JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Detailed Reviewed on Electricity Generation Through Speed Beakers Using Various Methods.

[1]Varun Kumar, [2]Shivendra Prakash Verma

[1]Masters Student, [2]Assistant Professor
[1]Department of Electrical Engineering,
[1]Rayat Bahra University, Kharar, Punjab, INDIA

Abstract: Nowadays, many vehicles on the road pollute and only use their mechanical energy for transportation; however, if we convert the kinetic energy of vehicles into electrical energy that can be used for street lights, we can save at least some electrical energy. The speed breaker can be used in a number of different ways to generate power, all of which are detailed in this paper. The outcomes of a large number of authors' experiments on each method of producing power are listed below. Crankshaft and piston mechanism, hydraulic speed breaker, rack and pinion method, and roller speed breaker are the methods presented here.

Index Terms **– Power Generation, Speed Breaker, Rack and Pinion, Roller Speed Breaker.**

I. INTRODUCTION

One of our country's major problems is the energy crisis. The production of electricity generates a tremendous amount of pollution. Even though we have a wide variety of renewable energy sources, conventional power generation methods are still available to us. We also have a lot of cars on the road, which contributes to more pollution. Along these lines, we are harming our current circumstance in numerous techniques.

Therefore, although not entirely, this project may assist the environment in escaping pollution in some small way. Since there are a lot of cars and trucks on the road, we can use their energy to make electricity. In order to move from one location to another, each vehicle makes use of its kinetic energy. In this cycle, it is squandering more energy. We can turn that kinetic energy into electrical energy and use it.

We can furnish the hindrances on streets with specific systems under them. Therefore, when a vehicle crosses the speed bump, the speed bump converts the vehicle's kinetic energy into mechanical energy, which is then transformed into electrical energy. There are many different ways to generate electrical energy using methods are:

1.1 Rack and pinion mechanism
1.2 Roller speed breaker
1.3 Crankshaft and piston mechanism
1.4 Hydraulic speed breaker.

1.1 Mechanism of a rack and pinion:

Numerous researchers have conducted experimental studies on the rack-and-pinion method of power generation because it is effective. A rack generates linear motion and a pinion transforms that linear motion into rotatory motion in this approach. That rotating movements are moved to the generator. In order to transfer the energy effectively, a gear train or transmission system is constructed in the middle. A generator is connected at the end of the transmission system. We are all aware that the generator's function is to transform mechanical energy into electrical energy. The effectiveness of the transmission system and the rack-and-pinion mechanism will determine the amount of power produced.

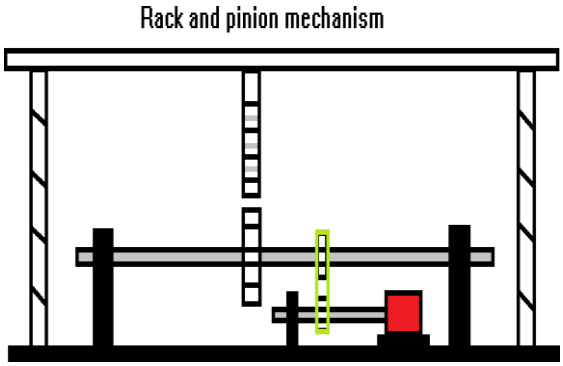

Fig.1: Rack & Pinion Mechanism

Working:

As a result, we see a lot of cars on the roads, as well as speed bumps indicating the speed limit on the roads. The speed bump's design is unique in that it functions as a kind of suspension system. Both ends of the speed bump are supported by a spring. As a result, the energy is transferred to the springs below the speed breaker and compressed whenever a vehicle or weight crosses it. The linear motion can be produced by the speed breaker during this procedure. The speed breaker's linear motions are absorbed by the rack and pinion mechanism because it is connected to the speed breaker. Consequently, the rack-and-pinion mechanism transforms linear motion into circular motion. That the transmission system is used to transfer circular motions to the generator. Different types of transmission systems exist, including gear trains, belt drives, and chain sprocket mechanisms.

1.2 Roller Speed Breaker

The speed breakers directly generate the circular motions in this kind of process. Using various friction materials as speed bump coverings, numerous authors carried out experiments on this process. However, the system's effectiveness in this method is entirely dependent on the vehicle's speed. The system's effectiveness directly correlates with the vehicle's speed. Therefore, the purpose of the speed bump is to slow down a vehicle in many commercial areas. Remembering that factor the speed breakers are planned with great erosion material so the hindrance can take additional energy from the vehicle. The remaining mechanism is the same for each process: the transmission system transfers the rotational energy from the speed breaker to the generator. This transmission system can be of any type, including a gear train, chain sprocket, or belt drive.

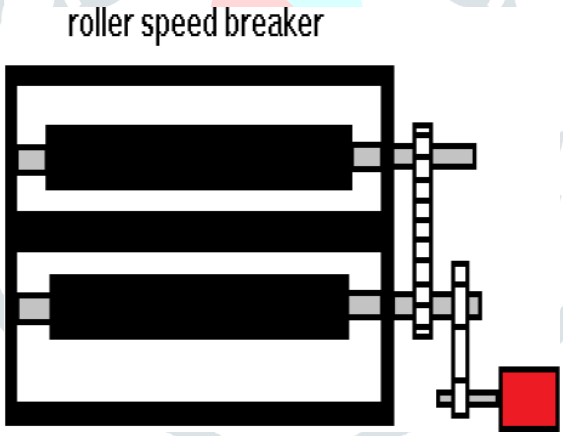

Fig. 2: Roller Speed Breaker

Working:

As the speed breaker is a roller both the finishes of the speed breaker are bearing upheld. A friction material covers or wraps the speed breaker. As a result, the bearing support and the friction between the wheels and the speed breaker cause the roller speed breaker to generate circular motions whenever a vehicle passes over it. Therefore, the circular motions seen here are caused by the speed bump itself. That the transmission system is used to transfer circular motions to the generator. There are no mechanical energy conversions required because the speed breaker itself generates circular motion. As a result, there are no significant energy losses or possibly fewer losses than in other processes. In addition, the transmission system and the kind of friction material used to wrap around the speed bump influence the system's efficiency.

1.3 Crank Shaft Mechanism

As is common knowledge, the crank shaft is used to convert linear motion into circular or rotary motion. This method is good for making power, but the system will produce a lot of heat and vibrations because it has so many moving parts. As a result, selecting such systems necessitates careful system design. The piston and crank shaft mechanism can produce circular motions because the specialized speed breaker can support linear motion. These cyclical motions can be transferred to the generator through an effective transmission system because our primary goal is to generate electrical energy.

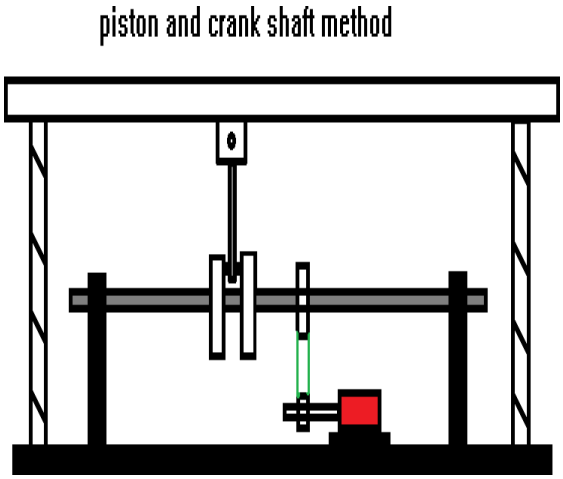

Fig. 3: Crank Shaft Mechanism

Working:

In automobile engineering, pistons are used to convert thermal energy into mechanical linear motion. The crank shaft mechanism transforms that mechanical linear motion into circular or rotary motions. That the power transmission system transmits the rotary motions generated by the crank shaft to the differential. The crank shaft mechanism used to generate power here uses kinetic energy rather than thermal energy to push the piston down or generate the linear motion. As a result, the kinetic energy applied to the speed breaker causes the speed breaker to push the piston down whenever a vehicle passes over it. As a result, the piston completes half a revolution on the crank shaft. Because of its inertia-based design, the crank itself performs the remaining half of its revolution to raise the piston. As a result, moving the speed breaker back to its original position returns the piston to its original position. The crank shaft mechanism is able to produce the circular motion in this manner. That the transmission system is used to transfer circular motions to the generator.

1.4 Hydraulic Speed Breaker

When compared to the crank shaft mechanism, the hydraulic speed breaker mechanism produced superior results. The pistons used in this process compress the oil.so that the system can receive power. There may be more expensive equipment here.

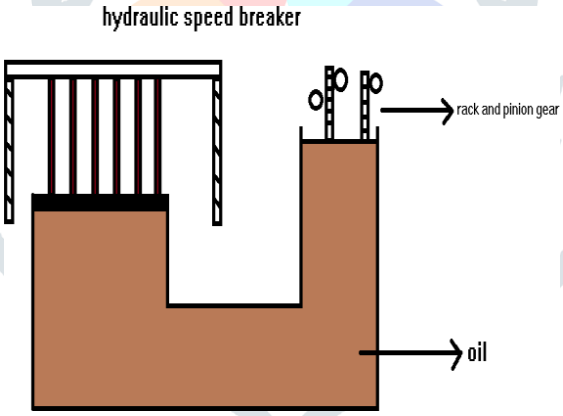

Fig. 4: Hydraulic Speed Breaker

Working:

Also in this case, the speed breaker is a spring supported at both ends to produce linear motion. Additionally, the speed breaker is equipped with pistons that are pushed down by the speed breaker whenever a vehicle passes over it.so that the under-the-piston oil can be compressed by the piston. The compressed oil reaches the accumulator via a route. The motor that generates torque is connected to the accumulator as well. The electrical energy is generated by applying that torque.

II. Literature Review

The connecting rod connects the speed breaker to the U-shaped shaft, and springs are used to provide the speed breaker's return motion after the vehicle passes over it. The sprocket is connected to the U-shaped shaft, and a chain drive mechanism transfers power from the U-shaped shaft to the small sprocket, which in turn transfers power to the DC motor through gear drives. This particular arrangement makes use of the following pieces of equipment: a permanent magnet DC generator that produces a 12 volt DC voltage that is stored in a lead 12-volt battery. The inverter and battery are linked.12 volts DC to 230 volts AC is converted with the help of the inverter [1].

The speed breaker that is being used is a roller that spins as the vehicle moves on it. The kinetic energy is converted into mechanical energy, which is then converted into electrical energy. Which means that the rollers are mounted on bearings on each side and arranged in a way that allows for free rotation when a vehicle moves over them. This causes the roller to rotate when the vehicle moves over it. A sprocket that is mounted on bearings is connected to the roller speed breaker. The motion from a sprocket to a gear is transferred through the chain drive, which drives the motor to generate electricity. As a consequence of this, we can observe that the roller's speed increases in tandem with the car's, thereby enhancing efficiency. [2]

Three rollers are utilized, and they are linked together by a chain sprocket mechanism to ensure uniform motion when a vehicle crosses the speed breaker. The process by which kinetic energy is converted into mechanical energy, which is then converted into electrical energy, is the same as that of the roller-type speed breaker. However, given that the test was conducted on a two-wheeler, this speed breaker power generator does not perform very well. It is also mentioned that the average number of vehicles that pass through a speed breaker on a given day is higher, indicating that it operates more efficiently. When compared to other processes, this one has the distinct advantage of having fewer moving parts and a lower cost of maintenance. In this process, we can lower the cost of maintenance by substituting a V-belt mechanism for the chain mechanism, which will also lower the cost of lubricating. In addition, the roller's fine rotational motions when a vehicle passes over them can be made more frictional by adding texture to the surface. [3]

The rack and pinion mechanism is used to generate power during the speed breaker process. When the car is moved along the speed breaker, its kinetic energy is converted into linear motion. The rack and pinion mechanism converts the speed breaker's linear motion into rotational motion. Maintenance costs are lower because there are fewer moving parts. The round movement made by the rack and pinion system is moved to the chain sprocket component and moved to the DC engine which in outcome produces the power. In this case, a flywheel is used to keep the rotation going at the same speed. [4]

Ammar Ahmed talked about the design of a bump-based movable-speed mechanism that stores kinetic energy that is lost when cars run over bumps. The integrated double-sided rack, with two racks on either side that are parallel to one another and attached to each pinion and connected to two distinct gears, is the basis of the system's design. To increase velocity, the pinion is positioned between two gears, and it is attached to the flywheel to conserve angular momentum and more effectively store rotational energy generated by the rack and pinion. For the purpose of converting mechanical energy into electrical energy, this flywheel is attached to a generator. The system's motion analysis is carried out on a Solid Works-designed cad model. Various degrees of frequencies are applied and broke down utilizing Autodesk Designer. The force sensors are positioned to record the force exerted by various automobiles. An equation that was further developed is used to perform uncertainty calculations in order to determine the accuracy of measured results. The generator that is chosen has less electrical damping and a resistive load in order to maximize efficiency. Based on the results, the mechanical energy harvester (MEH) has an overall efficiency of 57.5 percent. The comparison of the practical and simulation results shows that there is a 5.7% efficiency difference [5] An experiment with a load of 300 kilograms was conducted by Aniket Mishra. The power developed for 60 minutes (1 hour) was 441.45 watts. This could produce more power than necessary to power four street lights at night [6]. The experimental studies were carried out by Mohammad Ramadan, and the outcomes were approximately 26.2 to 44.7 W for masses of 65 kg and 80 kg, respectively. The output power also increases linearly as the masses grow. It is thought that the generated power could be used to power road radars, cameras, and street lights [7].

In order to simplify the model and facilitate installation, Sanket S. Khodke eliminated the use of chain, sprocket, and flywheel. At the circuit's conclusion, the rectifier is used to transform the AC power into pure DC power. The bridge rectifier that is utilized has four rectifier diodes [8].Both the rack-and-pinion method of power generation and the roller mechanism of power generation are utilized. As is common knowledge, the arrangement's rollers are rolled whenever a rolling motion occurs on them. As a result, power can be produced through this straightforward procedure. The speed barker’s roller arrangement causes the rollers to rotate when a vehicle passes through it. The roller's rotations are transferred to the gear arrangement, which then transfers the maximum number of rotations to the generator or motor, which generates electricity and is connected to the battery. Street lights on the road can glow thanks to this power. The roller method is less efficient than the rack and pinion method, which is more efficient, the maintenance required for the roller method is higher than for the rack and pinion method, and the designing of the roller method is simpler than for the rack and pinion method. [9]

Wrench System: As is common knowledge, the crank mechanism is utilized for the same purpose here as it is for converting linear motion into circular motion. A specialized speed breaker houses all of this equipment. At the point when the vehicle ignores the speed breaker as the top of the cylinder is in touch with the speed breaker, the cylinder makes the direct movement and the wrench toward the finish of the associating bar changes the straight movement over completely to the roundabout movement and utilizing gear system the speed of the pivots is expanded and moved to the generator. For a solitary wrench component when a vehicle passed on a speed breaker the cylinder makes a sum of 4 strokes and for a twofold wrench system is 8 strokes. When compared to other methods, this one has a greater number of moving parts, necessitating extensive maintenance. It also suffers from greater losses as a result of vibrations during motion. [10]

M. Prasanth led the analysis with 250 kg (around) and the result power created is 2.35 KW in 24 hours. Additionally, a dynamo-type electric generator is utilized, and spur gear is utilized for the gear. As the load is increased, the output power rises. Four street lights can be lit at night with the generated electric power. [11]

Various processes like the crank mechanism, roller mechanism, and rack and pinion mechanism are used to generate power from the kinetic energy of vehicles on the road. Experiments on the rack and pinion mechanism are also carried out. [12]

Under the specialized speed breaker is a pressure lever. Pressure is applied to the pressure lever when the vehicle passes over the speed breaker. This causes the flywheel to rotate, which is then transferred to the generator and converted into electrical energy. When pressure is applied to the pressure lever, the flywheel and a DC motor receive the rotations via a chain sprocket mechanism [13].

S.no	Weight in KG	Current in Watt	Author
1	70	52.49	Prashanth Narote et.al
2	71	35	Mohamad Ramadan et.al
3	605	6.675	M.Prasath et.al
4	30	353.16	Jyoti Maurya
5	7	2	Md.Saiful Islam
6	300	7.3575	Aniket Mishra and D.Venkata RaoÀet.al

Table 1: Weight Vs Current Produced

Chung-Cheng Hsiao discussed the creation of a mechanical roadway system for vehicle waste energy capture and electric generation in this paper. In autos the total fuel isn't consumed to run vehicles though just 15% is utilized and any remaining debilitates as wastage. The entire process involves creating a compressive system that uses a hydraulic system to capture energy during braking. Vehicles will decelerate while this energy is captured on downhill roadways where the piston arrangement is placed. When vehicles press on these piston plates, the fluid transports potential energy for storage. By lifting a weight, this storage system drives a generator using a hydraulic device. There are 136 pistons in this hydraulic drive, all of which are made of piston plates. The energy is stored and connected to a generator for electrical conversion. The arrangement of the oil reservoir is intended to preserve hydraulic fluid. The general productivity relies upon factors are plates of cylinder, likely capacity and transmission of water powered results as 90.38 %,95.09 % and 57.52 %. The use of this mechanical roadway system yields an overall efficiency of 41.03%, according to the findings. [14]

In this paper, Mohamed A. Hassan discusses the sensitivity analysis of energy harvesting, as well as the evaluation of the potential power and complete car dynamics for various modes of transportation. By providing various road irregularities as inputs, the complete car suspension model can be implemented in a MATLAB environment. Using more input modes results in more realistic views of vehicle dynamics on roads in complex situations when compared to assumed outcomes. Different analyses indicate that heavy-loaded vehicles are advantageous for cost-effective energy harvesting. Taking into account the knowledge of vehicle dynamics, it is an entirely comprehensive analysis. When a roll mode input is taken into consideration, damper power can reach 420 W for a given number of driving cycles. Due to its extremely low value, which is distinct from the impact of tire stiffness, harvesting of tire parameters has no effect on the damping factor of the tire. The characteristics of the tire, the environment of the road, and the speed at which the vehicle is traveling all influence the sensitivity to energy harvesting. The mean potential power fluctuates within a minimal range when body mass is increased. The relative movement for the collection of vibration energy is the powerful movement caused by the power of the wheel's body. When compared to transient speed, steady-state velocity results in a greater accumulation of energy at high speeds [15].

III. Conclusion

The speed breaker's various power generation methods are listed and carefully examined. The outcomes of a number of authors' experiments on each kind of mechanism are presented here. This article outlines each and every one of the mechanisms' benefits and drawbacks.

3.1 Advantages

- Generation of power without polluting
- Simple construction, advanced technology, and simple upkeep.
- There is no need for manual labor during generation.
- Energy readily available year-round.
- There is no fuel transportation issue

3.2 Disadvantages

- Crankshafts must be mounted on bearings, which causes a problem with balancing;
- Maintenance will be difficult; • Crashing may occur.
- Vibrations caused by the machine, which in turn harm the bearings.
- Because bearings are sliding, a problem with balancing arises whenever a variable load occurs, which is somewhat obvious in vehicles.

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] Mishra, A., Kale, P. and Kamble, A., 2013. Electricity generation from speed breakers. The International Journal of Engineering And Science (IJES), 2(11), pp.25-27.

[7] Ramadan, M., Khaled, M. and EI Hage, H., 2015. Using speed bump for power generation-Experimental study. Energy Procedia, 75, pp.867-872.

[8] Khodke, SS., More, V.M., Malkhede, Y.A. and Madke, A.V., Generation of Electricity by using Speed Breaker Mechanism

[9] Hossain, M.E., Hasan, M.R., Ahmed, K.T. and Shawon, M.N.M., 2017, September. Design and performance of power generation using speed breaker with the help of Rack and Pinion mechanism. In 2017 4th International Conference on Advances in Electrical Engineering (ICAEE) (pp. 7-11). IEEE.

[10] Al Zebda, J., Msallam, M., Al Yazouri, M., Shaheen, T. and Radi, A., 2017, October. Power Generation Using Hydraulic and Double Crank Shaft Speed Breaker: Gaza Strip as a Case Study. In 2017 International Conference on Promising Electronic Technologies (ICPET) (pp. 93-98). IEEE.

[11] Prasanth, M., Sankar, R., Dharshan, T., Nagaraja, R. and Dheenathayalan, P., 2002. Power Generation from Speed Breaker Using Crank Shaft.

[12] Rokonuzzaman, M. and Hossam-E-Haider, M., 2015. Analysis of speed breaker mechanism for more effective electricity generation. In International conference on mechanical, industrial and materials engineering.

[13] Islam, M.S., Rahman, S.K. and Jyoti, J.S., 2013. Generation of electricity using road transport pressure. International Journal of Engineering Science and Innovative Technology (IJESIT), 2(3), pp.520-525.

[14] Ting, C.C., Tsai, D.Y. and Hsiao, C.C., 2012. Developing a mechanical roadway system for waste energy capture of vehicles and electric generation. Applied energy, 92, pp.1-8.

[15] Abdelkareem, M.A., Xu, L., Guo, X., Ali, M.K.A., Elagouz, A., Hassan, M.A., Essa, F.A. and Zou, J., 2018. Energy harvesting sensitivity analysis and assessment of the potential power and full car dynamics for different road modes. Mechanical Systems and Signal Processing, 110, pp.307-332.