International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

POWER GENERATION USING SPEED BREAKERS: A NEW APPROACH

Dr. M.K. Bhaskar[1], Manish Purohit[2], Pankaj Sharma[3], Hansraj[4], Prinshu Gupta[5], Priyanka Chouhan[6]

[1]Professor, Department of Electrical Engineering, M.B.M. Engineering College, Jodhpur-342011, Rajasthan, India
[2,3,4,5,6]Students, Department of Electrical Engineering, M.B.M. Engineering College, Jodhpur-342011, Rajasthan, India

---

Abstract - *Energy is present in different forms in the nature and mankind has always thrived to harness these energies in one form or the other. In fact whatever happens in nature, results, out of the conversion of energy in one form or the other. The blowing of the wind, the formation of the clouds and the flow of water are a few examples that stand testimony to this fact. The extensive usage of energy has resulted in an energy crisis, and there is a need to develop methods of optimal utilization. Electricity in India generation was first developed in the 1800's using Faradays dynamo generator. Almost 200 years later we are still using the same basic principles to generate electricity, only on a much larger scale. But in this fast moving world, population is increasing day by day and the conventional energy sources are lessening. Therefore to overcome this problem we need to utilize conventional sources for conservation of energy. This paper includes how to utilize the energy which is wasted when the vehicles passes over a speed breaker. Lots of energy that is being generated when vehicle passes over it is wasted simply. This kinetic energy of the moving vehicles can be converted into mechanical energy of the shaft through rack and pinion mechanism. Then, this mechanical energy will be converted to electrical energy using generator which will be stored with the use of a battery. This paper harvests energy from speed breaker by making gear arrangement and using electronic gadgets. Large amounts amount of electricity can be generated saving lot of money and if implemented will be very beneficial for government.*

Key Words: **Road power generation system, alternative energy, regeneration, speed breaker, rack and pinion arrangement, e-vehicles etc**

1. INTRODUCTION

Road power generation system (RPGS) is a system planned to capture the wasted kinetic energy from cars and trucks on the roadways and convert into helpful electrical energy. The produced electric energy can be stored in dc batteries and further can be used in lighting sign boards, street lights, traffic signals, toll plazas, and charging e-vehicles. There are certain limitations of conventional energy sources viz. are pollution, more extraction time, limited sources availability, contribution to acid rain, high installation and maintenance cost, not sufficient for the future generations. The growing consumption of energy has resulted in the country becoming increasingly dependent on fossil fuels such as coal, oil and gas. Rising prices of oil and gas and their potential shortages have raised uncertainties about the security of energy supply in future, which has serious repercussions on the growth of the national economy. Increasing use of fossil fuels also cause serious environmental problems. Hence, there is a primary need to use renewable energy sources like solar, wind, tidal, biomass and energy from waste material. They are called non-conventional sources of energy. Increasing demand of energy adds to the need of identifying non-conventional resources of energy. In the following, we will discuss about power generation from speed breaker and the possible mechanism required for it.

In terms of energy conservation, energy crisis is an important factor. An energy crisis is a great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy crisis incurs to an oil crisis, energy shortage, electricity shortage, and thus electricity crisis. While not entering a full crisis, political riots that occurred during the 2007 Burmese anti-government protests were initially sparked by rising energy prices. Likewise the Russia-Ukraine gas dispute and the Russia-Belarus energy dispute have been mostly resolved before entering a prolonged crisis stage. Market failure is possible when monopoly manipulation of markets occurs. A crisis can develop due to industrial actions like union organized strikes and government embargoes. The cause may be ageing over-consumption, infrastructure and sometimes bottlenecks at oil refineries and port facilities restrict fuel supply. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in USA is 11980 KWh per year, whereas the consumption in India is 1149 KWh. One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. Supply of power in most part of the country is poor. Hence more research and development and commercialization of technologies are needed in this field. India, unlike the top developed countries has very poor roads. Therefore, we have to investigate other types of renewable sources, which produce electricity without using any commercial fossil fuels, which is not producing any harmful products. The latest technology which is used to generate the power by using renewable sources is "POWER HUMP". We every day come across, use and mesh up with the vehicles in our towns. But this mesh up could be answer of new type power generation. They

could actually light up small villages off the highway. IIT Guwahati has evaluated the machine and recommended it to the Assam ministry of power for large scale funding. IIT design department says it is a 'very viable proposition' to harness thousands of megawatts of electricity untapped across the country every day.

The Indian auto industry became the fourth largest in the world with sales increasing 9.5 percent year on year. The automotive industry in India is one of the largest in the world and one of the fastest growing globally. India's passenger car and commercial vehicle manufacturing industry is the seventh largest in the world, with an annual production of more than 4.02 million units in 2017.

2. WORKING PRINCIPLE

Whenever an armature rotates between the magnetic fields of south and north poles, an E.M.F is induced in it. So, for inducing the E.M.F. armature coil has to rotate, for rotating this armature it is connected to a long shaft. By rotating same emf is induced, for this rotation kinetic energy of moving vehicles is utilized. The power is generated in both the directions; to convert this power into one way, a special component is used called zener diode for continuous supply. Each generator is connected to a voltage regulator to make the voltage constant, so the battery won't damage. In order to store the power we added a battery. The battery is connected to an inverter to invert the DC voltage to AC which in turn can be used to light the streetlights. All this mechanism can be housed under the dome, like speed breaker, which is called HUMP. The electrical output can be improved by arranging these POWER HUMPS in series. This generated power can be amplified and stored using different electrical devices. This setup of speed breakers and electrical machineries for the production of electrical energy is a great approach to store and save the electricity both at once. The stored energy can then be use for various purposes and can be amplified for further use by using amplifiers. The mechanism for the generation of electricity is simple and can be done at an ease involving very few difficulties and limitations.

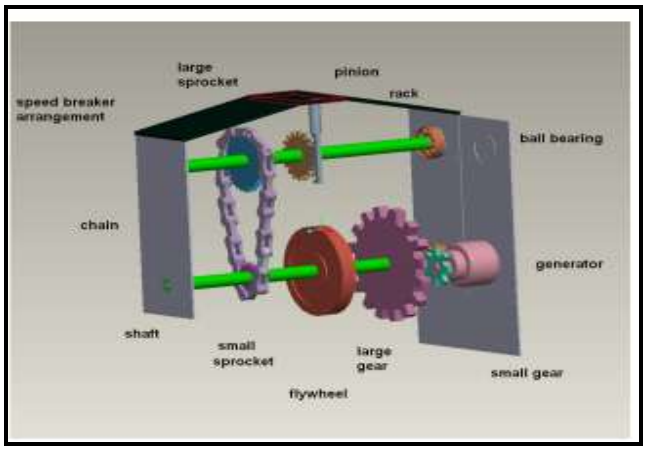

Fig-1 : Working of RPG system

The Speed Breaker is a flexible hump, which is pressed and released vertically down & up supported with springs. The Rack & pinion converts the linear motion into rotational motion. The rack moves vertically downward causing the pinion to rotate. The belt sprocket transfers the motion from the upper shaft to the lower shaft and increases the speed. The flywheel is used to store rotational energy. The gears arrangement, consists of three gears, one is larger than the other two to increase the speed. The small gears are connected to the generators. The generator converts mechanical energy to an electrical energy. The Amplifier increases the output power. When the load acted over the speed breaker the springs are pressed causing the rack to move downward and rotate the pinion to convert the vertical movement to rotational movement. Rack and pinion gears arrangements are consist of two gears. The circle gear is the pinion gear and the straight gear is the rack. Rack and pinion is used to convert vertical motion into rotational motion. The vehicles movement is converted into rotary motion using the rack and pinion arrangement. The axis of the pinion is coupled with the sprocket arrangement which is consists of two sprockets on a different shafts; one is larger size than the other which is smaller which help to increase the speed. Both sprockets are connected together with a belt, which transfer the power from the large sprocket to the smaller one. As the power is transmitted from the larger sprocket to the smaller one the speed at the larger sprocket is multiplied with a ratio so the smaller sprocket rotate faster. The axis of the smaller sprocket is coupled to a fly wheel which is a mechanical device that stores rotational energy; the fly wheel is coupled to the shaft at axis of the smaller sprocket and it's coupled with a gear arrangement. This stored mechanical energy is then converted into electrical energy by using generator and then can be used further.

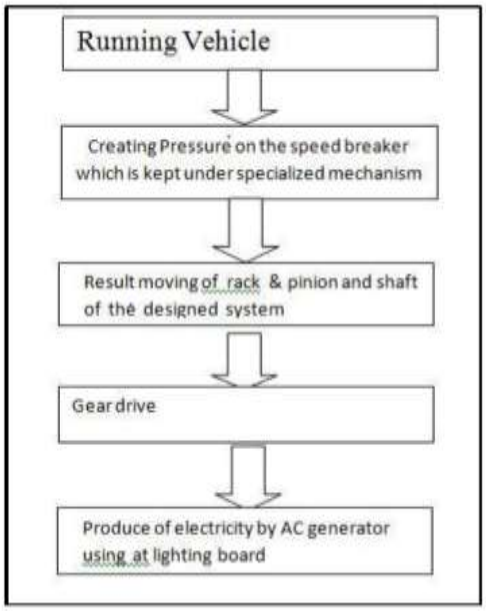

Fig-2 : Flow Chart of Road Power Generator and Working Model

Fig-3: Working Model

2.1 Important Components Used In RPG & Their Application

The working of an RPG system involves various components and their combination for generation and storage of electricity. Some of these components with the diagrams are described below:

(A) Rack And Pinion Gears: A rack and pinion is a type of linear actuator that comprises a circular gear engaging a linear gear, which operate to translate rotational motion into linear motion.

Fig-4 : Rack and Pinion Gears

(B) Unidirectional Bearings with Gear: A roller-element bearing is a bearing which carries a load by placing round elements between the two pieces. The relative motion of the pieces causes the round elements to roll (tumble) with little sliding.

Fig-5: A Unidirectional Bearing

(C) Dynamo: The dynamo uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating winding called the armature which turn within that field.

Fig-6: Dynamo

D) Shaft: A Shaft is a rotating machine element usually circular in cross section which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

Fig-7: Shaft

3. OUTPUT POWER AND WORKING PERFORMANCE OF RPG SYSTEM

The working Performance of RPG based system depends on how much output power is being developed through it. The developed output power depends on load of vehicle passing through the breaker arrangement and the speed of the moving vehicle. The generated power increases with increase in load and decreases with increase in speed.

(A) Output Power Calculations

(a) For Two Wheeler Arrangement
Let us consider,
The mass of a vehicle moving over the speed breaker = 100-150 Kg (Approximately)
Height of speed brake =14 cm
Work done = Force x Distance
Here, Force= Weight of the Body =150 Kg x 9.81 = 1471.5 N
Distance travelled by the body = Height of the speed brake =14 cm
Output power = Work done/Sec = (1471.5 x 0.14)/60 = 3.4335 Watts (For One pushing force)
Power developed for 1 vehicle passing over the speed breaker arrangement for one minute = 3.4335 watts Power developed for 60 minutes (1 hr) = 206.01 Watts
Power developed for 24 hours = 4.94424 KW

(b) For Four Wheeler Arrangement
Let us consider,
The mass of a vehicle moving over the speed breaker = 1500-3000Kg (Approximately)
Height of speed brake =14 cm
Work done = Force x Distance
Here, Force= Weight of the Body =2000 Kg x 9.81 = 19,620 N
Distance travelled by the body = Height of the speed brake =14 cm
Output power = Work done/Sec = (19620 x 0.14)/60 = 45.78 Watts (For One pushing force)
Power developed for 1 vehicle passing over the speed breaker arrangement for one minute = 45.78 watts.
Power developed for 60 minutes (1 hr) = 2746.8 Watts
Power developed for 24 hours = 65.9232 KW

(B) Analysis of Output Power

Table-1: Power v/s vehicle load

LOAD OF VEHICLE	POWER IN KW
1500	49.44
2000	65.92
2500	82.40
3000	98.88

Table-2: Power v/s time of passing of vehicle

LOAD	TIME IN HRS	POWER IN KW
2000	24	65.92
2000	21	57.68
2000	17	46.69
2000	15	41.20

Table-3: Output voltage v/s speed of vehicle

SPEED OF VEHICLE	VOLTAGE IN VOLTS
10	8.93
20	7.32
30	6.05
40	5.32

(C) Analysis of Output Voltage

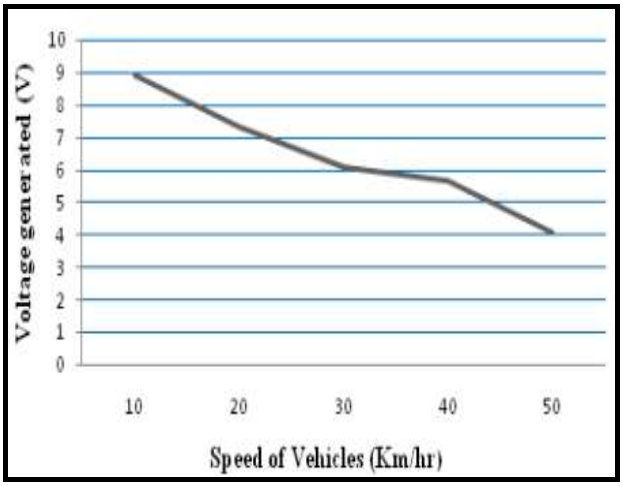

Chart-1: Output voltage v/s speed of vehicles

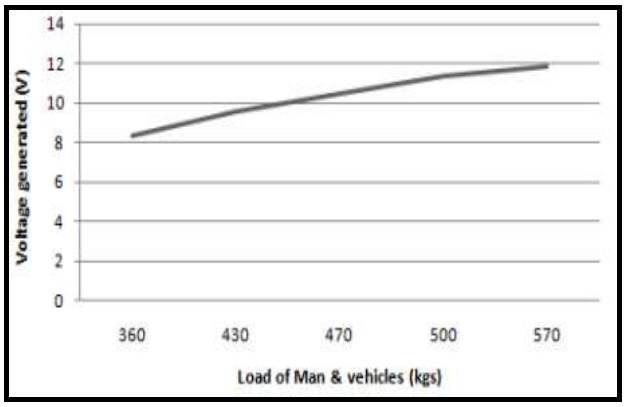

Chart-2: Output voltage v/s load of vehicles

4. ADVANTAGES OF ROAD POWER GENERATOR SCHEME

1. Simple construction, mature technology, and easy maintenance.
2. Pollution free power generation.
3. No manual work necessary during generation.
4. Energy available all year round..
5. The RPG emits no noise.
6. The unit will have minimum cost of installation.
7. This unit could be located at the close proximity to services and power grid.
8. Completely isolated street light or traffic lights.

Battery charging for electrical vehicles: As it is located nearby road. It can be most helpful for battery charging point for electrical vehicles. As number of e – vehicles is increasing day by day. This new technique thus be helpful for more use of e-vehicles which commonly have battery charging issues.

5. FUTURE SCOPE AND APPLICATION

Due to increase in population and automobile industries, length of the roads is increasing terribly. To meet the electricity demands new methodologies need to be implemented. This scheme discussed in this paper gives us rack and pinion arrangement that can be used for power generation having the following applications-

1. Local power generation.
2. Local display board.
3. Street lightening.
4. Charging the battery.

3. CONCLUSIONS

The utilization of energy is an indication of the growth of a nation. One might conclude that to be materially rich and prosperous, a human being needs to consume more and more energy. And this project utilizes the best source of energy that we get in day to day life. Consequently sincere and untiring efforts shall have to be made by engineers in exploring the possibilities of harnessing energy from several nonconventional energy sources. This scheme is a one step to path of that way. The overall goal was to design the speed breaker system while keeping the engineering, producer and customer models in check.

Road Power Generation is new type of unconventional source of energy. This is a type of vibration harvesting. This used waste energy of vehicles and converts kinetic energy to electric energy. RPG system can be a possible answer for battery charging stations and it may be possible that electric vehicles can be charged with green power by power earned from the wasted kinetic energy of the vehicles. The higher frequency of passing vehicles provides higher capacity of electricity generation by road power generation system. Road Power Generation System can be used in several ways, as it is considered worthwhile because it reuses the wasted energy caused every day in the roads. It is a new idea in the renewable energy industry. This paper has undoubtedly proven the concept of the speed breaker power production. The measured results are close to the predicted ones, whereas the power calculations are encouraging for a more realistic implementation.

REFERENCES

[1] N. Fatima, J. Mustafa, "Production of electricity by the method of road power generation" International Journal of Advances in Electronics and Electrical Engineering, IJAEEE, Volume1, Number1, pages 9-14, 2011.

[2] D. Venkata Rao, K. Prasada Rao, Chiranjeeva Rao and RU mamaheswara Rao, "Design and Fabrication of Power generation System using Speed Breaker," International Journal of Current Engineering and Technology, vol. 4, no. 4, August 2014.

[3] C. K. Das, S. M. Hossain, M. S. Hossan, "Introducing Speed Breaker as a Power Generation Unit for Minor Needs", IEEE International Conference on Informatics, Electronics & Vision (ICIEV),17-18 May 2013.

[4] Noor Fatima, Jiyaul Mustafa, "Production of electricity by the method of road power generation" International Journal of Advances in Electrical and Electronics Engineering - ISSN: 2319-1112. Vol-1

[5] Sharma P.C, Non-Conventional power plants (Public printing service, New Delhi.

[6] Ankita, Meenu Bala Power Generation From Speed Breakers, International Journal Of Advance Research In Science and Engineering, 2013.

[7] Bhagdikar, P. (2014, May). Generation Of Electricity With The Use Of Speed Breakers.

[8] Power Generation through Road Speed Breakers - an Experimental Approach Aisha Abdul Razzaq Al Ahmadi, Al Dana Rashed Almansoori

[9] Energy Harvesting For Backup Power Supply Using Speed Humps By Umair Ahmed Khan, Sheroz khan.