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Design and Fabrication of Foot Step Electricity Generation System

N. S. Kale[1], V. V. Ghatage[2], Prof. G. G. Deshpande[3]

UG Student, Department of Mechanical Engineering, SMSMPITR, Akluj, Maharashtra, India[1-2]

Asst. Professor, Department of Mechanical Engineering, SMSMPITR, Akluj, Maharashtra, India[3]

Abstract: In this project we are generating electrical power as non-conventional method by simply running on the train of people on the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step needs no fuel input power to generate the output of the electrical power. This project using simple drive mechanism such as rock and pinion assemble and power storage mechanism. For this project the conversion of the force energy in to electrical energy. The control mechanism carries the rack & pinion, D.C generator, battery and inverter control. We have discussed the various applications and further extension also. So this project is implemented to all foot step, the power generation is very high. The initial cost of this arrangement is high.

Keywords: Nonconventional method, Electricity generation, Foot step

I. INTRODUCTION

Electric energy is becoming increasingly important, and speed breakers can be used to reduce vehicle speed. These speed breakers can be made of rubber, concrete, or a mixture of both. Simple mechanisms, such as rack and pinion gears and small generators, can be introduced to implement power generation programs from speed breakers. The main concept of this project is to convert potential vehicle energy into rotational motion of a generator, thereby producing a significant amount of electricity. This approach is crucial as the number of vehicles on the road is increasing rapidly, and the current electricity shortage is a pressing issue.

Electricity can be generated using speed breakers, strange, isn't it? The benefits from this idea will be to generate electricity for the streetlights, hoardings and then for other use. Generally when vehicle is in motion it produces various forms of energy like, due to friction between vehicle's wheel and road i.e. rough surface "Heat Energy" is produced, also when vehicle traveling at high speed strikes the wind then also heat energy is produced which is always lost in environment and of which we can't make use of….OR directly we can say that all this energy that we can't make use of is just the wastage of energy that is abundantly available around us. In this project we are just trying to make use of such energy in order to generate an "Electrical Energy". This project will work on the principle of "Potential Energy To Electrical Energy Conversion" Potential energy can be thought of as energy stored within a physical system.

A. Relevance

Since 1953, speed bumps have been an innovative solution to car accidents, reducing speed and preventing accidents for drivers and pedestrians. These innovations have evolved over time, involving fields like materials science, mechanics, and physics. Sustainable energy development has led to the development of hybrid cars, solar panels, and wind turbines. Engineers must consider the environment, as the world consumes a significant amount of fossil fuel energy, contributing to climate catastrophe. Combining speed bumps with energy conservation is a promising solution, with countries like Japan and the UK using speed bumps for electrical generation.

Speed Bump Generating Electrical Power (SBGEP) converts kinetic and potential energy from cars into electrical energy stored in batteries for public lighting. This sustainable energy development eliminates energy waste and is suitable for various weather conditions. The device's effectiveness depends on the frequency of vehicle movement, ensuring it can supply enough electricity for public lighting during both day and night. Proper installation in a constant traffic area is crucial for optimal performance.

The use of thermal electric stations for powering the population could lead to global drought and decertification. Solar power stations offer a cost-effective solution, but they have limitations in meeting continuous, concentrated base load electric power requirements. Energy plays a crucial role in human life, and increasing population growth and standard of living are directly proportional to energy consumption. As the supply of fossil fuels is finite, there will be a finite

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supply of uranium, which could be exhausted if used on a large scale. Harnessing the inexhaustible solar energy source reduces dependence on fossil fuels and emits no pollutants into the atmosphere, making it an alternative to finite fuel systems. As a long-term solution, solar energy can be considered an alternative to finite fuel systems, ensuring no energy shortages today or in the near future.

B. Problem Statement

Need of electricity is on peak now a days. However there are very limited sources are available to produce electricity. Therefore it is always been better to identify various sources that can easily produce electricity with least minimal cost.

C. Objectives:

- To select an alternate source for generation of electricity for lightening the streets
- To design, develop and performance evaluation of the mechanical setup of the project work.
- To generate electricity at low price.
- To use wasted kinetic and potential energy of vehicle at speed breaker.

D. Scope of Study

The recent study is focusing on the generation of electricity by means of application of impact loads. Therefore, such kind of mechanism or system is suitable to perform the tasks at shopping malls, railway stations, Stairs and other relevant areas which are under the high human traffic.

E. Methodology

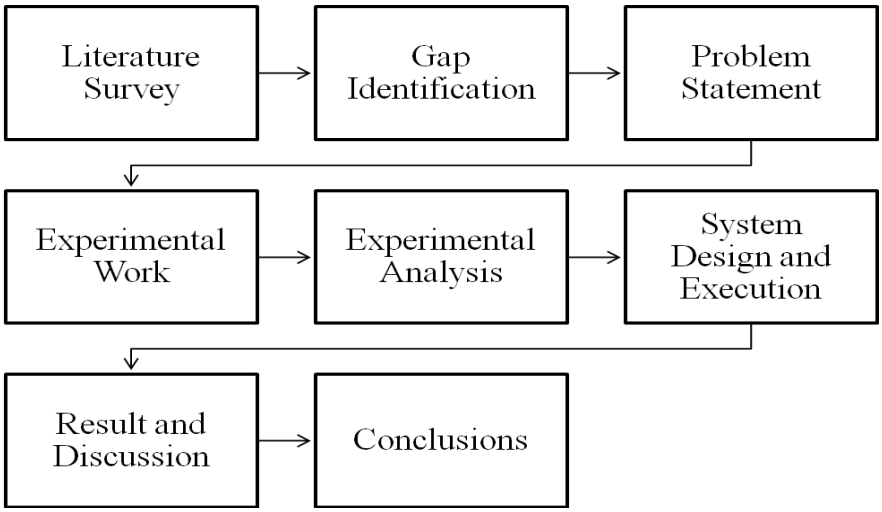

Figure 1: Methodology

II. LITERATURE REVIEW

The speed breaker is connected to a U-shaped shaft using a connecting rod and springs for return motion. The shaft is connected to a sprocket, and power is transferred to a small sprocket via a chain drive mechanism. The DC motor generates power using gear drives. The equipment includes a permanent magnet DC generator, generating 12 Volt DC, stored in a 12-volt battery, and connected to an inverter for conversion to 230 Volt AC.

The speed breaker is a roller-type device that rotates as the vehicle moves, converting kinetic energy into mechanical and electrical energy. The roller is connected to a sprocket on bearings, and the chain drive transfers motion to a gear for motor power generation. As the car's speed increases, so does the roller's speed, enhancing efficiency.

The speed breaker uses three rollers connected by a chain sprocket mechanism to achieve uniform motion when a vehicle passes over it. The efficiency of this speed breaker is low due to the two-wheeler test and the higher average

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number of vehicles passing daily. However, this process has advantages such as fewer moving parts and lower maintenance costs. A V-belt mechanism can be used to reduce lubricating costs and increase friction by providing a texture on the roller.

The speed breaker process generates power through a rack and pinion mechanism, converting kinetic energy from a car's movement into linear motion. This reduces maintenance costs and circular motion, which is transferred to a chain sprocket mechanism and DC motor, generating electricity. A flywheel is used to maintain a uniform rotation speed.

Ammar Ahmed designed a movable-speed bump-based mechanism to store kinetic energy dissipated by automobiles running on bumps. The system consists of an integrated double-sided rack with two parallel racks connected to pinions and two separated gears. The pinion is placed between two gears to increase velocity and is attached to a flywheel for angular momentum conservation. The flywheel is connected to a generator for converting mechanical energy into electrical energy. The motion analysis is performed using a solid works cad model, and various frequencies are applied and analyzed using Autodesk Inventor. Force sensors are placed to measure force applied by different automobiles, and uncertainty calculations are performed to find errors.

In Egyptian civilization, speed bumps were used to protect from mud on early roads. In 1906, in Chatham, the first speed bump was introduced using flagstones and cobblestones. Crosswalks were raised to lower car speeds, but the impact caused a panic among the 1,400 residents. The incident led to the loss of goggles, hats, and other protective items.

Arthur Holly Compton, a physicist and Nobel-prize winner, invented the "traffic control bump" in 1953. In 1970, the first speed bump was placed in Delft, Netherlands. In 1973, the British Transport and Road Research Laboratory published a report on different speed bump types. In Sweden and Australia, a new technology called "dynamic speed bump" was introduced, installed a few centimetres above road level, only for speeding vehicles detected by speed sensors. This system increases safety while reducing noise and pollution emissions.

Renewable energies are becoming a major strategy for countries to reduce pollution and energy consumption from fossil fuels. Speed bumps, used to reduce car speed and prevent accidents, have been developed using renewable energies. In London, the UK trailed this technology in 2009, which can produce between 10-36 KW of power for a steady traffic flow. This technology can generate between 1.3$ to 4.5$ of energy per hour for up to 16 hours, generating between $7,745$ to 27,782$ per year. The electricity left is transferred to storage or the national grid.

Other countries, like Japan, are also considering embracing this renewable energy source in the future. Researchers found that four ramps could produce enough electrical power to light up a road along one mile, and ten ramps could produce enough power from a wind turbine.

III. SYSTEM DESIGN

F. Proposed System

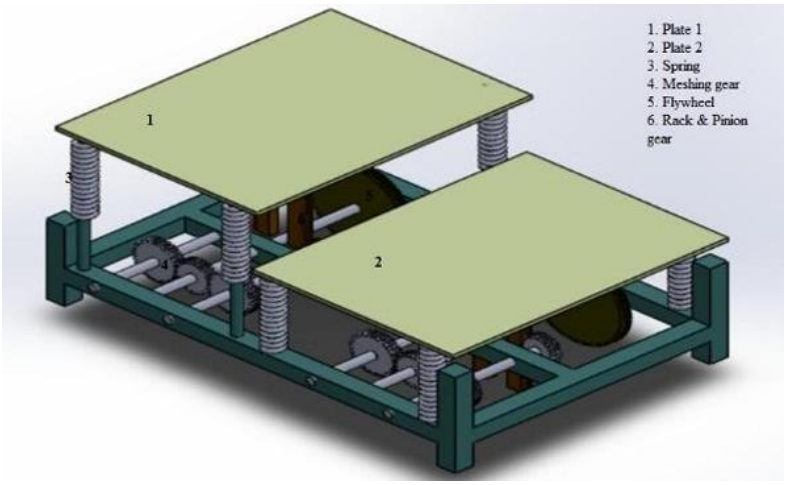

Figure 2: System Design

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G. Working

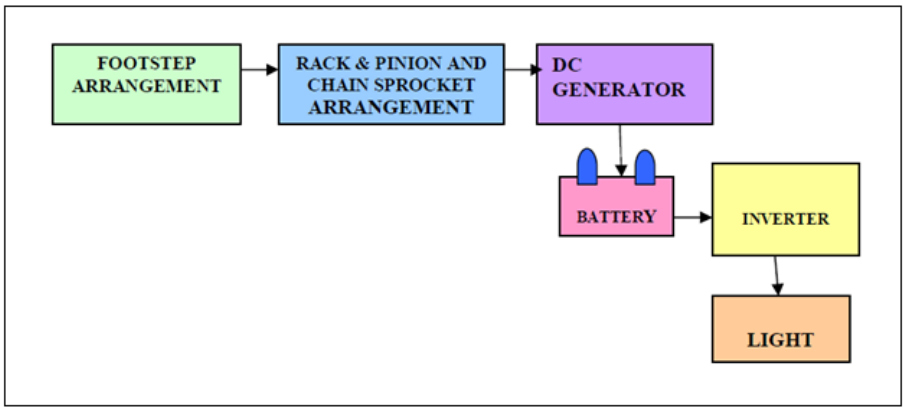

Figure 3: Working of System

As the speed breaker is a roller both the ends of the speed breaker are bearing supported. The speed breaker is covered or wrapped in a friction material. So, whenever a vehicle passes over the speed breaker, due to the friction between the wheels and the speed breaker, and the bearing support makes the roller speed breaker to generate circular motions. So, the speed bump itself creates the circular motions here. Those circular motions are transferred to generator by using the transmission system. Since here the speed breaker itself creates circular motion there no need of mechanical energy conversion, which means there is no lot of energy losses or may have less losses compared with other process. And the efficiency of the system depends on the type of the friction material using to wrap around the speed bump, and as usual the transmission system.

The present topic required to focus on the procedure to be followed to manufacture the desired product or model. In same context, this session of the chapter focuses the method of manufacturing and other aspect related to the designing of this particular model.

H. Constructional Details

The list of components is as follows;

- Drive Mechanism
- Bearing
- Supporting Plates
- Base Frame
- Generator
- Battery
- Speed Breaker

IV. WORKING PROCESS

- When a person moves from a foot step power generation system the plates move downward direction due to force is applied on the plate by virtue of impressing on the plate the force spring gets compressed.
- The rack here moves vertically downward.
- When the rack moves pinion will have engaged with the rack gear results in circular motion of the pinion gear.
- When the force will have removed on the plate the pinion reverses and moves another half circle.
- The dynamo attached to the pinion hence result in the sinusoidal wave form (for single dynamo).
- Then, in this result energy produced will stored on battery for used.

V. CALCULATIONS

Consider 120 man of mass 80 kg passes over a foot step power generation system in an hour. The height of rack is 14cm, the diameter of the final pulley is 18mm and having revolution speed (N) is equal to 37 RPM. Down word motion of foot step is due to the weight of moving the person and upward motion of foot step is take place due to the utilization of energy from springs.

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Let's us consider,

Weight(mass) of a man = m= 80 kg
Force=F= mg=80×9.8= 784N
r=9mm
T=r×F(Nm) T=9×10 $^{-3}$ ×784 T=7.056Nm
P=T×w P=7.056×2πN/60
P=7.056×2π37/60
P=7.056×3.87
P=27.34
Total generated power in forward and reversed stoke.
P=2×27.34W
P=54.68W
Revolution in one minute=200/60=3.33rev/min
Power generated in one minute=54.68×3.33=182.1(minute)
Power generated in one hour=182.1×60=10925.01W(hr)
Power generated in one hour=10.925 KW (hr)

VI. FUTURE SCOPE

This design is to be studied in future work for further details such as friction forces and gravitational force. The study conducted in this capstone design project is the ideal case where all external forces are excluded. However, to have a more realistic result, a more accurate study should be conducted. Moreover, the gear box will also be taken into consideration in the future work.

VII. CONCLUSION

From this project, we conclude that speed bumps generating electrical power are very efficient when it comes to producing electricity. The entire project assembles both mechanical background and electrical knowledge to come up with the idea of creating electricity from a source that is not harmful for the environment. The theoretical study shows that the design is very efficient since only a 200 Kg mass that goes aver the bump can produce 90 W of energy. In other words, it can supply enough electricity for a one streetlight of 70W, which is a considerable amount of energy.

REFERENCES

[1]. Singh, A.K., Singh, D., Kumar, M., Pandit, V. and Agrawal, S., 2013. Generation of electricity through speed breaker mechanism. International Journal of Innovations in Engineering and Technology (IJIET), 2(2), pp.20-24
[2]. Gupta, A., Chaudhary, K. and Agrawal, B.N., 2012. An experimental study of generation of electricity using speed breaker. International Journal of Mechanical Engineering (IJME), 1(1).
[3]. Bhagdikar, P., Gupta, S., Rana, N. and Jegadeeshwaran, R., 2014. Generation of electricity with the use of speed breakers. International Journal of Advances in Engineering & Technology, 7(2), p.589.
[4]. Maurya, J., Gupta, P., Gupta, P., Shahab, T. and Srivastava, A., 2016. Generation of electricity through speed breaker mechanism. IJES ISSN (e), pp.2319-1813.
[5]. Azam, A., Ahmed, A., Hayat, N., Ali, S., Khan, A.S., Murtaza, G. and Aslam, T., Design, fabrication, modelling and analyses of a movable speed bump-based mechanical energy harvester (MEH) for application on road. Energy, 214, p.118894.
[6]. B. Roemmele, "The New Jersey Motor Carriage Speed Reduces Of 1906," Quora, 01- Nov-2013. [Online]. Available: https://www.quora.com/What-is-the-history-of-speed-bumps. [Accessed: 13-Feb-2019].
[7]. "Speedbump," Wikipedia, 10-Feb-2019. [Online].Available: https://en.wikipedia.org/wiki/Speed_bump. [Accessed: 17-Feb-2019].
[8]. "Actibump,"Wikipedia, 12-Apr-2018. [Online].Available: https://en.wikipedia.org/wiki/Actibump. [Accessed: 03-Feb-2019].
[9]. W. by AZoM, "AISI 1015 Carbon Steel (UNS G10150)," AZoM.com, 11-Jun-2013. [Online]. Available: https://www.azom.com/article.aspx?ArticleID=6579. [Accessed: 22-Apr- 2019].
[10]. R. Phillips, "Speed bumps to get new role as a source of green energy," The Guardian, 08-Feb-2009. [Online]. Available: https://www.theguardian.com/environment/2009/feb/08/alternative-energy-speed-bumps. [Accessed: 03-Feb-2019].
[11]. Raunekk, "Energy from Speed Bump? (What next?)," bright hub engineering. [Online]. Available: https://www.brighthubengineering.com/hvac/32750-a-new-way-for- generating-energy-speed-bumps/. [Accessed: 03-Feb-2019].

