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Investigating Eco-Road: Generating Electricity from Speed Cushions

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Abstract: This study was conducted at Capiz State University, Roxas City-Main Campus (September, 2022 – May 2023). It aimed to develop a Speed Cushions Electric Generator. Specifically, it aimed to develop a speed cushion that will generate electricity when stepped by a vehicle. The first objective was to determine the output voltage of the device in relation to the RPM. According to the data gathered, the mean RPM and Generated Voltage for table 2 are 830 and 2.56V. The result implies that, as the RPM of the rotor increases, the generated voltage also increases. The second objective is the calculation of the transformer's efficiency and was based on table 3. The RPM and voltage for input are 668 and 0.75V in trial 1, while the mean RPM and voltage for output are 667 and 9.62V in trial 2. These are the given data used solve for the transformer's efficiency, since the RPM of input and output is close. The mean RPM and Generated Voltage for table 2 are 830 and 2.56V. The result implies that, as the RPM of the rotor increases, the generated voltage also increases. The third objective to determine the output DC voltage from the rectifier. The mean RPM and voltage for DC are 750.33 and 27.46V. In a star or wye connection, the line voltages are added if connected to a circuit. Therefore, the line voltages in the rectification stage are added that leads to high DC voltage generated. These results imply that the voltages generated can be used for lighting and charging of batteries.

Keywords: Road cushions, Slowdown ramp, energy harvesting, generator

I. INTRODUCTION

Since the Philippines has one of the largest vehicles in the world, the roads are shortcuts for many vehicles, which also means that many people are involved in traffic accidents. Acceleration buffers are installed to prevent collisions. These traffic devices are intended to slow down traffic on less frequent roads. Speed cushions are made from a variety of materials, including asphalt, concrete, plastic, metal, and rubber (INC et al., 2021).

From there, the researchers in this study designed and build a speed cushions electric generator that generates electricity, doubling the purpose of the speed cushions. Most people depend on cars for transportation, which causes congestion. It will benefit electricity generation and encourage vehicle movement. This energy source is environmentally friendly as it does not contain any chemical materials.

II. NEED OF THE STUDY

Speed cushions are usually used to slow down a car, but they can also be more productive, such as generating electricity when one crash into a car. This concept can be especially useful in parking lots where energy is used for lighting. It can be installed at the entrance and exit of the station. The present invention relates to the acceleration of energy production. In particular, it is easy to choose to use a road with many vehicles, and it is easy to generate a constant and stable voltage by continuously controlling the generated voltage for a certain period of time. The present invention relates to a high-speed gear with a power generator that can be used in the general field. Speed cushions are used to prevent vehicles from moving around schools, residential areas or private buildings. These cushions are considered pedestrian friendly and are usually produced in 75mm. Speed cushions generates electricity with the energy of cars through the cushions and there is an electrical power generator that can produce electricity and can be consumed for lighting and charging.

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III. RESEARCH METHODOLOGY

The methodology section outlines the plan and method that how the study is conducted. This includes Universe of the study, sample of the study, Data and Sources of Data, study's variables and analytical framework. The details are as follows:

3.1 Population and Sample

This study did not conduct a survey, therefore, there were no population and samples presented

3.2 Data and Sources of Data

The test for the RPM with be gathered using the digital tachometer; the generated voltage was gathered using a multi tester but without the connection of the transformer to avoid losses; the input and output voltage of the transformer was gathered using the multi tester; Lastly, the output DC voltage were gathered using the multi tester.

3.3 Theoretical Framework

Variables of the study contains dependent and independent variable. The study used pre-specified method for the selection of variables. The study used the generated AC and DC voltages as dependent variables. The independent variable of study is the RPM. As the RPM increases the generated voltages also increases and vice versa.

A combination of experimental and developmental methods was used all throughout the study. Developmental method of research was employed in making of this study with the following procedures in the fabrication and proper composition of materials, usage of tools, design and general acceptability in terms of the mechanical assembly for generating electricity from the speed cushions generator.

Meanwhile, the experimental method will be used in determining the RPM of the device, the output voltage of the device in relation to its RPM, and the output voltage that passes through the transformer.

3.4 Statistical Tools

The statistical tool used in this study for the computation of the result was the mean. The mean was computed to determine the average RPM and voltages. Also, the efficiency of the transformer was computed.

$$M = xN$$

where:
M = Arithmetic Mean
x = ***Sum of the Scores***
N = Number of Trials

where:
η = ***efficiency***
η = IsVsIpVp

Is = Secondary Current
Ip = Primary Current
Vs = Secondary Voltage
Vp = Primary Voltage

IV. RESULTS AND DISCUSSION

Measurement of the Voltage in relation to the RPM

Table 2 shows the trials 1, 2, and 3 where the RPM in trial 1 is 750 and the generated voltage is 2.09V, trial 2 where the RPM is 788 and the generated voltage is 2.52V, and the trial 3 where the RPM is 952 and the generated voltage is 3.08V. All the generated voltages are alternating current.

The mean RPM and Generated Voltage for table 2 are 830 and 2.56V. The result implies that, as the RPM of the rotor increases, the generated voltage also increases.

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Trials for RPM and Generated Voltage		
No. of Trials	RPM	Generated Voltage
1	750	2.09 ACV
2	788	2.52 ACV
3	952	3.08 ACV
MEAN	830	2.56 ACV

Table 2. Trials for RPM and Generated Voltage

Calculation of the efficiency of the transformer

Trials for RPM and Input & Output voltage of the Transformer				
Trials	RPM	Vp	RPM	Vs
1	668	0.75 ACV	782	10 ACV
2	462	0.54 ACV	667	9.62 ACV
3	650	0.69 ACV	596	8.37 ACV
MEAN	593.33	0.66 ACV	681.67	9.33 ACV

Table 3. Trials for RPM and Input & Output voltage of the Transformer

The calculation of the transformer's efficiency was based on the mean of table 3. The RPM and voltage for input are 668 and 0.75V in trial 1, while the mean RPM and voltage for output are 667 and 9.62V in trial 2. These are the given data used solve for the transformer's efficiency, since the RPM of input and output is close.

The calculation implies that the transformer's efficiency is 99.7% where can be considered as efficient.

Measurement of the Output DC from the Rectifier

Table 4 shows the Direct Current generated from the rectifiers. In trial 1, the RPM is 887 and the DC Voltage generated is 30.2V. In trial 2, the RPM and DC Voltage generated is 652 and 27. In trial 3, the RPM is 712 and the DC Voltage generated is 25.2V.

The mean RPM and voltage for DC are 750.33 and 27.46V. In a star or wye connection, the line voltages are added if connected to a circuit. Therefore, the line voltages in the rectification stage are added that leads to high DC voltage generated. These results imply that the voltages generated can be used for lighting and charging of batteries.

Trials for RPM and DC Voltage		
Trials	RPM	DC Voltage
1	887	30.2 DCV
2	652	27 DCV
3	712	25.2 DCV
MEAN	750.33	27.46 DCV

Table 4. Trials for RPM and DC Voltage

REFERENCES

[1]. AAC, 2004. Step-up and Step-down Transformers. https://www.allaboutcircuits.com/textbook/alternating-current/chpt-9/step-up-and-step-down-transformers/

[2]. A. Dubets, 2017. History of Gears. https://ugears.online/blogs/news/history-of-gears

[3]. A. C. Asuncion, 2020. Innovative regulation: Keeping the speed cushions just right. https://www.phcc.gov.ph/column33-bm-caca-competition-regulation/

[4]. Cambridge University Press & Assessment, 2021. speed cushions. https://dictionary.cambridge.org/dictionary/english/speed-cushions

DOI: 10.17148/IARJSET.2024.11630

[5]. D. Hawley, 2021. What Is the Suspension in a Car?. https://www.jdpower.com/cars/shopping-guides/what-is-the-suspension-in-a-car

[6]. D. Laws, 2013. WHO INVENTED THE DIODE? https://computerhistory.org/blog/who-invented-the-diode/#:~:text=Originally%20called%20a%20rectifier%20because,latter%20was%20itself%20coined%20by

[7]. Edison Tech Center, 2014. The History of the Transformer. https://edisontechcenter.org/Transformers.html

[8]. F. Atan, 2013. Recycling kinetic energy from speed cushions to generate electricity. https://www.semanticscholar.org/paper/Recycling-kinetic-energy-from-speed-cushions-to-Atan/1f8c4500d2ed071f7c2ff9ac1da8836a52cbab15

[9]. I. Limpangog, 2009. Speed Cushions or Road Ramps Generate Electricity. https://www.freedomwall.net/features/speed-cushionss-or-road-ramps-generate-electricity/

[10]. J. Braza, 2015. A COMPLETE GUIDE TO CAPACITORS. https://www.circuitbasics.com/what-is-a-capacitor/

[11]. LLC, 2023. How Does a Generator Create Electricity? How Generators Work. https://www.generatorsource.com/How_Generators_Work.aspx

[12]. M. Brain & C. Pollette, 2021. How Capacitors Work. https://electronics.howstuffworks.com/capacitor.htm#pt3

[13]. M. Pau, S. Angius, 2001. Accident Analysis & Prevention. https://www.sciencedirect.com/science/article/abs/pii/S0001457500000701

[14]. M. Ramadan, M. Khaled, H. El Hage, 2015. Using Speed Cushions for Power Generation –Experimental Study. https://www.sciencedirect.com/science/article/pii/S1876610215009601

[15]. M. Whelan, S. Rockwell, 2014. The History of the Transformer.https://edisontechcenter.org/Transformers.html

[16]. N. Supply, INC., 2021. HOW AN ASPHALT SPEED CUSHIONS IS INSTALLED. https://nacsupply.com/blogs/asphalt-advisor-blog/how-an-asphalt-speed-cushions-is-installed

[17]. S. Alanazi, O. Abulgaith, 2020. Speed Cushions Power Generator.https://digitalcommons.cwu.edu/cgi/viewcontent.cgi?article=1121&context=undergradproj

[18]. S. Che Mat, 2021. Recycling kinetic energy from speed cushions to generate electricity. http://eprints.uthm.edu.my/1903/

[19]. S. Glenn, Smith, 2013. Faraday's first dynamo: A retrospective. American Journal of Physics, Volume 81, Issue 12, pp. 907-917.https://ui.adsabs.harvard.edu/abs/2013AmJPh..81..907S/abstract#:~:text=In%20the%20early%201830s%2C%20Michael,mechanical%20energy%20into%20electrical%20energy.

[20]. S. Research, 2022. Belts, Chains and Gears: How Power Transmission Works. https://eepower.com/technical-articles/belts-chains-and-gears-how-power-transmission-works/#

[21]. S. Sild, 2021. Chain Drives & Types of Chains. https://fractory.com/chain-drives/

[22]. The AA, 2017. Do speed cushions make the roads any safer? https://www.theaa.com/breakdown-cover/advice/speed-cushionss#:~:text=Traffic%20calming%20first%20appeared%20around,cars%20whizzing%20past%20his%20university.

[23]. T. Thobias; G. M. Padayattil; P. Gopakumar, 2018. Emerging Smart Methodologies for On-Road Electrical Energy Harvesting.https://ieeexplore.ieee.org/abstract/document/8307792?fbclid=IwAR20Qz1wq3iZycCekx6kfjHzP2mZwDB_143EizD9lku_HieWfccHXIHHHGc

[24]. Utmel, 2020. Rectifier Diode: Function and Circuit. https://www.utmel.com/blog/categories/diodes/rectifier-diode-function-and-circuit

[25]. V. Kohli, 2023. From The different diode types explained. https://www.power-and-beyond.com/the-different-diode-types-explained-a-16442327153b39849b941c8b6559febd/