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ROAD POWER GENERATION USING SPEED BREAKER

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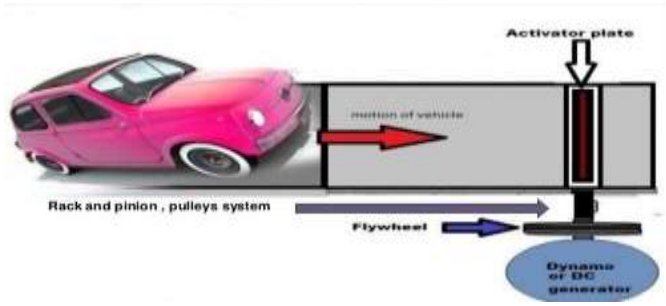
***Abstract*— In the present days, non renewable sources are depleting day by day. So, there is a necessity to find out a technology where energy can be produced without effecting nature and less pollution. In this paper, we mainly focused on design analysis and fabrication of working model. Here, the main principle involved is reciprocating motion converting into rotary motion. Reciprocating motion of connecting rod attached to speed breaker gets converted into rotary motion of crank shaft and thus increasing speed using gear and pinion and getting power using dynamo meter and storing in a battery. The main objective is to design and develop a mechanism which minimizes energy and to design a system such that electricity can be produced without destroying the nature and to provide free electricity to near grid stations, street lights, sign boards, and traffic signals and to provide electricity to the rural areas and users without any fuel cost. Our project attempts to show how energy can be tapped and used at a commonly used system, the road speed breaker**

Keywords— **power generation, energy conservation, speed breaker, Design Analysis, Dynamo Motor, connecting rod and Crankshaft.**

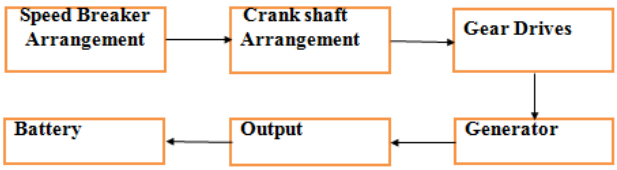
I. INTRODUCTION

For Renewable energies mainly refer to the wind, solar which are less harmful to environment, attracting researchers in design and development of renewable energy conversion systems. Although improvement of renewable energy converters is in a fast rate, the systems to extract the wasted energy in conventional energy conversion systems are not developed as much as its technologies.



For instance, as a car passes over a speed-breaker, most of car kinetic energy will be wasted as heat in it. On other hand, to ensure the security of the populated areas of streets, the speed-breakers are required. Therefore it is necessary to design a suitable and efficient topology for design of an energy conversion system for extraction of kinetic energy of vehicles. This device converts the kinetic energy of the vehicles into electric energy. This is done by moving plate installed on the road, this plate take the stroke motion of the vehicles and convert it to the rotary motion by crank mechanism and it generates the electricity

- **Block Diagram of the Design:**



As Mechanical moving parts is high and therefore there are very large frictional losses and therefore require more maintenance, Initial cost of this arrangement is very high. The overall efficiency is quite low as compared to other techniques.

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II. FABRICATION

2.1 Components used in the system:

- The following components are designed separately and are then assembled to get the power generation system. Wooden Table, Speed Breaker, Connecting Rod, Springs, Crank Shaft, A set of gears, Bearings and AC Generator.

2.2 Wooden Table & Speed Braker:

- A wooden table is prepared to give support the whole system
- Speed Breaker is used to transmit the pressure exerted by the vehicle on the connecting linkages, thereby producing mechanical movement in the connecting rod.

Figure 2.1: Frame of the table (Dimensions of the table: 3×3×4 feet)

Figure 2.2: Speed Breaker (Dimensions of Speed Breaker Cross Section: 1.2 × 3 feet**,** Length: 3 feet)

- The speed breaker is designed to resist the load of the vehicles passing over it. The speed breaker is made up of a single piece of wood. The curvature of the speedbreakeris designed in such a way that the vehicle passes away smoothly over it. The dimensions and cross section of the speed breaker is givenabove.

2.3 Connecting Rod:

- A connecting rod is an engine component that transfers motion from the piston to the crankshaft and functions as a lever arm. The connecting rod in this system also serves the same purpose.
- Together with the crankshaft, it forms a simple mechanism that converts reciprocating motion into rotating motion.

Figure 2.3: Connecting Rod

2.4 Springs:

- To apply force and control vibrations and control motion and to reduce impact i.e. as Shock absorbers.

Figure 2.4: Helical Springs

- Helical Springs used in this system are directly welded to a steel strip which is bolted or fastened tightly to the speed breaker.
- Specifications of the springs used Type: Helical Springs
- Material of the spring = ASTM A228 Steel (G = 80 Gpa)
- Wire diameter of the spring, d = 6mm
- Outer diameter of the spring, D = 60m

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- Length of the spring, l = 240mm
- Number of coils, n = 12
- Mean coil diameter = D- d
  = 60 - 6= 54mm

2.5 CrankShaft:

- The crankshaft, sometimes abbreviated to crank, is responsible for conversion between reciprocating motion and rotational motion.
- In a reciprocating engine, it translates reciprocating linear piston motion into rotational motion, whereas in a reciprocating compressor, it converts the rotational motion into reciprocating motion.
- The crank shaft used here is connected to the connecting rod by means of ball bearings.
- Specifications of the Crankshaft:
- Diameter of the cross section of crankshaft = 20 mm. Length of the crankshaft = 2100 mm.
- Length of the bend = 50 mm.
- Height of the bend = 30 mm

Figure 2.5 Crank Shaft

2.6 Gears:

- Gears are used here for amplifying the speed. The type of gears used in this model is Spur Gears.
- Two gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio
- Specifications of Larger Gear

- Material – Stainless Steel(303S31)
- Radial diameter 'D_1'–190mm
- Number of teeth 'T_1' –120
- Module = D_1/T_1 =1.58
- Pressure Angle =20º
- Circular Pitch –4.172mm

- Specifications of Pinion

- Material – Stainless Steel(303S31)
- Radial Diameter 'D_2' –58mm
- Number of teeth 'T_2' –35
- Module = D_2/T_2 =1.65
- Pressure Angle =20º
- Circular Pitch –4.172mm

Figure2.6: Gear

Figure 2.7: Pinion

2.7 Bearings & AC Generator:

- A bearing is a machine element that constrains relative motion and reduces friction between moving parts to only the desired motion
- An electric generator is a device that converts mechanical energy to electrical energy. A generator forces electric current to flow through an external circuit.

- Current Capacity – 1Amp, Voltage – 12V,Torque 1Kg

Figure 2.8: Ball Bearings

Figure 2.9: Generator

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III. WORKING PRINCIPLE

- Here the reciprocating motion of the speed-breaker is converted into rotary motion using the connecting rod and crank shaft arrangement
- The axis of the crankshaft is coupled with the larger gear
- As the power is transmitted from the larger gear to the smaller pinion, the speed that is available at the larger gear is relatively multiplied at the rotation of the smaller pinion.

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Figure 3.1: Transmission of power through Gear

3.1 Photograph of the assembled model:

- The figure below shows the photograph of the assemble

- **Figure 3.2:** Assembled Model of Speed Breaker Power/ Generation System

IV. DESIGN CALCULATIONS:

4.1 DESIGN OF SPRINGS:

- Material of the spring = ASTM A228 Steel (G=80 Gpa)
- Wire diameter of the spring, d = 6mm
- Outer diameter of the spring, D = 60mm
- Length of the spring, l = 240mm
- Number of coils, n = 12
- Mean coil diameter = D-d=60-6 =54 mm
- S

STIFFNESS OF THE SPRING, K = $G \times D^4 / 8 \times D^3 \times N$

$= 80 \times 10^4 \times (6)4$

$8 \times (54)^3 \times 12$

= 6.9 N/mm

4. 2 Calculation of Load:

- Stiffness of springs k =load/deflection
- Therefore, load, w = k ×deflection

= 6.9 × 60 = 414 N (We assume maximum deflection = 60mm) as we are using two springs of same specification total load W = 2 × w

= 2 × 414 = 828 N = 84.4 kg.

4.3 Calculation of Speed Multiplication:

- Speed ratio = $T_2/T_1 = 35/120 = N_1/N_2 = 0.29$
- Where, N_1 = speed of the gear N_2 = speed of the pinion
- T_1 = number of teeth in gear T_2 = number of teeth in pinion $N_2 = N_1/0.29$
- if the speed of the gear N_1 is 20 RPM then, the speed of the pinion $N_2 = 20 / 0.29$

=68.57RPM

4.4 Calculation oftorque:

Torque, T = force × perpendicular distance

$= 828 \times 30 \times 10^{-3}$ (perpendicular distance= 30mm)

= 24.840 N-m

Torque obtained at the pinion = 24.84 / 3.42

= 7.26 N-m

4.5 Design ofCrankshaft :

- From Torque Equation, T/J $= \tau/R = G\theta/l$

Where, T = maximum twisting moment (N-mm) τ = maximum shear stress (50MPa)

R = radius of shaft (mm) J = $\pi D^4/32$ (D=2R)

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D = shaft outside diameter (mm) l = length of the shaft (2.1 m)

θ = angle of rotation

= 2.5 $^{\theta}$ = 0.0436 radians

On the basis of strength, T/J = τ/R

$R^3 = \frac{32T}{16\,\pi\,(\tau)}$ (Substituting the value ofJ)

$= \frac{32 \times 24.84 \times 10^3}{16 \times \pi \times 50}$

= 316.272

R = 6.813 mm

- Therefore, we get the diameter of crank shaft as 13.62 mm.

On the basis of Rigidity, T/J = Gθ/l

$R^4 = \frac{32 \times T \times l}{16 \times \pi \times G \times \theta}$

$= \frac{32 \times (24.84 \times 10^3) \times (2.1 \times 10^3)}{16 \times \pi \times (80 \times 10^3) \times 0.0436}$

= 9513. 5728

R = 9.876mm

Therefore, we get diameter of crank shaft as 19.75 i.e. 20 mm approx. So we proceed with the highest value of the both diameter.

V. RESULTS :

5.1 Estimated power output:

Power = $\frac{2\,\pi\,NT}{60}$ watts

= $\frac{2\times\pi\times68.57\times7.26}{60}$ = 52.13 watts

Power obtained in 24 hours = 3.4 MW (approx.)

5.2 Experimental Results:

- The voltage generated at different load Conditions are observed and readings are tabulated as shown below.

Table 5.1: Output at different Loads

Load(kgs)	Voltage Generated(V)
40	6.58
60(man load)	8.33
130	9.45
170	10.22
200	11.23

5.3 Advantages of Power Generation System using Speed Breaker:

- Pollution free power generation
- Simple construction, mature technology, and easy maintenance.
- No manual work necessary during generation
- Energy available all year
- No fuel transportation required
- No consumption of any fossil fuel which is non-renewable source of energy.

VI. CONCLUSIONS :

- After the Project we arrived to the following conclusions
- ✓ Machine of low cost with simple design is fabricated.
- ✓ 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.
- ✓ This project utilizes the best source of energy that we get in day to day life
- ✓ The reason why this feature was used more than all of the other features are because the other features would not have as much effect on the complete system
- ✓ Future work would consist of a redesign of this model to see exactly how much data we may be missing with the assumption that we made with low price, weight and capacity

VII. SCOPE FOR FUTURE WORK :

- The gear transmission can be replaced by a series of chain drives for more power production
- A provision can be made for storing the generated power in a battery and utilizing in future.
- Stress analysis can be carried out on the speed breaker. Speed breaker can be designed in a more compact manner in order to resist the heavy load.

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