POWER GENERATION THROUGH SPEED BREAKER: A REVIEW

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Abstract

Now a day, electricity generation is the big task because consumption of electricity is very high due to awareness of peoples and electronic appliances. The need for conversion of energy is increasing day by day. There are a lot of kinetic energy of the vehicle that is being wasted because of speed breakers in the road. In this review paper, the energy can be utilizing in order to generate the sufficient amount of electricity that can be used for lighting the street. Whenever a vehicle passes through these breakers due to the kinetic energy of the vehicle the speed-breaker rotate about the axis. This leads to the rotation of gears and hence generate connected to it rotate and electricity is produce. During the day time this energy is stored and can be utilize at night for lightening the street.

Keywords: - *Rack & pinion, Breakers, Power generation, Energy, Gear mechanism*

1. Introduction: -

In the present scenario power has become the major need for human life. Energy is an important input in all the sectors of any countries economy. The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-conventional energy resources [1][2]. Here in this paper we are looking forward to conserve the kinetic energy that gone wasted, while vehicles move. The number of vehicles passing over speed breaker on road is increasing day by day. Whenever a vehicle passes over the breaker the gear attached to the breaker rotates this leads to the rotation of magnet inside the generator the electricity is produce inside the breaker. This electricity is stored and can be utilize for lightning the street during the night. The energy crisis is any great bottleneck in the supply of energy resources to an economy. The studies to sort out the energy crisis led to the idea of generating power using speed breaker. Firstly, South African electrical crisis has made them implemented this method to light up small villages of the highway. The idea is basic physics, to convert the kinetic energy into electrical energy that gone wasted when the vehicle runs over speed-breaker [5]. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in USA is 9000 KWh (Kilo Watt hour) per year, whereas the consumption in India is 1200 KWh (Kilo Watt hour).
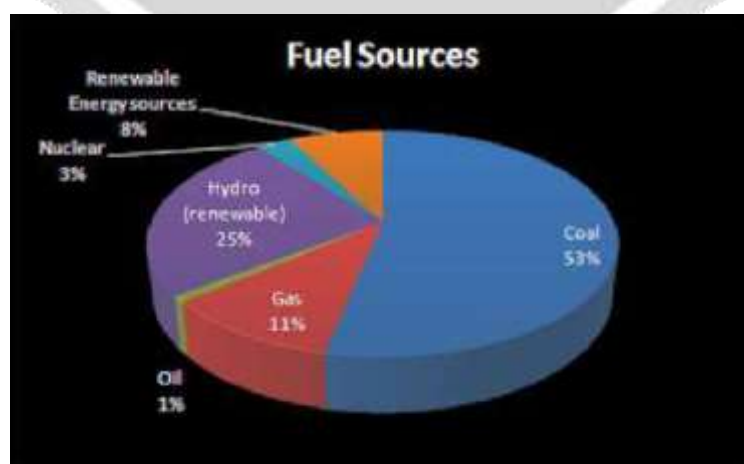

Fig. 1.1 Fuel Sources

2. MECHANISM-

In this paper, we used rack and pinion along with spring combination to generate extra power from speed breaker.

2.1 Rack and Pinion-

Whenever the vehicle is allowed to pass over the dome it gets compressed with the help of spring and the rack which is attached to the bottom of the dome moves downward in reciprocating motion. Since the rack has teeth connected to gears, there exists conversion of reciprocating motion of rack into rotary motion of gears but the two gears rotate in opposite direction. By the use of ball bearings, one of the rotary motions is utilized to generate power.

Fig. 2.1 Rack and pinion

2.2 - Air Compression Method-

The power is generated using Air compression mechanism. In this method when vehicle pass from the speed breaker the piston of the pump is goes down and air is compressed. The following figure shows air compression mechanism.
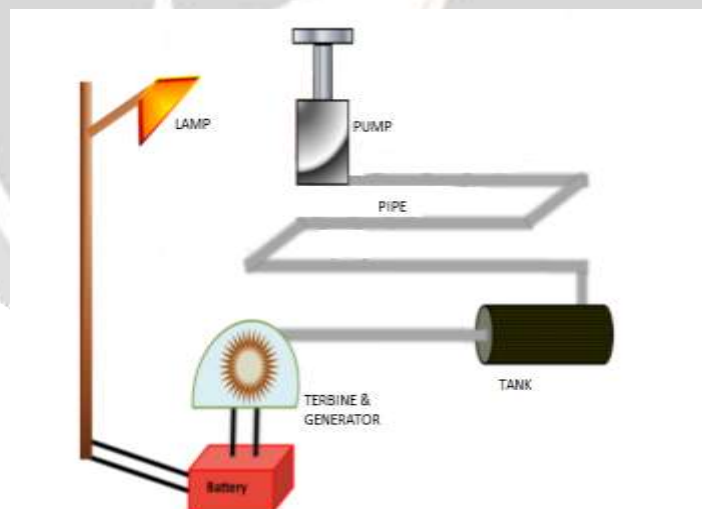

Fig. 2.2 Air Compression Method

This compressed air has some velocity so we can use it to rotate turbine. The tank is provided for the more compression and storage of air it is not necessary if a force by the pump is very high. The exhaust air goes to turbine which is connected with the alternator or any type of electric generator so we can generate electricity. This method is needed less maintenance and also low cost, here absence of any other rotational parts reduces losses. The reason for select this method is, it is applicable for constructing speed breakers which can generate electricity. The cost of construction is less and efficiency is high, the main problem in other mechanisms is constant output because there is only one way to store energy is battery. In this mechanism storage of air is also possible, so it can give constant output for longer period of time than any other mechanism.
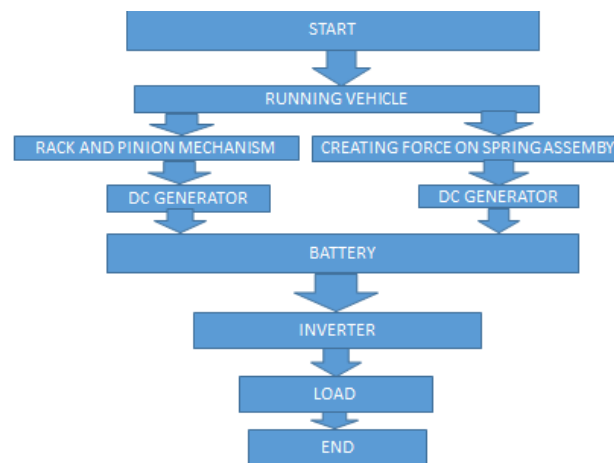
Fig. 2.3- Flow Diagram

3. Component used:

The following component are used to design this arrangement for power generation-

a) Plastic pipe
b) Gear
c) Bearing
d) Bearing stand
e) Iron rode
f) Wire
g) Iron stand
h) Wooden frame

4. Design of the Rack and Pinion Mechanism-

The design of the working model of the power producing breaker is being carried on Solid work design software. Keeping in mind about all the clearance required. Here we used three springs (two spring pistons and one helical spring) for damping the vibrations produced while passing the vehicles and take the roller at its original position after passing of the vehicle.
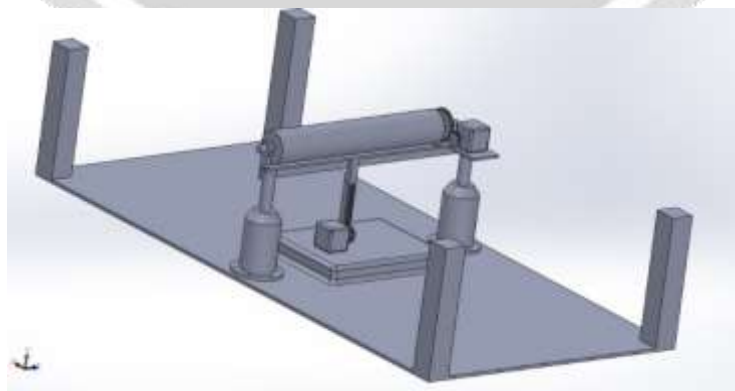

Fig. 4.1 Speed breaker mechanism arrangement

5. Analysis-

The is analysed on the basis of current and voltage output of the project model. The dimensions, the length of the roller is 27.5cm and has the diameter of 4cm. There are two dc motors that works as dynamo for the conversion of mechanical work into electrical energy.

5.1. Calculation for Rack and Pinion Mechanism-

Let, number of teeth on rack that is connected to the roller=14

Number of teeth on pinion engaged to the rack=20

Number of teeth on gear connected to pinion shaft=30

Number of teeth on gear connected to dynamo=15

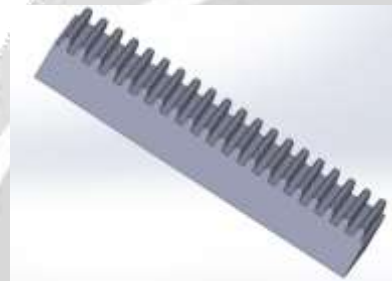Mass acting on the roller for the vertical motion= 10kg

Fig 5.1 Rack   **Fig 5.2 Pinion**

Hence,

Force acting on the roller=m X g = 10 X 9.81

i.e. Force= 98.1N

Height of speed breaker above the level=2.5cm=0.025m

The work done by the acting mass on the roller=Force X Distance

Power =Work done/time

= (98.1 X 0.025)/60

=0.0408 W

Power developed in 24 hour= 0.0408 X 60 X 24

= 58.752 Watt

We know, P=2πNT/6000

N=90rpm

T= (P X 6000)/(2πN)

T= (58.752 X 6000)/(2 X 3.14 X 90)

T=623.69 Nm

So, the total power developed through rack and pinion mechanism =58.752 watt

5.2 Calculations for roller mechanism-

Fig 5.3 Roller

Let mass of vehicle passing on the speed breaker, M= 10 kg

Height of roller above ground level =2.5 cm

Mass of roller, m = 0.3 kg

Roller radius,r = 2 cm

N_1 for roller = 500 rpm

N_2 for dynamo = 1000 rpm

Torque, T = force X distance

       = Mgh   =2.45 Nm

If 10 vehicle passes in 1 min i.e N= 1000/10   =100 rpm

Rating of generator used

V= 12-14 V

No= 150rpm

Current capacity=0.7 A

     EA/EAo = N/No

     i.e EA =N X EAo/No

= 10 X 14/150

=9.33 V

     Armature current, IA= load capacity/60

              = .7/60

              =0.01166 A

     Terminal voltage, VT = EA- armature current

              =9.33- 0.01166

              =9.31 V

Output Power   = VT X IA

              =9.31 X 0.01166

              =0.108 Watt

Power in 1 Hour   = 0.108 X 60

=6.48 Watt

Power in 24 hour i.e in 1 day,

=6.48 X 24

=155.528 Watt

Total Power Output in 1 day = power output of rack pinion mechanism + power output of Roller mechanism in 1 day
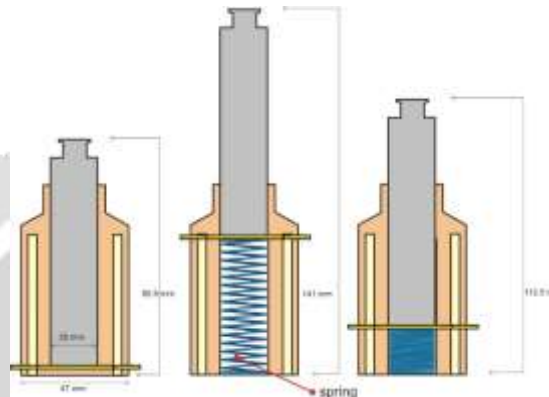
=(58.752 + 155.528) Watt = 214.28 Watt

Fig. 5.4. Spring Balancing

6. COMPARATIVE STUDY-

Various approaches were made to generate power through speed breakers but in some way every approach had its own limitations. In our model, we used combination of both roller and rack and pinion mechanism. Therefore, these repeated cycles will be possible with busy roads will store a good amount of power that can be stored in battery and it can be further utilized for useful purposes. Hence power is generated with maximum efficiency.

S.No.	Parameter	Rack & Pinion	Roller	Combination
1	Cost	Cheap	Moderate	Costly
2	Maintenance	Very easy	Easy	Low maintenance
3	Mechanical Setup	Less required	Less	Difficult
4	Efficiency	Low	Moderate	High
5	Output Power	Low	Moderate	High

Table- 5.1 Comparison between existing and our model

7. Conclusion:

The power producing breaker can be a vital solution for the emerging crisis about the energy conservation. Huge amount of electricity can be saved with the help of this breaker. Hence this will lead us towards the sustainable development. The energy that is being wasted during the breaker system can be utilize and its efficiency can be improved accordingly. For a flow of vehicles per day, which includes 2/3/4/6/8 wheelers, the energy produced will be much more significant compared to the experimental results obtained, thus making it a good energy producing setup as energy of vehicles on impact with the speed breakers is anyway lost. This is lost to heat and sound. This energy can be tapped, stored and used as back up or for small applications. Improvements have to be made in the setup to increase the efficiency which is discussed in following section. In this study a new technique has been proposed to gate electricity from speed breakers. This technique will help to conserve our natural resources.

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