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DESIGN AND CONSTRUCTION OF 3.5 KW SELF-LOOP GENERATOR SYSTEMS

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Abstract

Nigeria's power generation and distribution have been an indispensable factor in the progress of the national economy. Power generation and distribution play an important factor in all aspects of development, but even with the vast natural resources endowed in Nigeria in the forms of natural gas, oil and coal, Nigeria is still not able to solve the problem of erratic power supply. This problem has lead the country to find alternative means of power supply in generators that consume petrol and diesel. The problem with these generators is that they are very costly to run and maintain, and they have negative environmental impacts. In this work, the design and construction of 3.5 KW fuel-less generator was conducted which is a self-loop system that generates power without any dependence on an outside source (example fuel, solar). The design and construction of a 3.5KW self-loop generator was achieved through Faradays law of induction, using an alternator, electric motor, flywheel, rectifier and a DC power source. The system achieved self-power generation status successfully and the AC output was tested on load status and no load status with output voltages ranging from 120-220v.

KEYWORDS:
Power, Electricity, Generator, Self-loop, Environment.

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INTRODUCTION

Power generation and distribution have been an indispensable factor in the progress of an economy, ranging from manufacturing, banking, media, health care, aviation and so on. The role of electricity in any economy cannot be overemphasized. Electricity plays an important factor in all aspects of development, ranging from industry, environment, agriculture, and socio-economy in general. Even with the vast natural resources endowed in Nigeria in the forms of natural gas, oil, and coal, it is still unable to provide a lasting solution to the power crisis rocking the country and crippling most economic activities (Onuoha, 2016). **The operation of an electromagnetic generator was discovered in the year 1831-1832 by Michael Faraday, the principle of electromagnetic generators - a potential difference is generated between the ends of an electrical conductor that moves perpendicular to a magnetic field (Kusiak, 2010).** By using Faraday's Law; if the flux linking a loop (or turn) varies as a function of time, a voltage is induced between its terminals. The value of the induced voltage is proportional to the rate of change of flux (Wildi, 2002). A moving conductor cutting the lines of force (flux) of a constant magnetic field has a voltage induced in it, the changing magnetic flux inside a loop made from a conductor material will induce a voltage in the Generators (or alternators), motors, and transformers each use the principle of electromagnetism.

An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Most alternators use a rotating magnetic field with a stationary armature but occasionally, a rotating armature is used with a stationary magnetic field; a linear alternator is used. The main aim is to move and drive the rotor by any method and technique to produce power. Alternators generate electricity using the same principle as DC generators, namely, when the magnetic field around a conductor changes, a current is induced in the conductor. Typically, a rotating magnet, called the rotor turns within a stationary set of conductors wound in coils on an iron core, called the stator. The field cuts across the conductors, generating an induced EMF (electromotive force), as the mechanical input causes the rotor to turn. The rotating magnetic field induces an AC voltage in the stator windings.

Often there are three sets of stator windings, physically offset so that the rotating magnetic field produces a three-phase current, displaced by one-third of a period concerning each other (Mansoor-ul-Hassan, 2014). This study is about the construction and implementation of a self-loop generator with performance analysis (fuel less generator).

LITERATURE REVIEW

In an attempt to find a solution to the inconsistency of power supply of Nigeria, paper research on the development of self-induced fuel-less generating set for sustainable power supply in Nigeria using local available materials reveals the possibility of a feature of those local materials, it consists of a DC battery, DC motor, alternator, connecting shaft, charging panel (transformer, diode, and capacitor), and a frame. A 12V, 100Ah battery (power source) was connected to a 12V DC motor which in turn rotated to give the mechanical power through the shaft. The rotating DC motor (prime mover) turns the alternator to a full speed and this gives out the electrical energy. Part of the output power is recycled (feedback) to a battery charger to keep the battery on. The output result is as good as the conventional fuel generators (Esom & Aneke, 2020).

Another research on the comparison of two prototype designs was focus on construction and performance evaluation of V-belt and direct coupling fuel-less power generating set. Search for renewable energy is important as fossil fuel depletion has been noticed. There are three ways of transmitting mechanical power from one point to another. Belt and pulley drive, Gear and chain, and direct coupling. There are three ways of transmitting mechanical power from one point to another. Belt and pulley drive, Gear and chain, and direct coupling. This research technically investigates two out of the three ways of power transmission (Belt & Pulley and Direct Coupling Design). The evaluation of the work shows that the coupling design of power fuel-less generating is better than the Belt and Pulley design of the generating set with an efficiency range of 0% -89.9% for direct coupling while 0% -73.23% for V-belt design. (Centre & Uk, 2016).

A review of flywheel energy storage technology was made, with a special focus on the progress in automotive applications, flywheels are

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operational for grid frequency regulation, and many hundreds more installed for uninterruptible power supply (UPS) applications. Energy can be transferred into the flywheel either electrically or through a mechanical connection. The current trend is towards electric machines, transferring power in a contact-less manner between rotor and stator. This introduces two important advantages: a long lifetime and low standby losses (Hedlund et al., 2015).

A study of a design and fabricate a self-proclaiming generator in an automobile that synthesizes energy by itself or increases the efficiency of the battery. It harnesses the energy which in turn is utilized by the automobile. Initially, the vehicle uses an electrical charge to start. Then the dc motor is connected to the wheels, which in turn is connected to a charging circuit to drive the wheels. Another circuit with a generator and generator driving motor is connected to the battery. When power is supplied to the generator setup it drives the generator and output are maximized and this output is fed to the battery so that the efficiency of the battery is exhausted. The generator is designed in such a way that the output is doubled with a given input. This generator setup is useful in all the fields where the battery plays a main role (Pavanasudan & Uday, 2014).

METHODOLOGY

The work is constructed and implemented using the block diagram shown in Fig.1

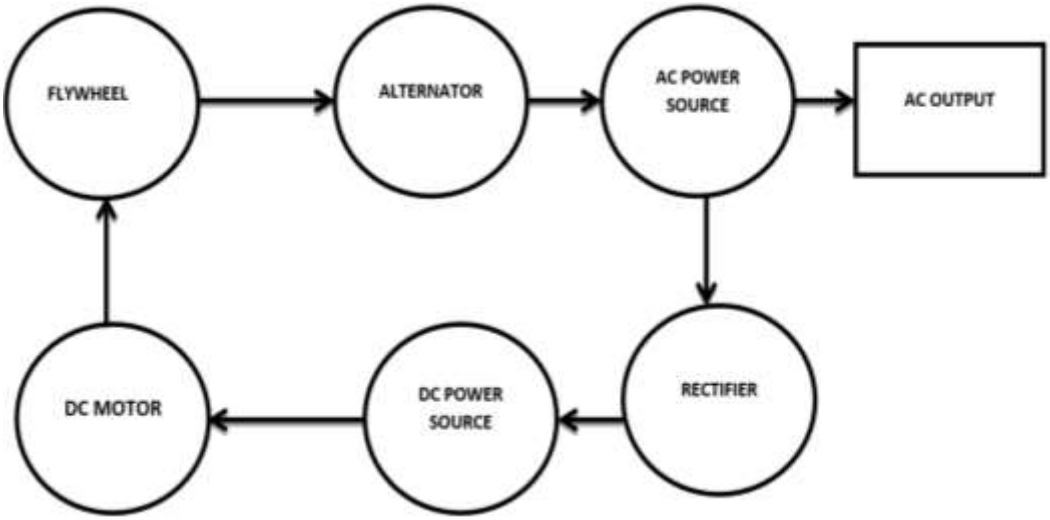

Figure 1: Block Diagram of 3.5 kW self-loop Generator

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The D.C Power Source is a type of power supply that gives direct current (DC) to power our device i.e. our DC Motor. Because DC power supply is commonly used on an engineer's or technician's bench for a ton of power tests, they are also often called "bench power supply". The 2 x 12 volts battery connected in series was used as a source of power supply unit to the D.C motor to induce electromotive force (EMF). The lead-acid battery is highly recommended for DC generating system. This serves as a storage bank for the direct current which is to be induced. The electric motors are electric generators reversed in function, and they convert electrical energy into mechanical energy, the continual stresses between two electromagnetic fields relatively moveable, just as generators convert into electromagnetic stresses, the mechanical energy applied to them. The power from the electric motor is transmitted into the alternator via a rotating shaft driven system, the electric motor used for this research work has the following configuration; 1500rpm (Speed), 24 V. The flywheel is a heavy wheel that makes an engine move smoothly by storing kinetic energy and keeping the engine at a constant speed throughout its cycle. A flywheel is a heavy wheel that stores energy and regulates the engine's rotation, making it operate at a steady speed. The Alternator with 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.

The alternator used for this Project research work has the following nominal parameters as specifications; Voltage is equal to 24V, Speed equals 1500 rpm while the minimum speed for accumulator charging initiation is 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. The rectifier is used to convert alternating current (DC) produce to direct current (DC) during the charging process. The AC Power source supplies an alternating electrical current that helps power or tests a separate piece of equipment by simulating electrical grid interruptions, harmonic, surges, or other events that could a device under test (DUT) malfunction. The AC output is the standard electricity format that comes out of

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outlets. The name comes from the waveform the current takes.

Construction Features of the project

The Frame

This part provides support to all components of the fuel-less generator. It serves as a table for all parts of the machine. A very strong metal iron was measured, cut to sizes, and welded together to make a stand of length, width, and height 2; brazed at different points.

Motor seat

A piece of angle iron of dimension mentioned for the frame was cut into length 21mm x10mm and which was welded to the mainframe.

Alternator seat

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

Flywheel seat

The battery and charging panel seat in a plate of area 60 x 19 mm^2, welded to the frame to make up with the seat of battery and the self-charging panel of the generating set.

Construction/Design Procedures

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

Step 1: The fabrication of the crankshaft with a bore-hole to hold the flywheel firm and also to hold the Pulley that drives the flywheel then drives the alternator.

Step 2: fabrication of the frame which was done with the use of very strong metal to support the weight of the flywheel and the remaining component.

Step 3: mounting or installation of the alternator, motor, and flywheel, using bolt and nut.

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RESULTS AND DISCUSSION

Result Test

To ascertain the workability, reliability, and operation characteristics of the fuel-less generator, tests were carried out on no-load and load conditions. Tables 1 and 2 below show the result on load and no-load.

Table 1: Test on-Load

Iteration Test	Load	input Voltage(v)	output voltage(v)
1	3	24	120
2	3	24	180
3	3	24	190
4	3	24	220

Table 2: ***Test on no-load***

Iteration Test	Load	input Voltage(v)	output voltage(v)
1	0	24	175
2	0	24	189
3	0	24	200
4	0	24	197

CONCLUSION

The project set out to construct a fuel-less generator that will provide an alternative to the many problems encountered when using the fuel powered generators. Some of those problems include environmental effects, cost effectiveness and convenience. To reach project goal, some problems where encountered, at first, a when D.C motors of 4.5hp, 180 VDC, and 4200 rpm was used to drive the system, to ascertain a maximum output of the alternator. The D.C motor was used to obtain a high speed. For the maximal output capacity of the alternator to be obtained. There was also difficulty in powering the motor as a result of the 180 VDC. A voltage converter was needed to convert the voltage from the 12 DC V to 180 DC, this was not achieved because of the cost restrain associated with the project. Alternatively, a 24 VDC motor,

powered by two (2) 12 volt batteries was used to power the system successfully.

In spite of the challenges encountered, the project goal, which was to design and construct a self-loop generator was successfully achieved and thus, providing a cost effective, noiseless, environmentally friendly source of energy.

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