

Magnetic Suspension System for Two Wheeler

Shende Vignesh¹, Nimbalkar Hrishikesh³, Pawar Sanjay⁴, Thorat Vijay², Raut P.S⁵

¹²³⁴B.E Student College Of Engineering Indapur, Vangali, 413106

Abstract: This project is based on suspension system of an two wheeler. This report gives information about magnetic suspension system. The aim of this project is to study and investigate the response of system, when it is subjected to road surface irregularities with the hope that it would help automobile industry. This project presents design, construction and working of magnetic suspension system. This system uses electromagnets as passive dampers, which is used to reduce displacement and acceleration of sprung mass in order to improve ride comfort. By using this type of absorber we can absorb the more number of shocks and variations are absorbed with the more accuracy. This type of Suspension has no problem of leakage of oil like hydraulic shock absorber. Also this has less maintenance than other types of shock absorber that we can made this type of shock absorber for the efficient work of vehicle and for reducing the maintained cost of vehicle.

Keywords: Magnets, Coil Spring, Design Parameter.

1. INTRODUCTION

We made a model of the Magnetic Shock Absorber which is mainly based on the application of magnetic property like when the same poles of two magnets come in contact with each other then they are repulsed from each other. This unit is mounted in vehicle such as other type of shock absorber. The working of this absorber is very simple. Two magnets are mounted in this way that one is mounted below and other is on upper side. Poles of these magnets are same at inner side so that they are repulsed from each other and space is made between them due to this. When the vehicle is running on the bump or the muddy road then the space between two magnets is reduced and then shocks and variations present in the vehicle absorbed by repulsion property of the magnet.

The automobile chassis is mounted on the axles not direct but through form of springs. This is done to isolate the vehicle body from the road shock which may be in the form of bounce pitch, roll or sway. These tendencies give rise to on the uncomfortable ride and also cause additional stress in the automobile frame & body. All the part which performs the function of isolating the automobile from the road shocks are collectively called a Suspension System. It includes the springing device used & various mounting for the same. Broadly speaking, suspension system consist of a spring & damper. The energy of road shock cause the spring to oscillate. The oscillations are restricted to a reasonable level by the damper, which more commonly called a Shock Absorber.

Objectives:

- To prevent the road shocks from being transmitted to the vehicle Components.
- To safeguard the occupants of vehicle from road shocks.
- To preserve the stability of the vehicles in pitching or rolling while in motion.
- To reduce the maintenance as well as initial cost.
- To increase the life of coil spring.
- To reduce the overall cost and weight of the vehicle.

- To prevents the vehicle body and frame from road shocks.
- To gives the good road holding while driving, cornering and braking.
- To gives cushioning effect.

2. LITERATURE SURVEY

S. Gopinath , R.J. Golden Renjith , J.Dineshkumar In this project two magnets are placed in a piston. One magnet is fixed with piston. Another one is movable, which is connected with rod. With magnets are replaced by air. Our magnetic shock absorber works on the basic principle of magnet that “opposite poles attract each other and same poles repel each other”. In this both magnets are facing same poles (both magnets are placed facing north and north or south and south). Both magnets are same pole. When the rod moves inside the piston movable magnet move towards the fixed magnet. Since both magnets are of same pole repulsion force is created between the magnets. So the movable magnet opposes the rod action and moves the rod up. The piston or cylinder is made up of non-magnetic material.

V.V.Borole, prof. K.K.Chaudhari are studied and describe the Electromagnetic suspension system for automobile and study different way to recover energy from suspension system by using piezo electric material to increase the efficiency of the automobile. Vehicle during running condition vibrate by means suspension operate by using motion of the shock absorber produce energy.

Chandrakant Chavan, 2G.M.Kakandikar, 3Swapnil S. Kulkarni. describe about the analysis of suspension spring to determine and it's fatigue life using finite element methodology. One of the most important part of the susp[ension syatem is the coi spring which are helical in shape steel bar that absorb the shock

Sushant Tandel, Bhagyesh Desai, Amit Desai, Amol Shirsat, and Dipak Tambe They describe about the design and fabrication of magnetic suspension system. According to authors of these papers the coil spring suspension system have imitation that after some period of time coils become not only harder but also reducing cushioning effect and these limitation overcome by the new concept of “MAGNETIC SUSPENSION SYSTEM” the cushioning effect provided by these system existing long life. They select material by considering Mechanical properties.

Suvriti Dhawan¹, Ravi Nandu² studied and describes the disadvantages of other types of suspension system with magnetic suspension the material properties used for the magnet, coil spring, shaft according to author the magnetic system have more and more advantages than the air, hydraulic suspension. The hydraulic and air suspension have leakage problem and which is dangerous for any suspension system because of that big reason magnetic suspension system were used.

Difference between Magnetic Shock Absorber and Spring Shock Absorber:

Sr. No.	Magnetic Shock Absorber	Spring Shock Absorber
1	It has more life	It has less life
2	Life is nearly about approximately 20 years	Life is nearly about approximately 10 years
3	The weight of magnet is more	The weight of spring is low as compared to magnets
4	If the power of magnets decreases then it is possible to recharge and it able to use again and again	Its strength at spring is decreased or loss it is necessary to replace it new one
5	It has very low maintenance	It ha s more maintenance

Working Principle of Conventional Shock absorber:

Shock absorber device was used for reducing the effect of sudden shock by the dissipation at the shock's energy on an automobile springs & shock absorber are mounted between the wheels and the frame. When the wheel hit a hole or a raised spot on a road. The spring's absorber the resultant shock by expanding & contracting. To prevent the spring from shacking the frame excessively, their motion is restrained by shock absorber, which are also known by the more descriptive term dumpers.

Working Principle Of Magnetic Suspension System:

Magnetic Shock Absorber which is mainly based on the principle of magnetic property like when the same poles of two magnets come in contact with each other then they are repulsed from each other. This unit is mounted in vehicle such as other type of shock absorber. The working of this absorber is very simple. Two magnets are mounted in this way that one is mounted below and other is on upper side. Poles of these magnets are same at inner side so that they are repulsed from each other and space is made between them due to this. When the vehicle is running on the bump or the muddy road then the space between two magnets is reduced and then shocks and variations present in the vehicle absorbed by repulsion property of the magnet. By using this type of absorber we can absorb the more number of shocks and variations are absorbed with the more accuracy. This shock absorber has no problem of leakage of oil like hydraulic shock absorber. Also this has less maintenance than other types of shock absorber. So that we can made this type of shock absorber for the efficient work of vehicle and for reducing the maintained cost of vehicle.

3. DESIGN OF MAIN SPRING

The spring is mounted in between two magnets to avoid impact of magnets. The outer diameter of spring can be selected considering the clearance between casing diameter and spring which avoid jam of spring. Outer diameter of spring,

$$D_o = 40 \text{ mm}$$

As per design data book for cold drawn wire steel

wire diameter,

$$d = 5 \text{ mm},$$

Inner diameter of spring,

$$D_i = 40 - 10 = 30 \text{ mm}$$

Calculating the load bearing capacity of spring For any service life,

$$\text{Shear stress} = 0.5 S_{ut} = 0.5 \times 1190 = 595 \text{ N/mm}^2$$

$$\text{Spring index } C = D_o/d = 40/5 = 8$$

$$C = 8$$

Then Wahl factor of spring,

$$K = \frac{4C-1}{(4C-4)+0.615/C}$$

For $C = 8$

$$K = 1.18$$

Now to Find load holding by spring P,

$$\text{Shear stress} = k(8PC/(d^2))$$

$$P = 618.47 \text{ N}$$

Thus spring hold the load of 708.54 N remaining load is absorbed by magnet.

Deflection of spring (δ) can calculate by,

$$\delta = \frac{8PD^3N}{Gd^4}$$

$$\delta = 56.04 \text{ mm}$$

$$\text{Spring rate} = P/\delta = 11 \text{ N/mm}$$

$$\text{Spring stiffness} = K = 11 \text{ N/mm}$$

$$\text{Number of turns} = N = 9$$

As spring has square and ground ends number of Inactive turns = 2

Total number of turn,

$$NT = N + 2$$

$$= 9 + 2$$

$$= 11$$

Solid length of spring,

$$L_s = NT d$$

$$= 115$$

$$= 55\text{mm}$$

Free length of spring,

$L_f = \text{solid length} + \text{deflection} + \text{axial gap}$

$$= 55 + 56 + 0.15(56)$$

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$$L_f = 120\text{mm}$$

Pitch of spring = L_f/N

$$\text{Pitch of spring} = 13.33\text{mm}$$

Design of Magnet:

Power Magnet Pair = **10,000GP** (Gauss Power) Weight Vehicle Body = 110kg = 1080N

Weight Of Person Setting On Vehicle = 140kg = 1374N

Total Load = Weight Vehicle Body + Weight Of Person Setting On Vehicle

$$= 1080 + 1374$$

Total Load = 1080 + 1374

$$= 2454 \text{ N}$$

Rear Suspension = 65percentage 2454

$$= 1595.1 \text{ N}$$

Considering Dynamic Loads Double(W) = 1595.12

$$= 3190.2 \text{ N}$$

For Single Shock Absorber Weight(W/2) = 3190.1/2 = 1595.1 N

Taking Factor Of Safety = 1.2

So Design Load = 1914.92N

Magnetic Power Per Unit Area = 2N/mm²

So Area Required For Suspension Of 300kg load

$$2 = 1914.12 = A$$

$$A = 957.06\text{mm}^2$$

$$A = 4d^2$$

$$957.06 = 4d^2$$

$$d = 34:90\text{mm}35\text{mm}$$

$$d = 35\text{mm}$$

Diameter of magnet = 35mm

Design of shaft

The shaft is subjected to pure bending stress

$$\text{Design force} = 1914.12 \text{ N}$$

$$\text{Bending length} = 165 \text{ mm}$$

$$\text{Bending moment} = F L$$

$$= 1914.12 \cdot 165$$

$$= 315829.8 \text{ N-mm } M = \frac{32 F(b)d^3}{3}$$

$$315829.8 = 32599.13d^3$$

$$d = 18\text{mm}$$

Design of hollow shaft:

$$M = F(b)l$$

$$M = 1914:12200$$

$$M = 382824\text{N} \square \text{ mm}$$

$$M = \frac{32F(b)d_o^3(1-k^4)}{3}$$

$$382824 = \frac{32F(b)873(10:894)}{3}$$

$$F(b) = 15:893\text{N}=\text{mm}^2$$

$$F(b) = 20 < 35\text{N}=\text{mm}^2$$

As induced stress is less than allowable stress the design of hollow cylinder is safe

4. FUTURE SCOPE

It is possible to do make modification in the magnetic shock absorber some of them are explained below:-

- 1) If the coils are fitted at the outer side of magnet then it is possible to generate electricity which is possible to use for head lamp or for battery charging.
- 2) If electric magnets are fitted in front of wheel & back, it will possible to give protection to vehicle by puncture down by iron metals.
- 3) If a path of electro magnet make and the magnet connected at down side of vehicle then it is possible to drive vehicle without energy and due to this there is no pollution.

5. CONCLUSION

This project has provided us an excellent opportunity and experience to use our limited knowledge. We gained a lot of practical knowledge regarding planning, purchasing assembling and machining while doing our project work. We feel that the project work is a good solution to bridge the gate between institution and industries. We are proud that we have completed the work with the limited time successfully. The MAGNETIC SUSPENSION SYSTEM is working well. We are also able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression on project work. Thus we have developed a MAGNETIC SUSPENSION SYSTEM which helps to know how to achieve low cost and minimize the size.

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