage, current and power conversion.

2.3 Control Unit

This unit performs the following work; converts direct current (DC) to alternating current (AC), removal of ripples, and rectification.

The size of the alternator been used, will determine the capacity of the generating set.

Mathematically; $P = IV \cos \Phi$

Where,

P = Power output (watts) =?

V = Voltage (Volts) = 220

I = Current (ampere) =5.35A

$\cos \Phi = 0.85$

Therefore, the capacity of the generating set, P = 5.35 x 220 x 0.85 = 1000W

The alternator which is a small domestic generator has three output lead cables which supplies, the load, capacitor and the diode.

2.4 Crank Shaft

The crankshaft acts as a link between the DC motor and the alternator which transfer the mechanical energy from the DC motor into the alternator to produce electric current.

2.5 Output Unit

The use of the control circuit unit will make it possible to provide output voltage within the range of 100V–240V which is the standard voltage requirement for all appliances. The red wire on the alternator was used to supply the household and offices as the mains.

2.6 Constructional Features

The constructional features are as discussed below:

2.6.1 The Frame

This part provides support to all components of the fuel-less generator. It serves as housing for all component parts of the machine. A piece of angle iron 40mm x 40mm x 5mm was measured, cut to sizes and welded together to make a stand of length 61mm, width 40mm and height 19mm; brazed at different points for regularity with angle bar of 1.5mm x 1.5mm.

2.6.2 The motor seat

A piece of angle iron of dimension mentioned for the frame was cut into length 21mm x 10mm.

2.6.3 Alternator Seat

A piece of angle iron of above dimension (1.5mm x 1.5mm) from the frame was cut into length 20.5mm x 12mm and was welded to the frame.

2.6.4 Alternator

A permanent magnet alternator is a power generating device that produces a sinusoidal output when a mechanical input to its hub or shaft is applied. This device is constructed very much like a brushless motor with the appropriate selection of insulation materials and winding to match the environment and application.

Alternator used for this project work has the following nominal parameters as specification

Voltage = 220V,

Current = 10.7 A,

Speed = 12000 rpm,

Minimum speed for accumulator charging initiation = 1300 rpm.

They are produced in a variety of power and voltage levels and generally are always examined from many points of view, such as reliability, efficiency, dimensions, weight and costs.

2.6.5 D.C Motor

Electric motors are electric generators reversed in function. They convert electrical energy into mechanical energy- the continual stresses between two electromagnetic field relatively moveable, just as generator convert into electromagnetic stresses, the mechanical energy applied to them (Aremu, 2009). Power from the electric motor is transmitted into the alternator via rotating shaft driven system. Electric motor used for this research work has the following configuration; 2200rpm (Speed), 24V.

Fig 2.1:D.C Motor (Adewumi, 2015)

2.6.6 CHARGER:

It charges the battery as the system generate light and return (recharges) current to the battery, the charger does this by putting energy into the rechargeable battery by forcing an current through

Fig 2.2:Charger

2.7 FABRICATION PROCEDURE

In the design of the fuel-less generating set, the following procedural steps are used to achieve the aims and objectives of the research work.

Step 1: Fabricating a crankshaft and boring a reasonable hole that will conveniently fit into the DC motor with thread hole for bolting the motor to the crankshaft.

Step 2: Fitting the fabricated crankshaft in to the DC motor.

Step 3: Inserting the DC motor with crankshaft into the crank casing of the alternator.

Step 4: Fitting the armature of the alternator into the casing.

Step 5: Dropping the stator core of the alternator into the armature.

Step 6: Inserting a long bolt through the bearing end of the stator and tighten firmly to connect the motor and the alternator together.

Step 7: Replacing the cover of the alternator and fasten both the cover and the crankcase together.

Step 8: Constructing a frame for the generator to provide support and rigidity.

Step 9: Connecting the terminals of the DC motor to equivalent terminals of the battery

Step 10: Connecting the red cables to the mains as output.

Fig 2.3: Fuel less Generator Construction In Progress

3.0 RESULTS AND DISCUSSION

3.1 Performance Evaluation

This evaluation is intended to establish the conversion efficiency between the fuel-less D.C source (PV) input and the AC output. This will include response to variations in input power, input and output voltage, ambient temperature. In all cases of the following tests, the ac output was measured on the utility side. In this test, the generator efficiency is show below. 6Owatt bulb is been used for the test.

TRIAL	No of bulb used (60W)	Load(W)	Efficiency (%)
1	0	0	98.7
2	3	180	89.5
3	6	360	76.9
4	9	540	72.6
5	12	720	68.7

Table 3.1: Evaluation of Fuel less Generator

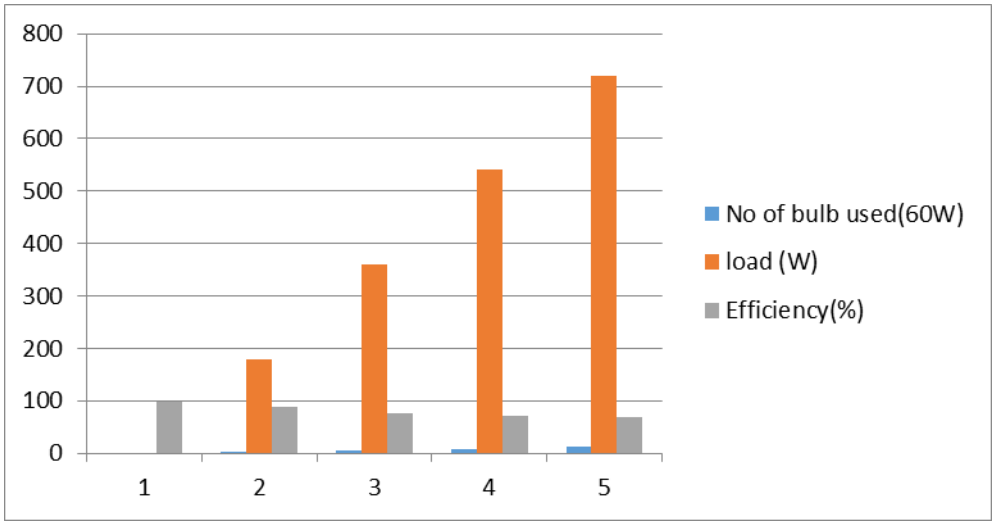

Chart showing the evaluation of fuel less generator

3.2 Machine Evaluation

The evaluation of the machine will be calculated using the formula below:

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100\%$$

3.3 Output Efficiency for fuel-less Power Generator

The load bank was connected to the fuel-less generator in order to power the light bulbs on the bank, which was connected to the extension wire. Stop watch was used to record the time at interval of 60 seconds for five different runs. While the multi-meter was used to read the voltage output in Volts with Current in Ampere and the mean voltage with current result was computed in the Table 3.1 above.

Output efficiency was computed using the data obtained after testing, as shown in the Table 3.1 above. Load capacity used for this research work ranges from 0 watt to1000 watts; that is from 0% to 100% loading. The speed of the motor used was 9000rpmwhile that of the alternator was 6000rpm. This simply means that there is direct coupling of the motor and the alternator since the speed is in ratio 1.5: 1. The power factor was kept constant ($\Phi = 0.85$), since the standard range from IEEE is between 1 – 0.7 and local load bank was used in testing the machine which consist of light bulbs. Each test was replicated five times.

4.0 CONCLUSION AND RECOMMENDATION

The following conclusions were drawn from the fabrication of 1000W (1KVA) fuel-less
Power generating set;

i). It can be deduced that the machine (fuel-less power generating set) had the peak efficiency of 89.5% at a load of 180W and the lowest efficiency of 68.7% at a load of 720W.

ii). It was also revealed that there is a decrease in the output of the machine when there is a high increase in the load.

iii). After proper statistical analysis, the machine is said to have an average efficiency of 56.4%.

iv). The input voltage which is usually supplied by the battery ranges from 11.68V at load of 900W to 12.67 at 0W for fuel-less power generating set compare to 10.3V at load of 1000W to 12.63V for power inverter. This can be accounted for due to the fact that fuel-less generating set has self-charging component while the inverter system depends on main source (PHCN or Power Generating Set) for recharging the battery.

v). Furthermore, the voltage output in the power inverter system is more stable than that of fuel-less power generating set as inverter system records output voltage which ranges between 146.8V at 1000W and 241.8V at 0W against the fuel-less generating set that recorded 28.24V at 1000W to 225V at 0W respectively.

Based on the design, construction and performance evaluation test conducted on the fuel-less power generating set, the following recommendations were made for further study

- Efficiency
- Number of trials (Power Loading)
- Input Power (W)
- Output Power (W)

(i) In order to obtain a good performance characteristic, a voltage well above 12V battery should be used to power the generator.

(ii) Design of special DC motor, alternator and transformer for the purpose of construction of fuel-less power generating set has to be encouraged by engineers in society in order to have clean and renewable energy especially for agricultural production.
(iii) The appliance can be adopted and made available for use in agricultural establishments.

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