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Study on Energy Production from Train Suspension

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Abstract:
In order to reduce the loss of vibrational energy from train suspension, our work aims at converting that vibrational energy in to electrical energy which can be used to lighten the lamps, fans etc in each compartment. So it is an effective method to conserve energy. The suspension consists of a spring attached to the base plate and it is connected to a magnetic rod which reciprocates inside an armature coil. The output, we use a rectifier to convert the AC in to DC and to eliminate fluctuation and this energy is stored in a battery through a filter capacitor. From the stored energy we can lighten lamps, fans etc. we can produce 4V power supply manually from our prototype. And by fixing it in train & increasing the no of magnets, we can produce much higher power. In this project work involve, the comparing of power that required in one bogie with the power obtained from the suspension by electromagnetic induction.

Keywords: Electromagnetic induction, Suspension

1. INTRODUCTION

Now a day's energy conservation has become more important. Our works aims at conversion of vibrational energy from train suspension into useful electrical energy. We made a small prototype based on electromagnetic induction principle. But actually in a train suspension has heavy force so much higher energy can be obtained. We are actually comparing totally energy required to run fan, lights in a compartment to the energy we get from suspension. By fixing this each suspension of a bogie , we get useful energy and our aim is to eliminate the wastage of energy. The train suspension consists of primary and secondary suspension. Primary suspension consists of spring and damper. primary suspension is placed between axlebox and bogie. Secondary suspension systems are located between the bogie and the carbody. They are used to bear the carbody and allow the bogie to rotate when the rail vehicle negotiates bends.

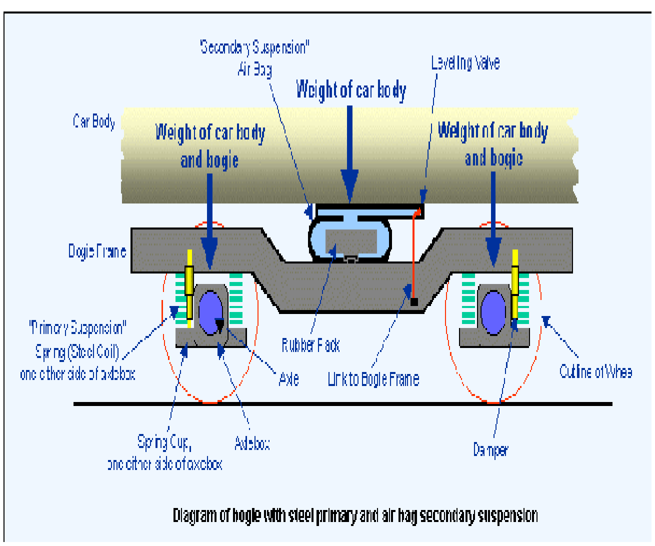


Figure.1. Train Suspension

Technical writing is writing that is done for the purpose of educating, informing or directing someone on how to do something. Technical writing is significantly different than other types of writing such as narrative, because technical writing is intended to impart to the reader some specific skill or ability. Technical writing isn't for everyone. It is often very detail-oriented and usually involves writing within fields where some advanced knowledge is required. When given a technical writing assignment, it also must be approached in a certain way in order for you to be successful. We suggest you just use this document as your guide and simply cut and paste your text over the material in this document.

2. LITERATURE REVIEW

(1) Failure Investigation of a Freight Locomotive Suspension Spring and Redesign of the spring for Durability and ride index

Priyanka ghate , Dr shankapal s, Sas tech journal 2012

In the present work, an attempt has been made to analyze in detail the reason for failure and a single non linear spring has been suggested to improve durability of the primary suspension and in the meantime the required ride index. Failure of the composite spring assembly was analyzed by applying the forces obtained from dynamic analysis. The dynamic analysis was performed using ADAMS/Rail at four different velocities and three different track conditions. The critical loading condition was achieved at a hunting speed of 132km/h on a curved track. A single spring set was considered in ADAMS/View to perform stress analysis to know durability. It is concluded that the new spring design can enhance durability and ride index.

(2) Railway Carriage Model to Study the Influence of Vertical Secondary Stiffness on Ride Comfort of Railway Carbody Running on Curved Tracks

Kalim H Ali, Prof R.A Khan , modern applied science 2011

A mathematical model of a railway carriage running on curved tracks is constructed by deriving the equations of motion concerning the model in which single-point and two-point wheel-rail contact is considered. The presented railway carriage model comprises of front and rear simple conventional bogies with two leading and trailing wheelets attached to each bogie. The railway carriage is modeled by 31 degrees of freedom which govern vertical displacement, lateral displacement, roll angle and yaw angle dynamic response of wheelset whereas vertical displacement, lateral displacement, roll angle, pitch angle and yaw angle dynamic response of carbody and each of the two bogies. Linear stiffness and damping parameters of longitudinal, lateral and vertical primary and secondary suspensions are provided to the railway carriage model. Combination of linear Kalker's theory and nonlinear Heuristic model is adopted to calculate the creep forces in which introduced at wheel and rail contact patch area.

(3) Design and analysis of a shock absorber

Sujeet Kumar, Jay Jayram Kumar, Atul Pandey IJARIIE Vol ,2016

. When a vehicle is traveling on a level road and the wheels strike a bump, the spring is compressed quickly. The compressed spring will attempt to return to its normal loaded length and, in so doing, will rebound past its normal height, causing the body to be lifted. The weight of the vehicle will then push the spring down below its normal loaded height. This, in turn, causes the spring to rebound again. This bouncing process is repeated over and over, a little less each time, until the up-and-down movement finally stops. If bouncing is allowed to go uncontrolled, it will not only cause an uncomfortable ride but will make handling of the vehicle very difficult. The design of spring in suspension system is very important. In this project a shock absorber is designed and a 3D model is created using Pro/Engineer. The model is also changed by changing the thickness of the spring. Structural analysis and modal analysis are done on the shock absorber by varying material for spring, Spring Steel and Beryllium Copper. The analysis is done by considering loads, bike weight, single person and 2 persons. Structural analysis is done to validate the strength and modal analysis is done to determine the displacements for different frequencies for number of modes. Comparison is done for two materials to verify best material for spring in Shock absorber.

3. METHODOLOGY

The movement of train suspension occurs sharply taking a turn , crossing the rails etc. So this movement creates a vibrational energy in the train suspension. This energy can be converted into useful electrical energy using electromagnetic induction. The up and down motion of the suspension is in to to and fro motion motion of magnet. The magnet is placed above armature coil which cut the magnetic flux and induce an emf. This can be stored in a battery.

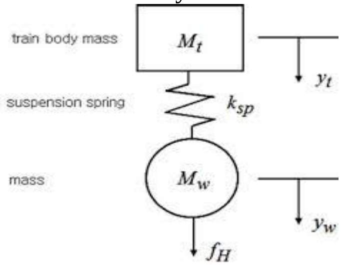


Figure.2. Free body diagram

Figure.3. Working Prototype

4. RESULTS AND DISCUSSION

4.1 Calculations of energy production from train suspension

Bogie/truck weight =236567N (3)

Transmissibility.

$$T=\frac{F_T}{F_o}=\frac{\sqrt{1+\left(2\zeta\frac{\omega}{\omega_n}\right)^2}}{\sqrt{\left[1-\left(\frac{\omega}{\omega_n}\right)^2\right]^2+\left(2\zeta\frac{\omega}{\omega_n}\right)^2}}$$

=1.22/1.065

=1.148

Ft =1.148*12057

Ft =13841.94N

Power produced = Tω

= F*r*2*π*f

= 13841.94*0.0952*2*π*26.5

=300w

4.2 Power consumption in a bogie

Compressor unit = 17KVA

Condensor unit = 0.75KW

Evaporator unit = 0.8KW

Water pump unit = 0.2KW

Water boiler = 2KW

Refrigerating unit = 0.8KW

Coach lighting

Fluoroscent lamp = 0.018KW

Incandescent lamp = 0.010KW

Halogen lamp = 0 .010KW

Total power is around = 25KW per coaches

For lights and fans = 828W

4.3 Technical specification of spring

Parameters	Units	**Value**
Wire diameter	mm	44
Coil diameter	mm	191
No of turns	mm	11
Stiffness	mm	549
Deflection	mm	121
Modulus of rigidity	N/mm2	78600
Free Height	mm	705.6

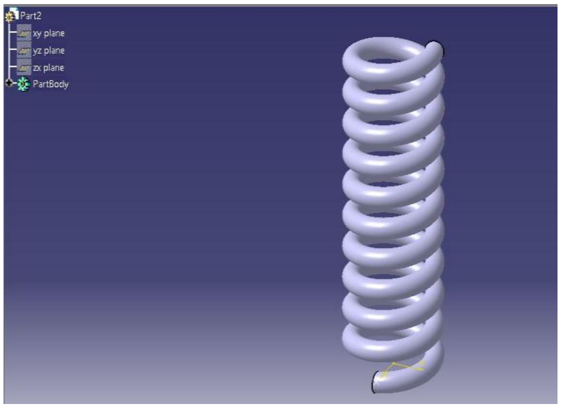


Figure.3. Cad drawing of Spring

4.4 Prototype Specifications

Spring diameter	8mm
Armature coil turns	285
Magnet diameter	8mm
Capacitor	220µf
Lead acid battery	12v
Resistor	IN4001A

4.5 Calculation of model tested

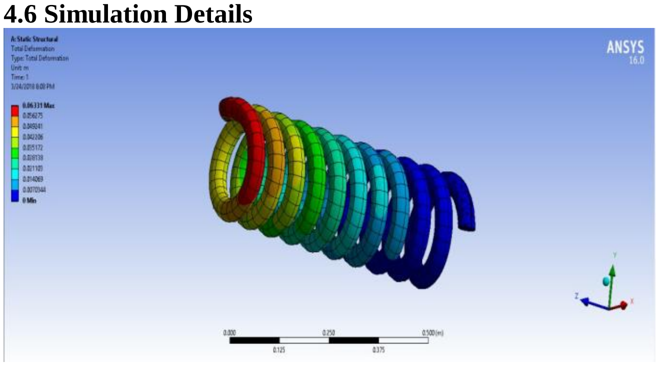
By measuring using a voltmeter we get the induced emf is around 4v.
According to electromagnetic induction

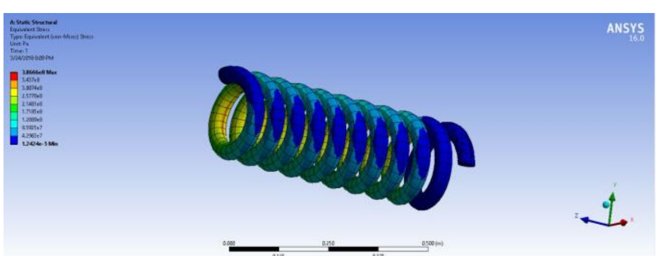
$E=N d\varphi/dt$

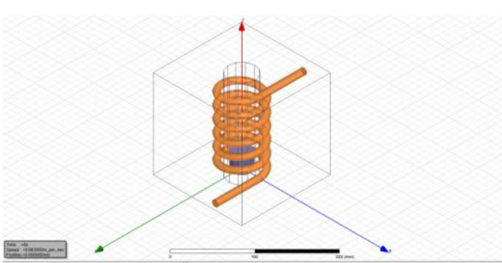
$4=585 d\phi/dt$

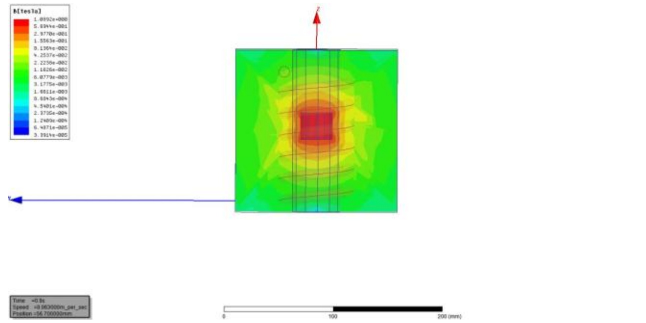
$d\phi/dt=0.00683$wb.

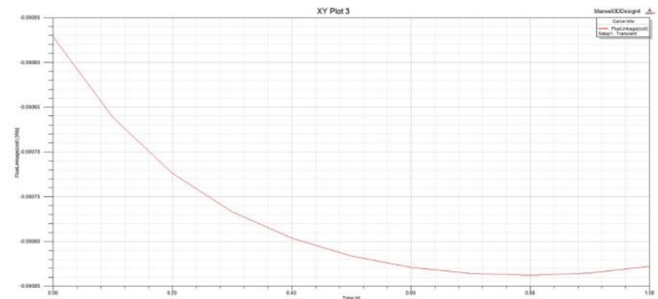
4.6 Simulation Details

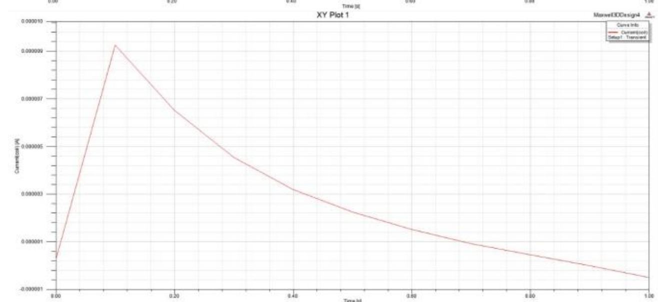












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5. CONCLUSION

Energy conservation is very important. The project was aimed at converting the wasteful energy of suspension into useful electrical energy. The maximum energy needed to run lights and fans is 828W and we get is 300W. So this much energy can be effectively utilized.

6. ACKNOWLEDGMENT

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