

# Implementation of Electro Magnetic Suspension in Automobile Application

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## ABSTRACT:

This project aims at design and fabrication of a combined form of electromagnetic suspension in two wheeler instead of using normal suspension for better ride and comfort. Electromagnetic suspension is the magnetic levitation of an object achieved by constantly altering the strength of a magnetic field produced by electromagnets using a feedback loop. In most cases the levitation effect is mostly due to permanent magnets as they don't have any power dissipation, with electromagnets only used to stabilize the effect. Suspension is a mechanical arrangement contributing to vehicle's road handling behavior. If roads were perfectly flat with no irregularities, suspensions wouldn't be necessary. It's these imperfections that apply force to the wheels. There are many types of suspensions such as double wish bone, trailing arm and air shocks. But these suspensions possess some disadvantages such as vibration, mechanical failure and stiffness vibration. So, in this project we have introduced the idea of 'ELECTRO MAGNETIC SUSPENSION' which will enhance the driving pleasure and control over road. Electromagnetic suspension will allow us to get variable stiffness and much higher comfort just by playing with magnetic field. It will also allow us to wear and tear along with less maintenance. The magnetic power which is produced by electro magnets using a feedback loop.

**Keywords:** Electromagnetic suspension, Damper Test, shock absorber

## I. INTRODUCTION

Motor cycles are an integral part of society, and a growing trend in developed countries due to climate change considerations (Urban Independence, 2017). Suspension systems are found on cross-country, downhill and mountain bikes with varying functionality. Suspension technology on motor cycles has evolved from seats with suspension springs in the 1900's to the many complex designs of modern motorcycles. The

competitive world has substantial research and development funding in suspension design. Motorcycle designers have recently started adding electrically controlled components including drive systems and gearing. (Charles R Goulding, 2017).Hydraulic damping is a common design in motorcycle suspension systems and works by forcing a viscous fluid through a valve or small gap in a plunger connecting the frame to the wheel, this provides a force opposite to the direction of motion, slowing the rate of motion of the suspension.The automotive industry is currently producing cars with electromagnetic magnetorheological (MR) suspension systems, resulting in superior ride quality and control. Magnetorheological suspension involves increasing damper oil viscosity by adding ferrous particles to the oil and applying a magnetic field to align the particles, slowing the flow rate of the oil and increasing oil viscosity in proportion to strength of the electric field (Auto evolution, 2009).

## II. CONCEPTUAL DESIGN

Computer aided design software is used for the drawing of the energy regenerative suspension system. This is to ensure that the component can be fabricated with accurate dimension. Accurate dimension helps the component of the electro magnetic suspension can be assembled together. Several concepts are designed on the CAD software and only one concept is chose for the fabrication. Material used for each of the part is different depending on the part function. The suspension designed is retrofit which does not disturb the present vehicle suspension suspension system. It is also functions automatically without any other power source so that the suspension can give out maximum electrical generation for the vehicle usage.

### III. COMPONENTS DESCRIPTION

#### 3.1. Frame structure

It is just to support the shock absorber arrangement. The whole parts are fixed in to this frame stand with suitable arrangement. It is made up of hollow MS pipes which are cut and welded at desired positions. It is a supporting frame for suspension which is made up of MS steels which is designed like three wheeler vehicle which consists of three wheels.

Supporting frame can be used with frame motor to move smaller structures and even build airships or similar or moving machines. They can be used to create contraptions such as bridges. Note that when joined to a block that is being blocked in any way by another block, the frame motor won't be able to move them.

To stop this place a cover of any kind and the support frame will then 'ignore' that side. Also you can transport items via support frames- any block touching the support frame would be moved, except other frame motors with their moving side touching the support frame itself or any red power machine facing the support frame.



Fig.1 Frame structure

#### 3.2 Cylinder

A cylinder is the central working part of space in which a piston travels. It has two heads. The top head accommodate the electromagnetic coil and core, which will produce the repulsive force when excited. At the top head its just bored to increase diameter, that will help to accommodate the electromagnet. Connection to the coil is passed through the top hole that is drilled at the top. The material of cylinder is usually mild steel, due to easy for machining.



Fig.2 Cylinder

#### 3.3 Piston

The piston is a cylindrical member of certain length which reciprocates inside the cylinder. The diameter of the piston is slightly less than that of the cylinder bore diameter and it is fitted to the top of the piston rod. It is one of the important part which converts the pressure energy into repulsive force in this shock absorber. The piston is equipped with a ring suitably proportioned and it is relatively soft rubber which is capable of providing good sealing with low friction at the operating pressure. The purpose of piston is to provide means of conveying the pressure.



Fig.3 Piston

### IV. WORKING PROCESS

Magnetic Suspension or magnetic ride control is a type of suspension system where the shock absorbers reacts to the road and adjusts much faster than regular absorbers. Magnetic suspension can adapt to uneven road surfaces several hundred times per second, in fact it takes only a few milliseconds to adjust any one of the shock absorbers. Magnetic suspension is described as the fastest reacting suspension in the world as sensors monitor the road surface up to 1000 times per second and an ECU can make variations within a few milliseconds resulting in the possibility of multiple damping variations being made in a second. Magnetic ride control uses a system known as magneto rheological technology for suspension damping. This ensures a comfortable ride along

various road surfaces. Magnetic suspension reduces vibrations, bouncing, noise and body roll very effectively on all road surfaces and at any speed that the vehicle could travel. The reduction of body roll may reduce the need for anti-roll bars. Another benefit is that these dampers easily offers the best of both worlds in the ride comfort/handling compromise that many other suspension systems are subjected to. Although this type of suspension offers a very comfortable ride, sport settings can be applied or tuned into the system to cater for performance vehicles. 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.



Fig.4 Assembly of electromagnetic suspension

## V. MRF TESTING

MRF Testing An experiment to test the ability of the MRF to alter viscosity in a magnetic field was conducted. An experimental setup was designed to test the time required for the fluid to run down a surface. A permanent magnet created a magnetic field behind the surface. The field intensity was controlled by the proximity of the magnet to the experimental fluid, without the surface in the clamp.



Fig.5 MRF Experimental setup

## VI. DAMPER TEST

In order to test the final MR Damper design an experiment was conducted to record and analyze the free response of the suspension at different currents in the electromagnet. The displacement of the suspension was measured using a Linear Variable Displacement Transducer (LVDT). The main objective of the experiment was to determine whether the damping increased with an increase in current, indicating that the design functioned as expected. The secondary objective was to determine the current-damping relationship for future control system designs.

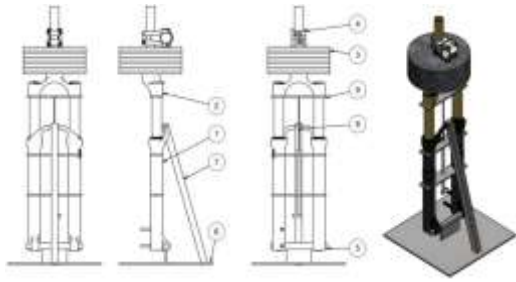


Fig.6 MRF Suspension experimental design

## VII. CONCLUSION

This project work 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 this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed the work with the limited time successfully. The ELECTROMAGNETIC SUSPENSION SYSTEM is working with satisfactory conditions. We are 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 project work. Thus we have developed a “ELECTRO-MAGNETIC SUSPENSION SYSTEM” which helps to know how to achieve smooth suspension system. The application of this system is high when compared to the cost. By using more techniques, they can be modified and developed according to the applications. This project is an experimental effort to demonstrate a new type of Electromagnetic suspension system using a solenoid coil.

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