Electricity Generation using Railway Tracks

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Abstract

Power Generation from railway tracks is an important concern in today's life because its carries large number of trains moving over it. In this project an attempt is made to design a mechanism which able to carry load and generate power using Simple mechanical elements. This mechanism used hydraulic press and Chain drive mechanism to transmit power. The mechanism design in this project is Alternative way to store the energy which is generated using train when passes over the railway tracks with continuous power production process. This mechanism is has advantages of less in cost to manufacture and maintenance free and requires less space to install it.

Keywords- Energy Harvesting, Non-Conventional Method, Railway Tracks, Hydraulic Press Mechanism

I. INTRODUCTION

In the present scenario power becomes the major need for human life. Energy is an important input in all the sectors of any countries economy. Energy crisis is due to two reasons, firstly the population of the world has been increased rapidly and secondly standard of living of human beings has increased. India is the country, which majorly suffers with lack of sufficient power generation. The availability of regular conventional fossil fuels will be the main sources for power generation, but there is a fear that they will get exhausted eventually by the next few decades. Due to limited sources of fossil fuels lots of research has been done to generate power from renewable resources.

II. WORKING MECHANISM

To design a Mechanism for Electricity generation using Speed Railway Track, Dynamometer of following specification is considered
Maximum power Capacity: 4000Wats
Rotational Speed: 3600rpm
Depending up on the dynamometer Specification, this project is designed to glow 40 watt bulb and considering factor of safety as 3, we need to generate minimum 120 watt.

A. Component used for Mechanism

1) Hydraulic Components

1) Two hydraulic cylinders
2) Hydraulic pressure gauge
3) Hydraulic line

2) Mechanical Components

1) Chain drive
2) Flywheel
3) Gear box
4) Bearing

3) Electrical Components

1) Dynamo
2) Battery
3) Light Emitting Diode
4) Multimeter

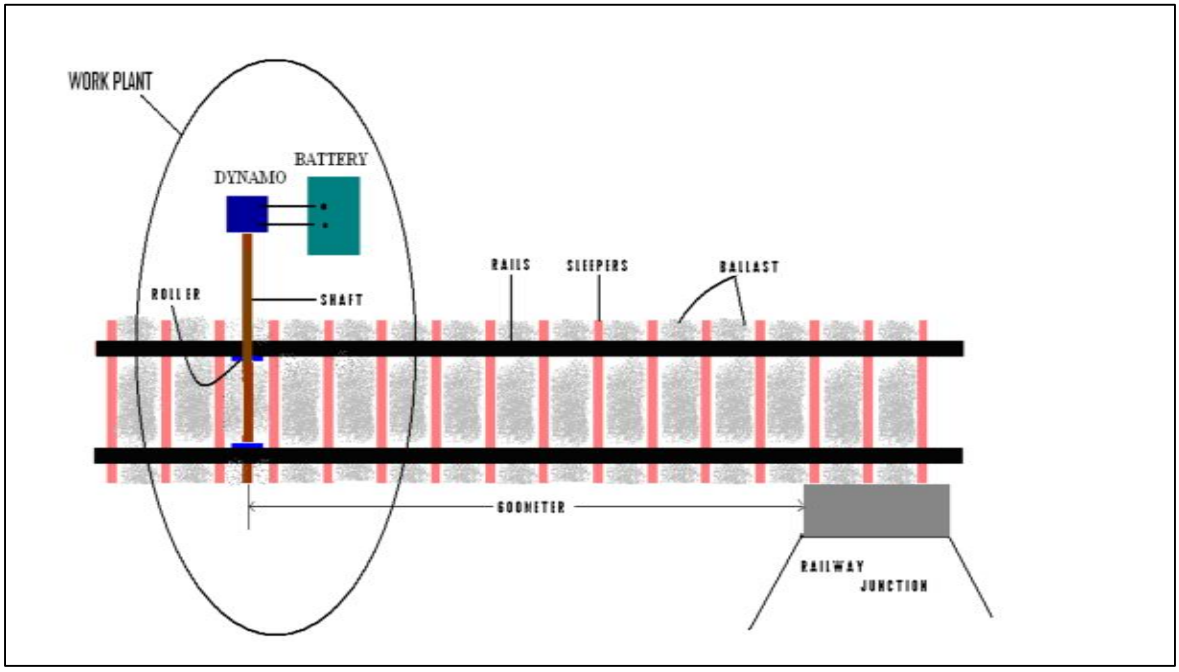


Fig. 1: Detail View of Working Mechanism

III. THEORETICAL CALCULATION

A. Design of Hydraulic Cylinder

Diameter of cylinder -18 Let the diameter of cylinder -1 is 90mm & force on piston rod is 133KN(push force) so,
We can calculate the pressure on hydraulic liquid.
Fpush = Pπd 2/ 400
Fx400 = P π x 62
470.39 bar=P
p = 470.39 bar which is within a limit.
So, Diameter 60mm is safe, stroke of cylinder-1 is 52mm
Volume of cylinder-1 V1 = A1 x stroke 1
= π x 62 x 5.2 4 = 147.02
For both cylinder volume should be equal so v1=v2=147.02cm Diameter of cylinder -2 V2= A2 x stroke2
A2=V2/stroke2
A2=9.42cm π x d 2=9.4 4d
2=9.42 x 4/3.14
d 2=12
d=3.46
d2=34mm

CYLINDER-1	CYLINDER 2
DIAMETER=60MM	DIAMETER=34MM
STROKE=52MM	STROKE=156MM

Type of Cylinder Block cylinder with steel housing B1.509 [for p=147.02 bar]
Push force producedby the piston rod of cylinder -2, can be calculate by
F = P x π x d22/ 400
F = 470.39 x π x 5.42
400 F = 42.70
CONVERSIONS: 1KN=1000N=98.1kp 1bar=105 N/m2
AS per observation a train having 10 wagens requires 15sec to pass over one sipper & 10 wagens gives the 20 strokes of piston so, for 20 strokes -15sec 1 stroke - ?

Stroke time=15/20=0.75sec
Now, Piston Speed can be calculated as, V = Stroke
Stroke time (th) = 15.6 0.75 = 20.8 cm/sec
Flow Rate Q: Q = A x V = 9 x 20.8 = 188.84 cm 3/s = 0.000188 m 3/s
Power can be calculated as,
Force on cylinder (F)=42700N
Area = 3.14x (0.034)2 = 9.079x10-4 m2
Pressure Intensity (P): P = load = 42700
Area 9.079x 10-4 = 470.30561N/m 2
Head Corresponding to the above Pressure Intensity,
H = P. = 470.30561x105
Density x g 1000x 9.81 = 4794.14 m of water
Power = PgQH /1000
=1000x9.81x0.000188x4794.14 1000
= 8.8417kW

B. Design of Shaft

Torque transmitted by shaft

$$T = \frac{P \times 60}{2\pi N}$$

P = 4000W
N = 3600 rpm

$$= \frac{4000 \times 60}{2 \times \pi \times 3600}$$

= 10.60 N-m
We know that, Torque transmitted by shaft is

$$T = \frac{\pi}{16} \times \tau \times d^3$$

Assume, τ = 42 MPa

$$10.60 \times 10^3 = \frac{\pi}{16} \times 42 \times d^3$$

d= 10.87 mm
Taking FOS = 3
d = 10.87 × 3
= 32.61 mm
Taking higher value, d = 35mm
Assume length of shaft = 200 mm

C. Design of Spring

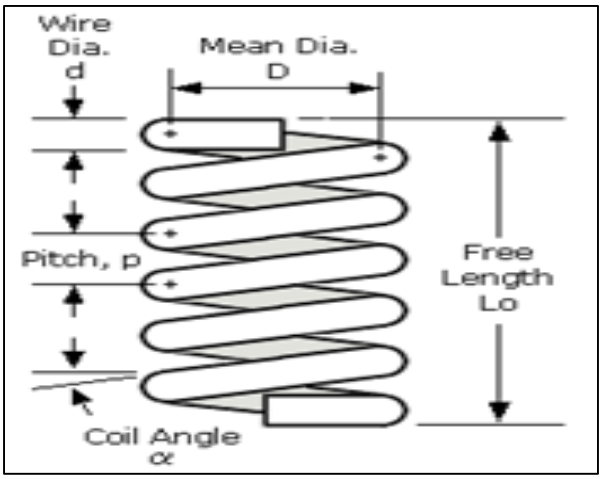


Fig. 2: Compression Spring Profile

Designed data for springs are as follows
Diameter of wire (d) = 30mm
Mean diameter of coil (D) = 150mm

Spring Index (C) = $\frac{D}{d}$= $\frac{15}{3}$ = 5
Assuming Carbon steel material of spring
Modulus of rigidity (G) = 80GPa
Modulus of Elasticity (E) = 210GPa
For Severe service condition, Maximum allowable shear stress in the material is
τ = 224 GPa
Depending upon the above said limit, it is possible to calculate the Maximum load can spring handle before failure by following formula

$\tau = \frac{k_s \text{ X } 8WD}{\pi d^3}$

Where Ks = Shear stress Factor

$Ks = 1+\frac{1}{2C}$

$= 1 + \frac{1}{2X5}$

Ks = 1.1

Therefore, $\tau = 1.1\frac{8WX150}{\pi X30^3}$

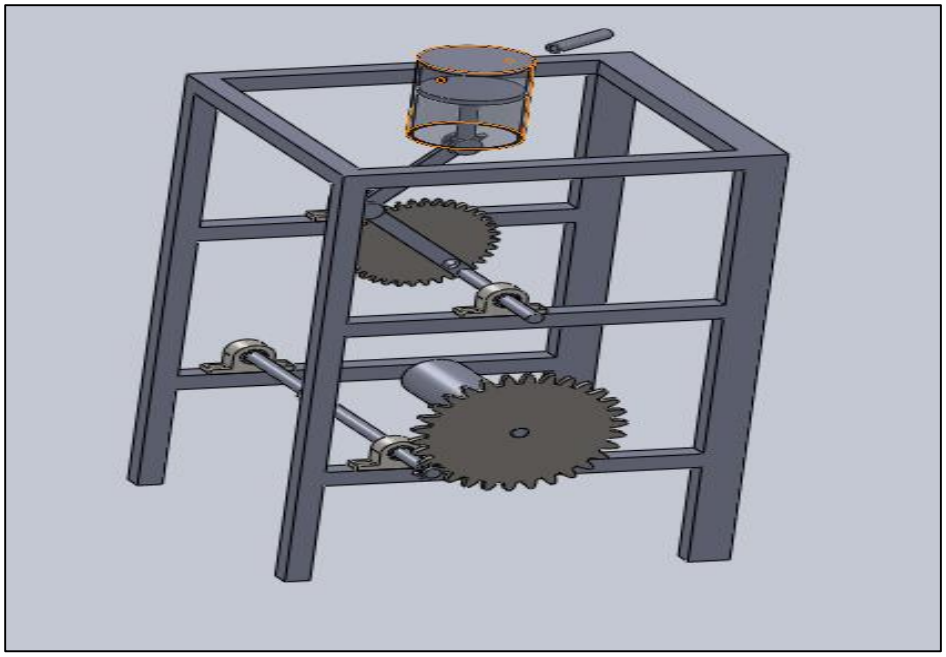
W= 14396.07N
Deflection in the spring is given by

$\delta = \frac{8wD^3\eta}{Gd^4}$

$= \frac{8X14396.07X150^3X15}{80000X30^4}$

δ = 89.98mm
It shows that springs are designed to carry load up to 1440kg in one stroke of vehicle on railway track.

IV. 3D MODELLING OF MECHANISM BY USING SOLID WORKS



V. PROBLEM DEFINING

The concept of electricity generation using railway track was first defined by using rack and pinion mechanism. But the problem listed in the following were as follows:

1) As number of contact pair increases these leads to friction losses
2) Not recommended for long life of the system
3) Also more wear and tear and maintenance required

Also the problems were faced with the reliability.

So these problems were resolved using hydraulic press concept using two double acting hydraulic cylinders to obtain sustainable output from the system. We also reduced number of contact members.
Also four bar chain mechanism is used to convert sliding motion into rotary motion. Which would more efficiently transmit the energy.

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VI. RESULT

These new design leads to more generation of electricity. And also it is more optimum and reliable in usage. The compact design of the structure leads to its easy and compatible mounting wherever required. Also less number of contact pairs leads to less frictional forces developed. These will lead to non-conventional energy generation which would further be used in the nearby railway infra-structure.

VII. CONCLUSION

This is actually a process, an evolution of the electricity network for generation in a way that is interactive, flexible and efficient. While considering cities with Major railway connectivity with an average of 12 railway passing per hour. Hence large amount of mechanical energy is obtained. Future aim of the research is to develop our country by enriching it in utilizing its sources in more useful manner for rail road as well as domestic applications. There is an ever increasing demand for energy in spite of rising prices of oil and other fossils fuels. So this concept will help to enhance more power generation. “GENERATION OF ELECTRICITY USING RAILWAY TRACK” is a green, clean and cheap readily available energy source. As law of energy “Energy can neither be created nor be destroyed, it can be converted from one from to another form” hence conversion of mechanical energy into electrical energy is the idea behind the project.

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