

POWER GENERATION THROUGH SPEED BRAKERS: THEORETICAL CONCEPT AND STUDY

Abstract

This chapter goal is to introduce an unconventional power source that has the potential to provide energy. Today, energy is the most important form of strength and without it, living is inconceivable. The majority of electricity produced today comes from traditional sources, which may be running out faster than you think. Here comes the desire to explore for alternatives in which we can produce the power using non-traditional resources and no pollution. One such method that we saw was the generation of power through road friction and air compression. Complete association is set up beneath the rate breaker at the road, and as a car drives over it, the rollers attached to a generator spin, producing electricity. Given that there are more cars on the road every day, this approach might prove beneficial for producing electricity. These days, we see a lot of cars on the road, polluting the environment and using their mechanical strength best for transportation. However, if we could convert some of that mechanical energy into a small amount of useful electricity, we could use it to power street lights and save at least a hug amount of electrical power. This chapter lists and extensively examines the employment of several different power generation techniques. The results of several experiments conducted by various writers on various electricity technology methods are discussed below. The methods listed here include the crankshaft and piston mechanism, hydraulic velocity breaker, roller velocity breaker, and rack and pinion method.

Keywords: Rack and Pinion; Hydraulic speed breaker (HSB); Specialized Speed Breaker (SSB); Roller Speed Breaker, Piston & Crank Shaft Speed Breaker (CSSB)

Authors

Dr. Virendra Sharma

Department of Electrical Engineering
Arya College of Engineering & IT
Jaipur, Rajasthan, India.
vsharmakiran@gmail.com

Er. Nitin Kumar Jangid

Department of Electrical Engineering
Arya College of Engineering & IT
Jaipur, Rajasthan, India.
nitinkumarjangid00@gmail.com

I. INTRODUCTION

Finding unconventional sources of power is even more necessary given the high percent rise in power use. With an annual production of 23.96 million motors in FY 2015–16, India's automobile industry is both one of the largest and fastest expanding in the world. This figure might be the key to producing energy using unconventional resources. One of the key issues with our utilization is the power catastrophe. The amount of pollutants produced by producing power is pretty high. Despite having a wide variety of renewable electricity assets, we can still afford the standard traditional ways of power generation. Many automobiles on the road contribute to additional pollution in a manner comparable to that of these pollutants. Thus, we are harming the ecosystem in several ways. Therefore, although not certainly, this chapter can help to the environment get away from pollution. We can develop electric strength by using the energy from the many automobiles that we observe on the road. To move from one place to another, every car uses its kinetic energy. It is losing additional power during this procedure. That kinetic energy can be utilized and transformed into electrical energy. On roads with specific systems underneath them, we will provide the speed dump. Therefore, each time a car over a speed breaker, the speed breaker turns the vehicle's kinetic energy into mechanical electricity, which is then converted into electric electricity. The process used to generate electrical power using this method is diverse. they're.

- Pinion and Rack Mechanism
- Speed Breaker of Roller
- Piston and Crankshaft Mechanism
- The Hydraulic Pace Breaker

1. Rack And Pinion Mechanism: Many authors have undertaken experimental studies with this system since the rack and pinion method of power generation is ecologically benign. In this method, a rack generates linear motion, which a pinion converts into rotating motions, which the generator then receives. On the method to switch the power effectively, an equipment train or transmission device is established in between. There is a generator connected at the end of the transmission device. We all understand that the generator's purpose is to transform mechanical energy into electrical energy. The effectiveness of the rack and pinion system and the transmission device will determine how much energy is produced.

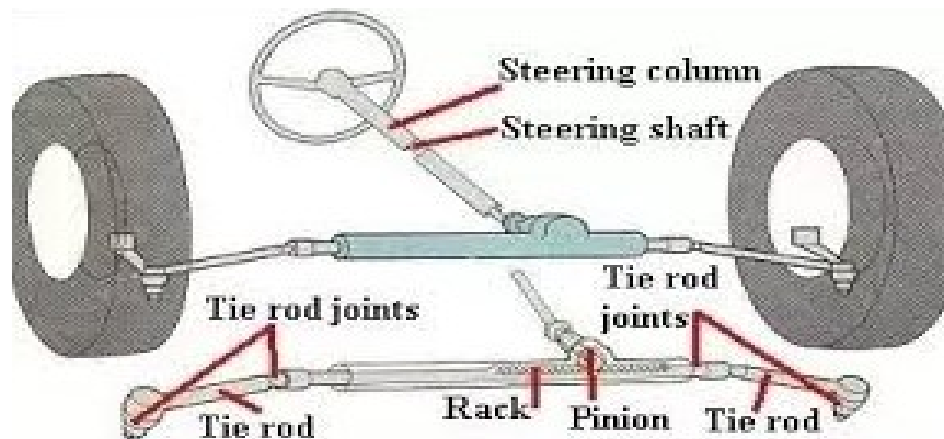


Figure 1: Rack and pinion Mechanism

Working: The authors observe a large number of vehicles on the highways, as well as speed bumps that indicate the posted speed limit. The rate bump's layout is distinct in that it is fashioned into a form of suspension system. Both ends of the rate bump are supported by springs. As a result, every time a vehicle or other object passes over the speed breaker, the springs below it is compressed and given power. The rate breaker in this system has the ability to provide linear movement. When the rate breaker is connected to the rack and pinion mechanism, the linear motions produced by the rate breaker are transmitted through the rack and pinion mechanism. Thus converting the linear movement to the circular movement using the rack and pinion system. By employing the transmission device, which is shown in Fig. 1., circular motions are sent to the generator. The transmission system can take many different forms, such as an equipment train, belt force, or chain and sprocket mechanism.

- 2. Roller Pace Breakers:** With the help of the rate breakers, circular motions are immediately produced in this kind of operation. Numerous writers conducted experiments using this method while using particular types of friction material as a speed bump covering material. But with this method, the device's effectiveness is directly correlated with the speed of the car; that is, the device's performance depends entirely on the speed of the vehicle. Therefore, a car's speed is reduced by the velocity bump in many commercial districts. In order to allow the velocity bump to absorb more force from the vehicle, the velocity breakers are made with correctly fractioned fabric. The final mechanism is the same for all methods; rotational power from the pacemaker is transferred to the generator via a transmission device, which can be any type, such as a tools train, chain sprocket, or belt drive.



Figure 2: Roller speed breaker

Working: - Because the speed breaker is a roller, bearings support both ends. The velocity breaker is covered or enclosed with a friction cloth. Every time a vehicle drives over the roller pace breaker, it creates circular motions as a result of the friction between the wheels and the velocity breaker and the bearing help. In this instance, the rate spike itself is what causes the circular motions. The transmission system transmits circular motions to the generator. There aren't many electricity losses here because the pacemaker itself generates the circular motion; in fact, there may be fewer losses than with other techniques because there isn't a requirement for mechanical power conversion. The kind

of friction fabric used to surround the velocity bump in the device affects how effective it is, as seen in Fig. 2.

- 3. Crank Shaft Mechanism:** The crank shaft, as we all know, is utilized to convert linear movement to circular or rotating movement. This technology can be used to generate power, but because it has so many moving parts, there could be a lot of heat and vibrations inside the device. As a result, when choosing on such architectures, the device must be carefully designed. The piston and crank shaft mechanism can generate circular motions because the specialized speed breaker can generate enough money linear movement. These circular motions can be sent to a generator via a green transmission system because producing electricity is our main objective.

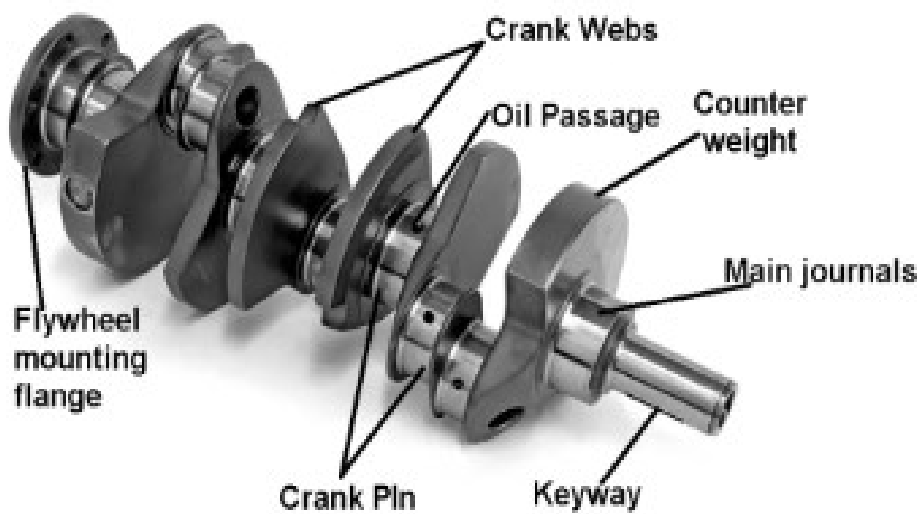


Figure 3: Crank Shaft Mechanism

Working: -The purpose of using a piston in vehicle engineering is to transfer heat energy into mechanical linear motion. The crank shaft mechanism converts mechanical linear motion into round or rotating motion. The rotating motions produced by the crank shaft are sent to the differential via the strength of transmission system. The crank shaft mechanism in this example of energy technology uses kinetic energy rather than thermal energy to push the piston down or produce the linear movement. As a result, the piston is pushed downward each time a vehicle passes over the velocity breaker thanks to the kinetic energy supplied to the velocity breaker. Crank shaft completes half a revolution as a result of the piston. The crank makes the opposite half of the revolution to move the piston higher since it is built on the principle of inertia. The piston then completes its initial task by moving the speed breaker back to its starting position. The crank shaft mechanism can provide circular movement in one of these ways. The transmission machine, as shown in Fig. 3, transfers the circular motions to the generator.

4. **Hydraulic Speed Breaker:** When compared to the crank shaft system, the hydraulic speed breaker mechanism produced better results. The oil is compressed using pistons in this technique. in order that the strength is delivered to the device. The entire system may be more expensive right now.

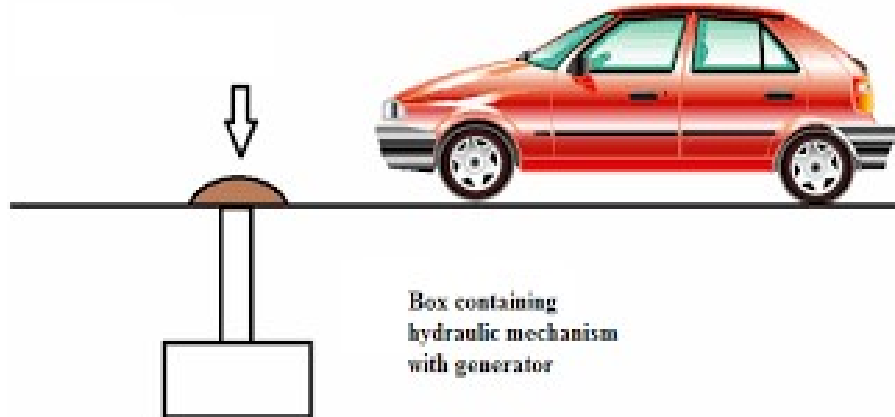


Figure 4: Hydraulic Speed Breaker

Working: In this instance, the velocity breaker is also a spring that is held in place at both ends to allow for linear movement. Additionally, pistons are placed beneath the velocity breaker so that each time a car passes over it, the velocity breaker will pull the pistons down. As a result, the oil supplied beneath the piston can be compressed by the piston. Transport of the compressed oil to the accumulator. Additionally, connected to the motor, which produces torque, is the accumulator. The torque in Fig. 4 is employed to produce the electric power.

II. REVIEW OF POWER GENERATION

In the actual world, springs are used to supply the velocity breaker's return motion after the vehicle passes over it. The velocity breaker is connected to the U-shaped shaft through the connecting rod. A series pressure mechanism is used to transfer power from the U-shaped shaft to the small sprocket, which is subsequently passed to the DC motor via tools drives, resulting in the creation of energy. The gadget used in this interesting arrangement includes the following features: generator with an eternal magnet that produces 12 volts of direct current. The 12-volt lead battery maintains the direct current voltage. The battery and inverter are connected. The inverter converts 12 volts direct current (DC) to 230 volts A.C as reported in [1-3].

The velocity breaker is actually a roller type that rotates when the car acts on it, converting kinetic energy into mechanical electricity, which is then converted into electric energy. In the real world, the velocity breaker is connected to the U-shaped shaft through the connecting rod, and springs are used in it. The rollers are fixed on bearings on all sides and are organized in a free rotational pattern, which causes the roller to rotate when a vehicle passes over the curler. Linking to a sprocket mounted on bearings is the curler speed breaker. In order to produce energy, movement is transferred from a sprocket to tools that drive the motor using chain pressure. As a result, we can see that as the car's speed rises, the roller's velocity also does so, helping to increase the efficiency mentioned in [4].

To achieve consistent movement while passing a car over the velocity breaker, three rollers are coupled by a series sprocket mechanism. The entire mechanism is similar to that described previously in the curler type velocity breaker in that kinetic energy is converted into mechanical electricity, which is then converted into electric strength. However, because the test is carried out on a -wheeler, the performance provided by this speed breaker strength of generator is much fall down. Additionally, it is believed that a speed breaker typically passes more motors every day, which naturally results in increased efficiency. The main benefit of this method is that it has fewer moving parts than previous approaches, and it is also far less expensive to defend. By switching to a V-belt mechanism instead of a chain one, we can lessen the cost of protection while using less lubricant. And the amount of friction can be enhanced by giving the roller a tactile quality so that it rotates with excellent quality as a car passes over it, as shown in [5].

The rack and pinion system produce the electricity needed for the speed breaker operation. As the vehicle passes through the velocity breaker, its kinetic energy is converted to linear motion, and the linear motion of the velocity breaker is then converted to rotating motion via the rack and pinion mechanism. The cost of maintenance is reduced because switching out parts is less expensive. The chain sprocket system transmits the rotational motion created by the rack and pinion gear to the DC motor, which generates power here. A flywheel is employed to maintain a constant rotational speed, as shown in [6].

Ammar Ahmed explained how a system based on movable-velocity bumps can be used to store the kinetic energy lost as vehicles pass over bumps. The system is constructed as follows: each pinion is connected to two separate gears, and each double-sided rack has parallel racks coupled to each of them. If you wish to appropriately increase and save rotational energy that occurs during rack and pinion movement, the pinion is attached to the flywheel and positioned between two gears to boost speed. A generator that transforms mechanical energy into electrical energy is connected to this flywheel. Using a cad version that is designed in stable works, the device's movement is evaluated. Autodesk Inventor is used to implement and analyze different degrees of frequency. With the help of outstanding motors, force sensors are installed to record the amount of pressure applied. To determine the correctness of measured effects, uncertainty calculations are done, and an Equation is developed. Generator selection is generally based on lower electric damping and resistive load for improved performance. Based on the obtained results, the total efficiency of the mechanical strength harvester (MEH) is calculated to be 5.75%. It is far concluded by comparing the practical and simulated outcomes, which leads in a 5.7% difference in efficiency as in [7].

Aniket Mishra conducted an experiment with a weight of 300kg, and the energy produced for 60 minutes (1 hour) is 441.45 watts. The electricity provided by this could be sufficient to power four streetlights at night [8].

The experimental study was carried out by Mohammad Ramadan, and the results ranged from around 26.2 to 44.7 W via hundreds of sixty-five kg and eighty kg. As the weights rise, the output strength rises linearly as well. The road lighting fixtures, cameras, and radars at the roads are thought to be able to receive power from the generator [9].

To simplify the version and ensure a tidy installation, Sanket S. Khodke eliminated the usage of the chain, sprocket, and flywheel. On the termination of the circuit, the rectifier

is utilized to convert AC current to pure DC electricity. Four rectifier diodes make up the bridge rectifier, which is the type of rectifier employed [10].

Strength technology is implemented using the rack and pinion system, and electricity technology is implemented using the curler mechanism. As we are all aware, whenever a rolling motion occurs at the curler association, the association's rollers likewise roll. Therefore, power can be produced by using this straightforward procedure. The rollers in this curler setup speed breaker circle as a car travel through it. The curler's revolutions are transferred to the gear system, which in turn transfers the majority of them to the generator or motor. As a result, energy is generated at a quantity 6 difficulty, and the generator is linked to the battery. This power enables the roadside lighting fixtures to illuminate. Here are some of the differences between the roller and rack and pinion approaches, such as how the curler approach is less environmentally friendly while the rack and pinion technique is, how roller approach requires more maintenance than rack and pinion method, and how curler method is easier to design than rack and pinion method [11]. the crank mechanism as we are all aware, the crank mechanism is employed to change linear motion into circular motion, and it serves the similar purpose here as well. This entire setup is placed beneath a customized velocity breaker. The piston creates a linear motion as the car crosses over the rate breaker because the piston head is in contact with the speed breaker. The crank on the connecting rod's release converts the linear motion to a circular motion, which is then increased in speed and transmitted to the generator by means of an equipment mechanism. While the car is being driven on a pacemaker, the piston completes a single crank mechanism in a total of four strokes and for a double crank mechanism is 8 strokes. In compared to other approaches, this strategy uses a wide variety of transferring components, thus it requires a lot of maintenance and suffers from higher losses because of vibrations at specific points of motion [12].

M. Prasanth carried out the experiment using 250 kg (about), and in 24 hours, 2.35 KW of output power were produced. The gear utilized is spur equipment, and the generator is also an electric generator of the dynamo type. With a surge in load, the output of power will increase. According to [13], the electrical energy produced can be used to power 4 nighttime street lights.

The employment of several approaches, including crank mechanisms, roller mechanisms, and rack and pinion mechanisms, to harness the kinetic energy of moving vehicles is explored, and experiments on the rack and pinion mechanism are carried out [14].

Under the specialized pace breaker is a stress lever. The strain lever is put under pressure as the automobile passes over the velocity breaker, which causes the flywheel to spin. The flywheel's rotation is subsequently transferred to the generator, where it is converted to power. When pressure is applied to the stress lever, revolutions are transferred to the flywheel and then to a DC motor by using a chain sprocket system [15].

Chung-Cheng Hsiao talked about developing a mechanical roadway system for capturing car and electric technology waste energy in this chapter. Only 15% of the fuel required to power cars is actually consumed, with the remaining 85% being wasted. It's all about developing a compressive machine for generating power when braking with a hydraulic system. Cars will slow down as this energy is absorbed on downhill roads where the piston association is positioned. Vehicles press such piston plates, and the resulting fluid results in the transportation of enough electricity for storage. Through the use of a hydraulic tool, those

storage systems operate a generator. The 136 pistons of this hydraulic drive are made up of piston plates. The power is conserved and supplied to the generator so that it can be converted into electrical energy. The oil reservoir is set up to store hydraulic fluid. The overall effectiveness is dependent on the piston plates, garage capacity, and hydraulic transmission results, which are 90.38%, 95.09%, and 57.52% respectively. It has been determined that using this mechanical roadway machine results in a 41.03 percent improvement in typical performance [16].

In this book article, Mohamed A. Hassan discusses the sensitivity analysis of power harvesting, the evaluation of the electrical capacity, and the whole vehicle dynamics for various road modes. The simulation of full auto suspension in a MATLAB environment is carried out by providing various inputs of road abnormalities. As opposed to assumed outcomes of automotive dynamics on roadways using more input modes, the complicated conditions of inputs offered results in the sensible perspectives. According to several analyses, heavy-loaded vehicles are suitable for electricity harvesting that is cost-effective per unit. It is an analysis that fully considers vehicle dynamics knowledge. There is a reach of up to 420 W. when a roll mode entry is taken into consideration. Due to its extremely low cost, which is entirely different from the influence of tire stiffness, there is undoubtedly no impact on tire parameters at some point in the harvesting process. The sensitivity to power harvesting fully depends on the tire's properties, the road's surroundings, and the user's pace. It is possible to calculate the variation of suggest capacity energy in the minimal range by employing the expanding frame of mass. The steady movement resulting from the wheel body's power is a motion proportionate to the strength of the vibrations. In comparison to transitory speed, it is determined that at some point in consistent-nation speed, there is a succession of higher amounts of power at high speeds [17-18].

Electricity is produced by replacing traditional speed breakers with a simple system. As vehicles pass over the speed breakers, the rack and pinion mechanism operate, generating energy with the help of high-tension springs. As the number of automobiles on the road grows, this method of producing electricity becomes more efficient. It can be efficiently positioned near toll plazas, parking lots, and other areas with high vehicle density. There is a rack and pinion, spring assembly mechanism that transfers motion to a DC motor/generator for electricity generation. This approach generates power from the mechanical energy of moving automobiles on the road at a low cost [19].

In today's world, power is very important. People have been studying science for a long time to find out where power comes from and to make improvements for the future. The ability to generate power effectively is very important. To make a country richer economically. This project involves using the energy that is unused from vehicles as they pass over a speed bump. There are four ways to make electricity from speed bumps. These include using racks and gears, gears and a spinning wheel, and springs. We can use the energy produced by cars driving over speed bump to generate power. The energy from moving vehicles can be turned into power using certain mechanisms like rack and pinion systems or others. After that, the moving energy will be turned into electricity using a machine called a generator. This electricity will be stored using a battery [20]. this text can be rewritten in simpler words: This article will provide information on how Can speed bumps be used to make electricity. These tasks can be completed. If you put a special type of gear called a rack and pinion along with a generator. connected to the set of gears mentioned earlier. following text has been rewritten in simpler words: The text below has been

simplified. Electricity can be saved in different kinds of cells or other storage devices. Rewrite this part in easy words: segments, parts, divisions. The paper also includes examples of calculations for the energy calculations are being performed. the things people can do on a computer: browse the internet, send emails, play games, create documents, and watch videos. The example calculations for the average weight of a passenger. A car is a vehicle that can take you from one place to another. This text explains all the most important parts about the subject. More research is currently being done on this topic [21].

III. CONCLUSION

In our daily lives, electricity is quite crucial. The current strategies and procedures for strength generation have become insufficient to meet our needs because of the significant increase in population. On this work, we learn how to generate electricity from speed bumps, where the gadget made is reliable and will help preserve our natural resources. If we were to apply this technology in the near future, the world would benefit greatly because the power generated could be used to power things like street lights, avenue alerts, roadside signal forums, bus stop illumination, checkpoint lighting fixtures, and many other things. It's too late to think about alternate resources because the traditional ones are being used up quickly. Therefore, this system now benefits the United States of America's greater economic system as well as providing opportunities. This energy generation system is still within its current state of development. In the future, it will be possible to use it to produce electricity at some point of the year. Power generation using this technique is unaffected by any environmental factors. It is a heavily polluting mechanism for generating power. Enforcement at parking lots for multiplexes, retail stores, toll booths, indicators, etc. The power produced can be used for a variety of things, including charging batteries and lighting up the streets. These speed limiters may be made for big trucks, which would increase input torque and in the end output of the generator.

REFERENCES

- [1] Y.Siva Mallesh 1 , P. Santosh Kumar 2, G. Ravi Teja 3 , B. Sanjay 4,2021. "A Detailed study on Power Generation using Speed Breakers" 2021, International Journal of Innovative Science and Research Technology.
- [2] Rishabh Jain,Dr Prashant Sharma,Rishabh Jain,2017,"Review of literature on power generation through speed barkers" International Journal Of Engineering Sciences And Research Technology.
- [3] 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 (IJET), 2(2), pp.20-24.
- [4] 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).
- [5] 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.
- [6] 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.
- [7] Azam, A., Ahmed, A., Hayat, N., Ali, S., Khan, A.S., Murtaza, G. and Aslam, T., 2017. "Design, fabrication, modelling and analyses of a movable speed bump-based mechanical energy harvester (MEH) for application on road." Energy, 214, p.118894.
- [8] 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.
- [9] Ramadan, M., Khaled, M. and El Hage, H., 2015." Using speed bump for power generation-Experimental study." Energy Procedia, 75, pp.867-872.

- [10] Khodke, SS., More, V.M., Malkhede, Y.A. and Madke, A.V., 2006 "Generation of Electricity by using Speed Breaker Mechanism"
- [11] 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.
- [12] 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.
- [13] Prasanth, M., Sankar, R., Dharshan, T., Nagaraja, R. and Dheenathayalan, P., 2002. "Power Generation from Speed Breaker Using Crank Shaft."
- [14] Rokonzaman, 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.
- [15] 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.
- [16] 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.
- [17] Abdel Kareem, 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.
- [18] Jamal Al Zebda; Mohammed Msallam; Mohammed Al Yazouri; Tareq Shaheen; Abdulsalam Radi, "Power Generation Using Hydraulic and Double Crank Shaft Speed Breaker: Gaza Strip as a Case Study", International Conference on Promising Electronic Technologies (ICPET), Deir El-Balah, Palestine, 2017.
- [19] M. Iswarya; G.R.P. Lakshmi, "Generation of electricity by using speed breakers", IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI), Chennai, India, 2017.
- [20] Vijay Kumar Yadav, Durgesh, Sonu Prajapati, Akash Porwal, "Electric Power Generation through Speed Breakers", International Advanced Research Journal in Science, Engineering and Technology, Vol. 7, Issue 2, February 2020.
- [21] Vedant Ajay Utikar, Suraj Ramu Gowda, Arnav Ashutosh Kulkarni and Manas Milind Kulkarni, "Power Generation using Speed Breaker", International Journal of Engineering Research & Technology (IJERT), Vol. 10 Issue 09, September-2021.