

Electric Power Production from a Renewable Energy Source - Speed Breaker Generators

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Abstract: *Power is a scarce commodity in Nigeria as in most developing countries like India. Constant power shortages are witnessed in various cities and villages. Electricity is the form of energy which is most widely used in nature. Electric power obtained from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources are called primary sources. Electricity generation was first developed in 1800's using Faraday's dynamo generator. After almost 2 centuries later, the same basic principles are still being used to generate electricity, but on a much larger scale. The primary energy resources are the conventional types and are in limited quantity because they are not renewable, and on the other hand create a lot of pollution to the atmosphere. A revolutionary method of power generation through speed breaker power generators is proposed as a renewable energy concept. On speed breakers, tremendous amount of energy is being wasted by vehicles, and several models were introduced to utilize this energy through speed breakers. This paper attempts to show different methods of renewable energy generation through speed breaker.*

Keywords: *Speed breaker, power generation, renewable energy, chain drive, gears, translator-stator topology.*

I. Introduction

In 1906 the New York Times reported on an early implementation of speed bumps in the U.S. A town of Chatham, New Jersey, which planned to raise its crosswalks five inches above the road level: "This scheme of stopping automobile speeding has been discussed by different municipalities, but Chatham was the first to implement it".

According to information from Ministry of Transport, Nigeria has over 56,000km of roads and statistics provided by the Ministry of Road Transport & Highways in India show that the lengths of national highway by 2012 was 76,818 km. In year 2002, 58.8 million and in 2004, 72.7 million vehicles were plying on Indian roads. The annual rate of growth of motor vehicle population in India has been almost 10 percent during the last decade [9] [10] [12]. There is tremendous vehicular growth in India year by year. Nigeria has over 50 million vehicles plying on its roads with a growth rate of 15 % in 2012, [11]. On the Roads these vehicles waste tremendous amount of energy due to speed breakers, the increasing traffic and number of speed breakers on roads gave rise to the manufacturing of an innovative device which can channel the energy being wasted by vehicles on speed breakers to some useful work. Different models to harness this energy were introduced according to the road conditions. After each generation the efficiency of model increased and the limitations diminished. Different kinds of models have variant designs, some use gears, belts, dynamos etc with different applications at different places. Each model was encouraged due to limitations of previous ones. This paper illustrates various models and provides the review of different technologies used in the generation of energy with the help of speed breakers.

1.1. Use of Only Speed Breakers and not Rough or Plane Roads

Now the question arises as to why only the speed breaker is used and not the rough or plane roads where the kinetic energy of the vehicle is more than that obtained on the speed breaker. The answer to this question is obvious; consider for example: A car or any heavy vehicle moving with a speed of 100 mph on the road and passing over this roller which is fitted at the level of the road then this roller will gain the speed of nearly 90 mph (due to losses). Now suppose a bicycle is moving with a speed of 20 mph and is going to pass this roller (which is moving at a speed of 90 mph), then due to this difference in the speed there will be a collision. That is the main reason for using this concept on the speed breaker, [7]. The rough or plane road will not provide the torque necessary for energy generation.

1.2. Energy Estimation

When the vehicle moves over the speed breaker, speed breaker reduces its speed. As these breakers have a little height it gains an increase in its potential energy. A vehicle weighing 1,000kg passes over the system it pushes the damper to a depth of 10 cm it can produce approximately 0.98 kilowatt power (ideally). So from one such speed breaker on a busy highway, where about 100 vehicles pass every minute, about one

kilowatt of electricity can be produced every single minute. This type of energy is a non-conventional resource or renewable energy.

While moving, the vehicles possess some kinetic energy and it is being wasted. This kinetic energy can be utilized to produce power by using a special arrangement called POWER HUMP. It is an Electro-Mechanical unit [2]. It is a mechatronic type of arrangement. The amount of electricity consumed in one night by all the street lights around Chennai city (India) is equal to consumption of electricity in a remote village for one month and 14 days [5]. The design of speed breakers was developed long ago but only utilized by few nations, as there were limitations of speed breaker power generators. These power generators can be classified according to their mechanism and the type of power generated through it. The classifications are given below.

II. Classifications Of Speed Breaker Power Generator

One type of speed breaker design for power generation, may not be suitable for all the road conditions, therefore, different types of designs are introduced, [5].

2.1. Connection through Chain Drive Mechanism.

When the vehicle comes on the speed breaker, because of its weight, the top portion of the speed breaker moves downwards and the shaft consisting of the U portion rotates in a particular direction. Due to this rotation of the shaft, the sprocket will rotate and the rotational energy from one shaft is transferred to the other shaft with the help of chain drive mechanism, Fig. 1. This rotates the gear on the bottom shaft, which in turn will help to rotate the gear placed on the motor. This rotation of the gear starts the generator and generates electricity which can be stored in the battery and can be converted to A.C. current using inverter and can be used for lighting of the lamps signals sign boards on the road etc. [1].

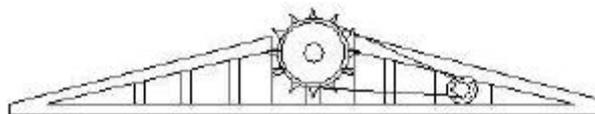


Fig. 1. Chain Drive Speed Breaker Mechanism

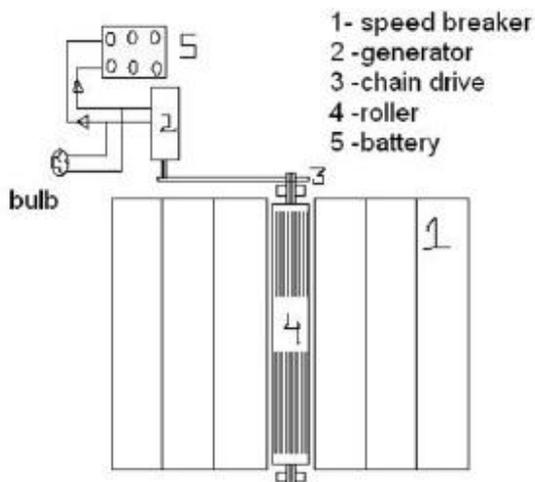


Fig.2. Rack and Pinion Arrangement.

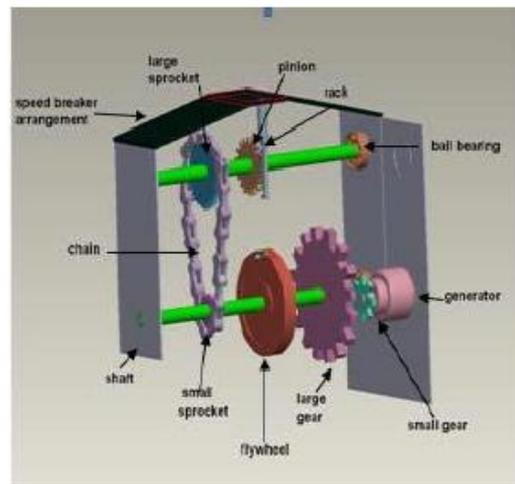


Fig.3. Sprocket Arrangement

2.2. Rack and pinion system.

The work is concerned with generation of electricity from speed breakers-like set up. The load will act upon the speed breaker & further the load will be transmitted to the rack and pinion arrangements, Fig.2. Here the reciprocating motion of the speed-breaker is converted into rotary motion using the rack and pinion arrangement. The axis of the pinion is coupled with the sprocket arrangement. The sprocket arrangement is made of two sprockets, Fig.3, one of larger size and the other of smaller size. Both sprockets are connected by means of a chain which serves in the transmission of power from the larger sprocket to the smaller sprocket. As the power is transmitted from the larger sprocket to the smaller sprocket, the speed that is available at the larger sprocket is relatively multiplied at the rotation of the smaller sprocket [4].

2.3. Direct use of load

The load can be directly used by using reciprocating device, Fig.4. It may be done with the help of shafts and spring as horizontal rod connected with shaft at its centre and springs at its both ends. This

mechanism will give it a reciprocating motion and hence power can be generated. This motion is used to compress the air using compressing device and after compression, the air gets collected in a cylinder and can be further used [3].



Fig. 4. Reciprocating Device.

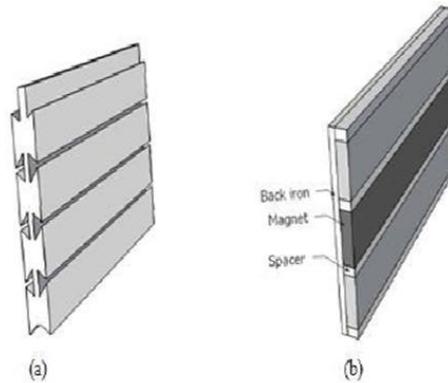


Fig. 5. Translator and Stator topology

2.4. Use of translator and stator topology

(a) Translators.

Each translator is a double slotted planar plate. The translator is wound as three-phase connection winding. The generated power in the translators is delivered to output terminals of generator using flexible wires.

(b) Stators.

The stator is a planar back iron with mounted magnets on it. The arrangement of magnets is N-S-N. There is a spacer with high permeability between each two adjacent magnets, Fig.5. The operation principle of the SBG (speed breaker generators) can be described as follows. As the vehicle wheels pass the SBG, the translators will be pushed down. Since the magnets have provided a high density magnetic field in the air-gaps, motion of translators will cause induction of voltage in the translator's windings. The produced power will be transferred via the flexible wires to output terminal of generators. It should be noted that, the flexible wires can be interpreted as brush and slip rings in electrical rotating machines [6].



Fig. 6. Compressed Air Method

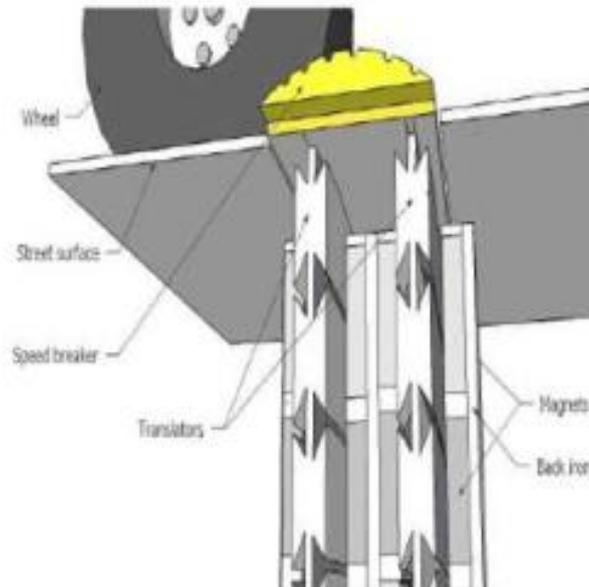


Fig 7. Translator and Flywheel Mechanism

2.5. Pressure through Lever Mechanism

When pressure lever, Fig.8, is pressed the flywheel will rotate by chine sprocket gear mechanism, it will force the DC generator to rotate because DC generator and flywheel are in same shaft, Fig.7. DC generator will **produce electricity by the rotation** of armature coil and generated electricity will be stored in a rechargeable battery. A rechargeable battery, storage battery, or accumulator can be used as storage device .This electricity can be used later for different purpose [10].

It can be seen from different designs that the storage devices are used according to convenience of situation, as it simply depends upon the need, that is, the form of energy required which may be, for electricity, either in form of direct current [1] or in the form of alternating current[1]. The power also may be stored in the form of compressed air as mentioned above in section 2.3.

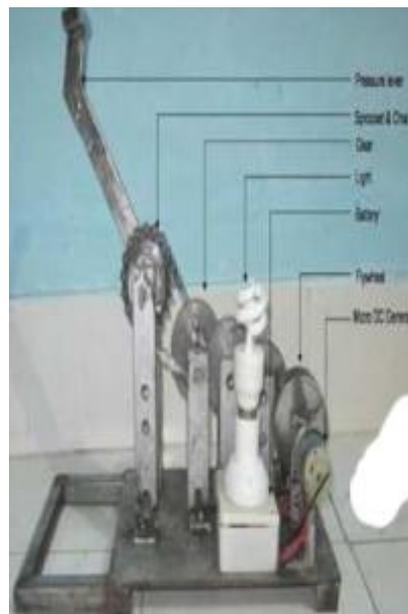


Fig 8. Lever Mechanism

III. Impications Of Using Speed Breaker

The power generated through speed breaker mechanism can be considered renewable source which does not pollute the environment. Below are the advantages and challenges of using speed breaker mechanism for power generation.

3.1. Advantages of using speed breaker as power generator

- Require simple construction methods.
- Free from all types of pollutions.
- It is economical and easy to install.
- Maintenance cost is low.
- This concept is quite promising due to its good efficiency as well as energy recovery criteria.
- No fuel transportation problem.
- No consumption of fossil fuel which is nonrenewable.
- No manual work necessary during generation.
- Energy available all year round.
- We can use it at all places according to desired design.

The Indian Institute of Technology, IIT, Guwahati has evaluated the machine and recommended it to the Assam ministry of power for large scale funding. IIT (Indian Institute of Technology) design department says it is a “very viable proposition” to harness thousands of megawatts of electricity untapped across the country every day, [8]. It is therefore recommended that Nigerian Ministry of power should also begin implementation of this technology to improve power generation across the country. A storage module like an inverter will have to be fitted to each such rumble strip to store this electricity. The cost of electricity generation and storage per megawatt from speed-breakers will be nearly USD500,000 as opposed to about \$1.2million in thermal or hydro power stations [8].

3.2. Challenges

- i. Selecting suitable generator.
- ii. Selection of springs.
- iii. Achieving proper balance of speed and torque.
- iv. Such speed breakers can be designed for heavy vehicles, thus increasing input torque and ultimately output of generator and hence it will not work with light weight vehicle.
- v. Require more suitable and compact mechanisms to enhance efficiency.
- vi. We have to check mechanism from time to time in short span of period.
- vii. Because of Rain water it may get damage.

IV. Conclusion

In the coming days, demand for electricity will be very high as it is increasing every day, speed breaker power generator will prove a great boom to the world in the future. The aim of this research is to introduce another innovative method of green power generation in order to contribute toward developing the world by enriching it with utilization of available resources in more useful manner. Any country, especially Nigeria and other developing nations, can only develop when there is steady and available power supply for its citizens and not by getting breakdown in middle course of time or unreliable power sources. Now time has come for using these types of innovative ideas and it should be brought into practice. It is suggested that further developments should be done to minimize above mentioned challenges. This research can also be modified by using camshaft and pulley stem or concepts of fluid mechanics can be used instead of gears, so as to minimize the inherent complexities and difficulties. By using the concept of power generation new ideas should be introduced which would help in reduction of friction and increase the efficiency of the generators.

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