



# INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

## REVIEW ON ENERGY HARVESTING BY RACK AND PINION MECHANISM

M.A.Gandhewar<sup>1</sup>, R.R.Pande<sup>2</sup>, G.Nimkar<sup>3</sup>

<sup>1</sup>UG Student, Mechanical Engineering, JDIET Yavatmal, Maharashtra, India, [mohitgandhewar@gmail.com](mailto:mohitgandhewar@gmail.com)

<sup>2</sup>UG Student, Mechanical Engineering, JDIET Yavatmal, Maharashtra, India, [rahrajpande@gmail.com](mailto:rahrajpande@gmail.com)

<sup>3</sup>UG Student, Mechanical Engineering, JDIET Yavatmal, Maharashtra, India, [gauravn3223@gmail.com](mailto:gauravn3223@gmail.com)

### Abstract

In today's age man is searching for alternate of the non-renewable energy sources, the more reliable and less polluting and more importantly that may be applied to daily purpose need fulfilment of people. That is why we need to look for the sources of energy mostly from renewable and human power is also a type of renewable type of energy. On this concern of harvesting energy from non-conventional sources we have focused on the rack and pinion mechanism where the human power in various alternative ways will provide motion to the mechanism and energy can be generated by means of generator arrangement. The use of human-power in more efficient manner for generation has been possible due to modern technology. The main focus of the project is to utilise the normal activities of humans in the direction of getting useful applications of them in the field of energy generation not like the conventional ones. The rack and pinion mechanism is good enough to be installed at the places where activities like walking, running, gym, exercise, etc. are carried as their resultant motion will apply effort on this arrangement that will be utilise to harvest energy. The rack and pinion mechanism is also applicable at the speed breakers where the heavy load of the vehicles will be acting on the system that will provide motion to rack and thus pinion will rotate that will harvest energy from the load acting of the vehicle and this application is very beneficial for lighting the streetlights.

**Index Terms:** rack and pinion, dynamo, energy harvesting, mechanism, motion etc.

\*\*\*

### 1. INTRODUCTION

During last few decades, electrical energy is the basic requirement of human beings. The ratio of electricity requirement is increasing day by day. But we know that the resources for power generation are limited, and this has caused the energy crisis. The conventional sources of energy are generally non-renewable sources of energy, which are being used since a long time. To improve the power generation technologies and to make them more sustainable, non – conventional technologies have been discovered. In that case rack and pinion gear mechanism (chain and sprocket used here) are more favourable for harvesting of useful motion. In this project the force produced by humans while doing exercise, running, walking etc. is converted into electrical energy using proper mechanical setup and a generator. On this system we do not have to put on any extra efforts as we may use this rack and pinion arrangement on footstep pathway at railway station, on the gym machines, on cycling or in any exercise machine as our concept is to utilise the energy in the form of efforts one has given to the system.

### 2. LITERATURE REVIEW

A lot of considerable work in the field of energy harvesting has done in past couple decade by using the rack and pinion mechanism and some of them are quite useful to provide in consumption of energy at the streetlights.

One has applied this mechanism in the speed breaker so when the vehicles travel by the speed breakers, rack will travel by the weight of the vehicle in downward motion and thus pinion

will rotate resulting in generator shaft rotation will generate power.

Another has developed a system working on the basis of foot step press that provides the motion to rack and pinion and thus to harvest energy by the weight applied on the surface where it is established.

The application of this system in the gym pull up and pull down provide the contraction and expansion of springs attached on the rods and resulting motion of rack and pinion thus provides energy generation.

### 3. OBJECTIVES

In this project we are converting Mechanical energy into Electrical energy. We are trying to utilize the wasted energy in a useful way. By using Rack and Pinion arrangement we are converting to and fro motion of during the gym, cycling, exercise, walking, weight load, into rotational motion of the dynamo.

We are using rack and pinion arrangement directly to rotate the dynamo. By using chain drive mechanism to obtain better efficiency.

Through Dynamo the rotational energy is converted into electrical energy.

### 4. COMPONENTS

#### 4.1 RACK

Function- To change the translator motion in to rotary motion

Properties- strength, Rigidity, Resistance to shock

## 4.2 PINION

When velocity ratio is of importance, the successive positive drive is by gears or toothed wheels. A gear drive is also provided, when the distance between the driver and follower is very small.

## 4.3 DYNAMOMETER

It is well known that whenever electric current flow through the conductor a magnetic flux is immediately brought into existence in the space surrounding the conductor. We say that when the electrons are under motion they produce magnetic field. The converse is also true, i.e., when magnetic field embracing a conductor moves relative to the conductor, it produces a flow of electrons.

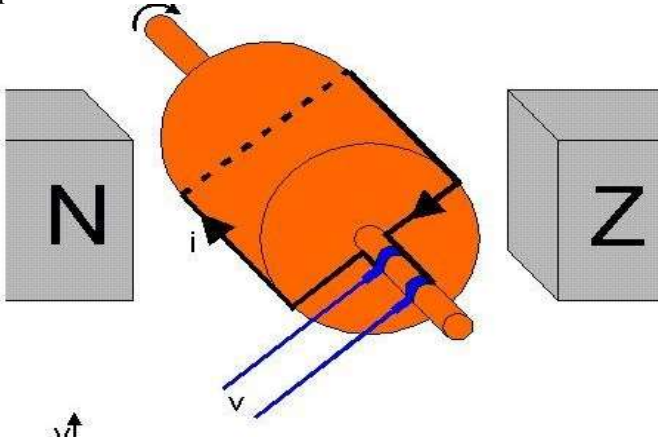


Fig.: Dynamometer

## 5. RACK AND PINION MECHANISM

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and forces a train up a steep slope. For every pair of conjugate involutes profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius. A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear shaper cutter. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion. The rack carries the full load of the actuator directly and so the driving pinion is usually small, so that the gear ratio reduces the torque required. This force, thus torque, may still be substantial and so it is common for there to be a reduction gear immediately before this by either a gear or worm gear reduction. Rack gears have a higher ratio, thus require a greater driving torque, than screw actuators. A rack and pinion mechanism is used to transform the rotary motion into linear motion and vice versa. A single gear and pinion meshed with a sliding toothed rack. This combination is

converts rotary motion into back and forth motion. Windshield wipers in cars are powered by rack and pinion mechanism.

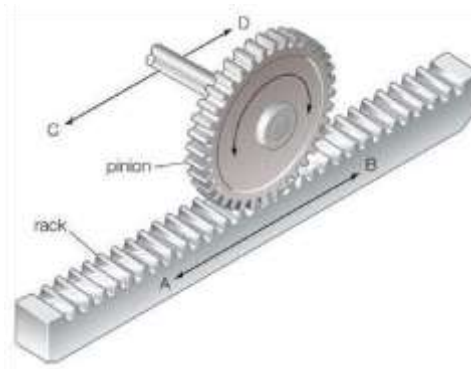


Fig.: Rack and Pinion

## 6. APPLICATIONS

1. Power generation by footsteps at railway stations, markets, bus stand, airports, etc.
2. It is applicable at the speed breakers.
3. Power generation using gym pulling can be used in colleges, schools, gym centres.
4. Foot step generated power can be used for agricultural, home applications, street-lightening.

## 7. CONCLUSION

1. This type of power generation is identified to be cheaper than many other alternatives and the model has less number of parts and the assembly would cost very less with all the components being available regularly and no model specific parts are to be manufactured.
2. There is many more extension that can be made to this project. Generators of more load capacity can be used to get more power.
3. More frictionless medium to transfer power to generator and increased gear ratio for harvesting energy at high scale. This mechanism is very reliable as we have to arrange the rack and pinion and let the system do the work.
4. The power generation using foot step gets its energy requirements from the Non-renewable source of energy there is no need of power from the mains and there is less pollution in this source of energy.

Out of the above conclusions of this mechanism, the first is found to be most valid option for consideration.

## REFERENCES

- [1]. Rajat Gupta, Suyash Sharma, Saurabh Gaykawad, "A Revolutionary Technique of Power Generation Through Speed Breaker Power Generators", International Journal of Engineering Research & Technology, Vol. 2 Issue 8, August – 2013.

- [2]. M. Sailaja, M. Raja Roy, S. Phani Kumar, "Design of Rack and Pinion Mechanism for Power Generation at Speed Breakers", International Journal of Engineering Trends and Technology, Volume 22 Number 8-April 2015.
- [3]. Abhishek N., Shivasharana Yalgi, "POWER GENERATION BY FOOTSTEPS USING RACK AND PINION MECHANISM", International Journal of Engineering Research And Advanced Technology, Special Volume. 02, Issue.01, May-2016.
- [4]. Roshan Ojha , Rahul Raj, Shravan Kumar, T. Hari Prasad, "POWER GENERATION BY GYM PULL UP", International Research Journal of Engineering and Technology, Volume: 03 Issue: 06 | June-2016.
- [5]. Arun Kumar K., Ajith Kumar V, Daniel Arockiaraj J, Guru Prasad U. S, " ENERGY HARVESTING USING RACK AND PINION MECHANISM", IOSR Journal of Mechanical and Civil Engineering, Volume 15, Issue 1 Ver. IV (Jan. - Feb. 2018), PP 75-80.
- [6]. Ali Azam, M. Aqeel Aslam, Shoukat Ali, F.Q. Yousef-Zai, 4<sup>th</sup> International Conference on Energy, Environment and Sustainable Development 2016 (EESD 2016).