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DESIGN OF POWER GENERATING SPEED BREAKER

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Abstract: -

Now-a-day's strength has grown to be the main need for human existence. The cheapest and new source of strength is acquired by using the conversion of one type of energy into other. The renewable sources of energy become more famous due to non-polluting and truely to be had from the man or woman. The availability of regular conventional fossil fuels is going to be the most sources for electricity era, however there's a fear that they're going to get exhausted ultimately via next few decades. So, non-traditional resources are needed to be evolved for electricity technology that is clean, surroundings friendly and sustainable. In this research we suggest a renewable non-traditional strength source supported velocity breaker mechanism. The generated electricity is frequently used for the lamps close to the rate breakers and this will be first-rate boon for the rural villages too. In this paper it's in particular concentrated on the working of the newly developed rack and pinion mechanism that's hired to increase the power from velocity breakers, its practical implementation. Task consists of the usage of energy which is wasted. While transferring, the cars possess some K.E that's being wasted. This kinetic electricity can be utilized for the production of electricity. The Kinetic energy of the cars may be converted into mechanical energy of the shaft through rack and pinion mechanism and this shaft is hooked up to the electrical dynamo and it converts the electricity into electricity proportional to vehicles density. This generated strength is often regulated with the assistance of Zener diode for endless supply. The electric output is often progressed by way of arranging those power humps serial and this generated power are regularly amplified and saved by means of the use of different electric powered devices. The protection value of the hump is almost nullified. By adopting this technique, we are able to fulfil future needs to a degree and save lots of power.

Keywords: *Fossil fuels, Renewable Non- Conventional, Electrical dynamo, Zener Diode, Vehicle Density.*

I. INTRODUCTION

Energy is an important part of everyone's life. Every event in day to day we require energy. But nowadays we see there is somehow shortage of energy face by world. Crisis of energy is the main problem generated these days. Many conventional sources are also depleting like coal, oil, fossil fuels etc. We have to find a solution to these problems and need to find alternative sources to generate energy as good as good. There is also increasing in population rate over the world, especially in India the growth rate is very high. Due to rate of population increased, vehicles on roads are also increasing in large numbers. Energy can be created in large amount when vehicle are passes on roads but this energy is wasted as there is no implement to use that energy. So, this is our responsibility to use this kind of energy for good source of purpose. By implementing specially designed speed breaker setup on roads we use energy produced from it. We can convert this mechanical engineering into useful energy. When the vehicle passes on speed breakers which are implemented in various positions to slow down the vehicles, safety purpose, the energy is produced by this setup.

By generating that kind of energy and overcome the energy crises problem, we made a project on this. There are many kinds of mechanism we can use in this set-up like Roller mechanism, Rack and pinion mechanism, Hydraulic mechanism, Crank shaft mechanism. We use Rack and pinion mechanism in our project. The vehicle's weight and speed can be used to generate energy. The method employs a speed breaker press, which is then used in conjunction with a rack and pinion arrangement to press down and run the generator motor, creating electricity. The speed breaker is returned to its original position using the spring mechanism. This is we can store somewhere and make the use of this energy in day to day life like in street lights, singles, Toll tax collection center, etc. This project is eco-friendly and their less need of manpower. It is a cheap source, pollution free and required less floor area. And this is a renewable source so depletion not occurs in this. So, we are generating electricity (energy) without depending on any other factors. Technology also helps to conserve natural source. And lastly it is a good alternative source over the depleting conventional sources.

II. LITERATURE SURVEY

Speed bumps are kinematic systems that receive their kinematics from passing cars and convert generated

kinetic and potential energies to electrical energy. The mass of the driving vehicle experiences vertical translation as a result of the speed bumps systems, resulting in potential and kinetic energy.

For the construction of an energy conversion system for the extraction of kinetic energy from vehicles, an appropriate and efficient topology is required. The purpose of this work is to present a new speed-breaker generator (SBG) for extracting kinetic energy from vehicle traffic in the street. This device converts the kinetic energy of the vehicles into electric energy.

N. N. Ghuge (2014) explains vehicular traffic in big cities is more, causing a problem to human being. It has advantage that it does not utilize any external source. Now is the moment to put these types of new ideas front and centre, and research should be conducted to improve their impact. This can be implemented at metropolitan cities.

III. METHODOLOGY

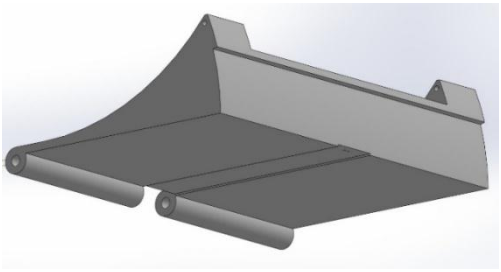


Fig.1

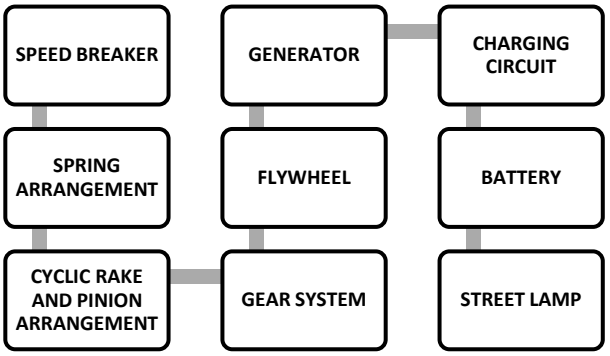
The principle of electricity generation through speed breaker is fundamentally based on converting the kinetic and potential energies of vehicles to electric energy. When vehicles pass over the speed breaker, kinetic and potential energies are produced from the vertical displacement of speed breaker. This energy is then converted into electricity with the help of generator and charging circuit.

There are number of proposed ways to convert up and down motion of speed breaker into rotary motion. They are

- Roller mechanism
- Crank-shaft mechanism
- Magnetic mechanism
- Rake and pinion arrangement
- Hydraulics Mechanism

In our project, we have used rake and pinion arrangement mechanism and some parts of roller mechanism.

Flowchart: -



IV. COMPONENTS USED

1) Speed Breaker

Speed Breaker is used transform the force exerted by vehicles on the other arrangements, thereby producing downward motion on the cyclic rake. The speed breaker is made up of C-25 carbon steel. The speed breaker is designed in such a way that the road acts as a one way. The dimensions of the speed breaker are mentioned in the following table.

2) Curved Rack

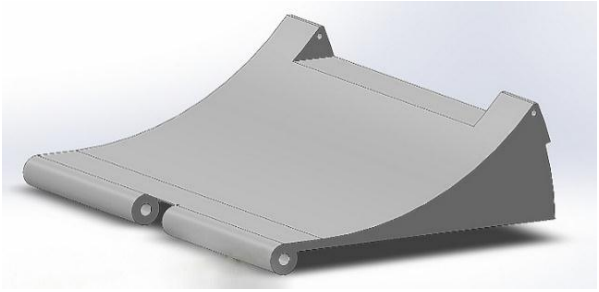


Fig.2

When an object needs to perform circular motion, then curved rack is used. The moving track of this device can be driven by a motor situated in the middle if the diameter of the moving track is reasonably small. However, if the diameter is relatively large, the same friction force is eliminated, because the diameter is large, the output torque of the motor is also greater. If the diameter is large, a very large output torque is large; the output torque of the motor is also greater.

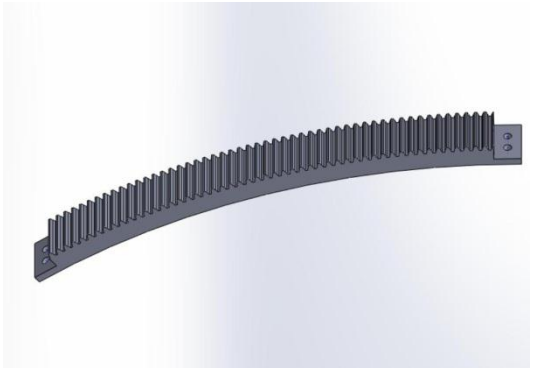


Fig.3

If the diameter is large, a very large output torque is required, and it is not easy to control, therefore we have used a curved rack. In this project, the speed breaker follows a rotational motion through one end of speed breaker.

3) Spring

Springs are used in this project for following reasons,

- Apply force
- Control vibrations and motion
- Reduce impact.

4) Bearing

A bearing is a machine detail that constrains relative motion and decreases friction between shifting parts to simplest the favored motion. The design of the bearing may also, for example, offer without spending a dime linear motion of the transferring part or free of charge rotation round a hard and fast axis; or, it may save you a motion via controlling the vectors of regular forces that endure at the moving elements. Many bearings also facilitate the preferred motion as a lot as viable, inclusive of via minimizing friction. Bearings used here are Ball Bearings and are installed at the crank shaft for connecting the connecting rod.

5) Gear system

Gears are used here for amplifying the velocity. The form of gears used in this version is Spur Gears. Two gears out of which one is a pinion and other is a bigger gear are used right here. These gears mesh with one another so one can transmit torque. A transmission is a pair of gears that work together to create a mechanical advantage.

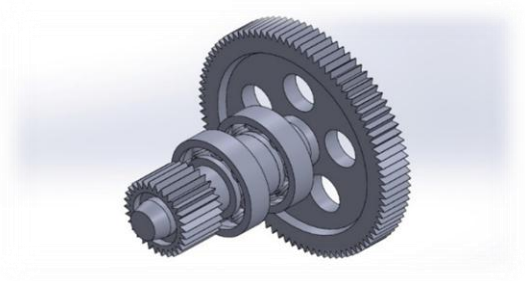


Fig.4

6) Generator

In this system, a 500 rpm DC generator is employed to transform mechanical input from mechanical setups into electrical output. The rotation of the shaft derived from the curved rack and pinion system feeds the input to the DC generator.

Specifications of Generator:

Current Capacity = 0.75 A
Voltage = 12 V
Torque = 2 kg

V. DESIGN

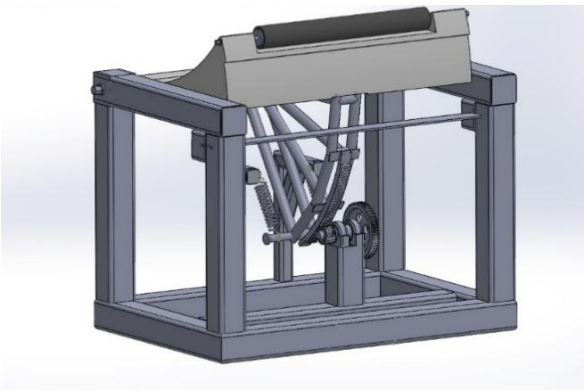


Fig.5

Fig.6

VI. DESIGN CALCULATIONS

1) Spring Design: -

Specifications of the springs used
Type: Helical Springs
Material of the spring = ASTM A228 Steel
Modulus of elasticity = G = 80 GPa
Let, Exerted force (P) = 2000 N
Maximum deflection of spring (δ) = 250 mm
Spring index(C) = 7
S_{yt} = 1760 MPa
S_{ut} = 2346 MPa

Step 1: Calculation of wire diameter,

Calculating Wahl factor (K)
K = (4C-1)/4C-4) + 0.615/C
= 1.213
$\tau = 0.5 \times S_{ut}$
= 1173 MPa
But, $\tau = 8KPC/\pi d^2$
$d = (8KPC/\pi*\tau)^{1/2}$
= 0.00607 m
= 6 mm

Step 2: Calculation of coil diameter,

D = Cd
= 7*6 = 42 mm

Step 3: No. of coils,

$\delta = 8PD^3N/Gd^4$
$N = \delta Gd^4/8PD^3$
= 20.375 = 20 coils
It is assumed that the spring has square and groundends. The number of inactive coils is 2. Therefore,
N_t = 22 Coils

Step 4: Free length of spring,

Solid length of spring = N_t*d = 22*6 = 132 mm.
It is assumed that there will be a gap of 1 mm between consecutive coils when the spring is subjected to the maximum force. The total number of coils is 22.
The total axial gap between the coils will be (22-1)x1= 21 mm.

Free length = Solid length + Total axial gap

= 132 + 21
= 153 mm

Dimensions of spring are shown in following table,

Sr. No.	Parameters	Values
1	Material	ASTM A228
2	Type	Tension helical spring
3	Modulus of elasticity	210 Gpa
4	Poission's ratio	0.313
5	Modulus of rigidity	80 Gpa
6	Spring coil diameter	42 mm
7	Spring wire diameter	6 mm
8	Total number of coils	22
9	Spring constant	8000 N/m
10	Spring deflection	0.25m (Maximum)
11	Length of spring	153 mm

2) Gear Design: -

Specifications of Gears: -

Sr. No.	Parameters	Pinion	Larger Gear
1	Material	C-30 (Carbon content 0.270 - 0.340 %)	C-30 (Carbon content 0.270 - 0.340 %)
2	Young's Modulus	200 GPa	200 GPa
3	Yield Strength	350-550 MPa	350-550 MPa
4	Pitch Circle Diameter	55 mm	165 mm
5	Pressure Angle	20º	20º
6	No. of Teeth	30	95
7	Module	1.83 mm	1.74 mm
8	Circular Pitch	5.45 mm	5.45 mm
9	Addendum	1.83 mm	1.74 mm
10	Dedendum	2.288 mm	2.175 mm

3) Speed Breaker: -

Specifications of Speed Breaker:

Sr. No	Parameter	Values
1	Material	C-25 (Carbon content 0.220 - 0.290 %)
2	Young's Modulus	190 GPa
3	Shear Modulus	73 GPa
4	Poission's Ratio	0.29
5	Yield Strength	240 MPa
6	Length	750 mm
7	Width	490.9 mm
8	Height	190 mm
9	Radius of Curvature of Speed Breaker	504.2 mm

4) Bearing Design: -

Let us assume the radial force acting on the bearing be Fr = 3000 N,

From PSG 4.13, Selecting Deep groove ball bearing (DGBB) SKF6206,

And we get,

d = 30 mm, D_1 = 36 mm, D = 62 mm, D_2 = 56 mm, B = 16 mm, r = 1.5 mm, r_1 = 1 mm, C_0 = 1000 Kgf, C = 1530 Kgf.

We know that, Equivalent dynamic load capacity, $P_e = S(VXF_r + YF_a)$

X = 1,
Y = 0,
V = 1 (for Inner race),
S = 1.2

Hence, $P_e = 1.2(1*1*3000)$
= 3600 N

The relation between the bearing life and the dynamic load capacity is expressed as,

$L_{mr} = (C / P_e)^k$

Where, K = 3, for ball bearing,

$L_{mr} = (15300 / 3600)^3$
= 76.765 millions of revolutions.

Rating life of bearing at 90% reliability in operating hours is,

$L_{mr} = L_{hr} * N * 60 / 106$,

Therefore, $L_{hr} = L_{mr} * 106 / 60 * N$,

Taking N = 100 RPM,

$L_{hr} = 76.765 * 106 / 60 * 100$
= 12794.2 Hrs.

5) Power Calculations: -

Downward Travel of speed breaker,

$S=r\theta$

since, r=505.9mm &θ=28 degree

$S = 505.9 * (28*3.142)/180$
=247.66mm

1.2 rotations of small gear per down stroke.
2.4 rotations of small gear in total stroke. (Down and upward)
2.4 rotations of large gear in one total stroke.
For one vehicle, strokes = 2
Rotation of small and large gear per car are
= 2.4 * 2 = 4.8
Now, as gear ratio is 3
Rotations of generator shaft per stroke = rotations of any gear (small or large) * 3
Rotations of generator shaft = 4.8 * 3 = 14.4
Now, let assume 120 vehicle passes in 1 hour.
No. of vehicles per min. = 2
Rotations of generator shaft =28.8 RPM
We should change the unit of rotational speed as rad/s (radian per second)
1 rotation = 360 degree = 6.28 rad
1 rpm = 6.28/60 rad/sec.= 49.737
= 0.10466667 rad/s
28.8 rpm = 3.014400096 rad/sec
Also, we should check the unit of torque is Nm.
Assume the weight of vehicle is 2000N
Torque = 2000 * 82.5 = 16500 Nmm
= 16.5 Nm
Torque acting on bigger gear = 16.5
Subtracting 20 % losses we get,
Torque = 13.2 Nm
Now, Power generated is given by
= Torque * Rotations (rad/sec)
= 13.2 * 3.0144 = 39.79 W (In one min)

VII. EXPECTED OUTCOMES

- Electricity generation without depending on other factors.
- 3 to 4 LED street lights can be lightened.
- Technology will help to conserve natural source.
- Good alternative sources over depleting conventional source.
- Pollution free less floor area, no manpower required.
- Renewable source, so depletion not occurs.

VIII. APPLICATIONS

- This tool can be utilized in locations such as schools, public locations, hospitals, railway stations and many others.
- We designed and manufactured this tool such that every company huge or small may want to have enough money it.
- It is designed such that a three- storey constructing waste may be incinerated without difficulty
- Also used in Street light, lamppost, avenue lamp, light widespread, or lamp. Modern lamps may have mild sensitive photocells to show them on at dusk, off at sunrise, or activate mechanically in darkish climate.
- Traffic Lights: -Traffic lighting, which will also be known as stoplights, visitor lamps, traffic alerts, signal lighting fixtures, robots or semaphore, are signaling devices located where we can apply this project.

IX. CONCLUSION

- Kinetic energy and downward force exerted on road by vehicles which were losing is made in use in this project.
- This wastage factors are used for power which is generated by this speed breaker mechanism.
- Efficiency is been increased due to smooth working of mechanism.
- Frictional losses in previous designs are been reduced to greater extent, therefore the power is generated more efficiently.
- No other equipments are required to make the roads to work as one way as this mechanism is one side mechanism. Also, modification can be done to make it to work astwo-way mechanism.
- In different phrases installing an energy generator mechanism on road will provide energy that may be applied to lighten city streets, boulevards, and supply low-voltage powers to cameras or velocity-sensors.

X. REFERENCES

Research Papers: -

1) Jyoti Maurya,Pooja Gupta, Pooja Gupta,Tarannum Shahab, Amitabh Srivastava, "Generation of Electricity through Speed Breaker Mechanism" The International Journal of Engineering and Science (IJES), Volume 5, Issue 4, 2016.

2) Amal Abraham, CibinGeevarghese Jacob,Glen Martin Thomas,Jobby George,Jose Tom,"Eco Friendly Power Generation from SpeedBreakers" IJIRST – International Journal for Innovative Research in Science & Technology, Volume 3, Issue 11, April 2017.

3) Ankit Gupta, Kuldeep Chaudhary & B.N Agrawal, " An experimental study of generation of Electricity using Speed breaker", International Journal of Mechanical Engineering (IJME), Vol.1, Issue 1, Aug 2012.

4) D.Venkata Rao, K.Prasada Rao, S.Chiranjeeva Rao and R.Umamaheswara Rao, "Design and Fabrication of Power generation System using Speed Breaker" Accepted 10 June 2014, Available online, Vol.4, No.4 Aug 2014.

5) Md. Emran Hossain, Md. Rokib Hasan, KaziTahsan Ahmed, Md. NaoshatMunimShawon, " Design and Performance of Power Generation Using Speed Breaker with the Help of Rack and Pinion Mechanism" Proceedings of the 2017 4th International Conference on Advances in Electrical Engineering, Dhaka Bangladesh, 28-30 September, 2017.

6) Mrs. S.S Pitre, Mr. Rahul Raj, Mr. Sachin Raina, Mr. Akash Bhoria, Mr. Alok Kumar, "Electricity Generation Using Speed Breaker" (IRJET), Volume: 05, Issue: 03, Mar-2018.

7) Miss. GaMiss, Gauri S. Khakare, Miss. Jyoti M. Pathade, Mr. Nitin D. Khomane, Miss. Pooja W. Belikar, Prof. P. J. Bhakre, "Design of Hardware Model for Electricity Generation by Speed Breaker through Rack and Pinion Mechanism" International Research Journal of Engineering and Technology (IRJET), Volume: 05, Issue: 06, June 2018.

8) Pruthviraj Jadhav, Abhishek Raykar, Saurabh Kuntala, AmolPatil, "Design, Fabrication and Testing of power generation Using vehicle movement by flywheel mechanism", JETIR, Volume 6,Issue 4, April 2019.

9) Shah MohazzeShah, MohazzemHossaina, C. K. Dasb, Md. ShahdatHossanc, SamsJarind, "Electricity from Wasted Energy of the Moving Vehicle Using Speed Breaker",Articlein Journal Teknologi, March 2015.

10) M.Sailaja, M. Raja Roy, S. Phani Kumar,"Design of Rack and Pinion Mechanism for Power Generation at Speed Breakers" (IJETT) – Volume 22, Number 8-April 2015.

Books Referred: -

1) Design of Machine Elements by V. B. Bhandari.

2) PSG Data Book.