

EM-POWERD SUSPENSION SYSTEM FOR MONOSHOCK ABSORBER VEHICLE

Hareesh H¹, Fahad M F², Dhiraj Nayona³, Govind M⁴, Prof. Pradeep P D⁵

B-TECH Student, Dept. of Mechanical Engg. KMEA Engineering college, Ernakulam, Kerala, India.¹

B-TECH Student, Dept. of Mechanical Engg. KMEA Engineering college, Ernakulam, Kerala, India.²

B-TECH Student, Dept. of Mechanical Engg. KMEA Engineering college, Ernakulam, Kerala, India.³

B-TECH Student, Dept. of Mechanical Engg. KMEA Engineering college, Ernakulam, Kerala, India.⁴

Professor, Dept. of Mechanical Engg. KMEA Engineering college, Ernakulam, Kerala, India.⁵

ABSTRACT

Electromagnetic Shock Absorber which is mainly based on the principle of magnetic property like when the same poles of two electromagnets 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 electromagnets are mounted in this way that one is mounted below and other is on upper side. Poles of these electromagnets 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 electromagnets is reduced and then shocks and variations present in the vehicle are absorbed by repulsion property of the electromagnet. By using this type of absorber we can absorb the more number of shocks and variations 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 absorbers. We can make this type of shock absorber for the efficient work of vehicle and for reducing the maintenance cost of vehicle

Key words:- *Electromagnetic suspension, Shock absorber, Electromagnet, Microcontroller unit.*

1. INTRODUCTION

The past few decades has witnessed the evolution of automobile technologies that all intended to promote the experience and comfort of the human beings. The transportation has become the integral part of our daily activities. When the people got tired of walking, they shifted to bikes. When they tired of bikes, they shifted to cars and so on. All that matters for the people is their level of comfort.

But in present scenario, the road conditions are not favorable for people who prefers comfort. The potholes, difference in road levels, improper tarring etc causes discomfort to the passengers and also damages the vehicle. The accidents due to potholes and improper tarring has been increased in our country. So many people has lost their lives on those roads. Those road conditions also causes damage to the vehicle which increases its maintenance cost. The automobile suspension becomes relevant in these situations.

For an automobile, its suspension system keeps a vital role in ensuring the comfort of the passengers inside and also it also makes the vehicle stable in different road conditions. Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality, which are at odds with each other. The components of the suspension system perform six basic functions: Maintain correct vehicle ride

height, Reduce the effect of shock forces, Maintain correct wheel alignment, Support vehicle weight, Keep the tires in contact with the road and Control the vehicle's direction of travel. The suspension system is the shock absorbent system that a vehicle has. It is designed to smoothen the ride and increase the life of the vehicle.

Here, we are using electromagnets in the suspension system by increasing the number of wavy actions of suspension to avoid accidental jerks and guts. In case of speed bumps and potholes an electromagnetic suspension will be very helpful and reliable. When comparing to other suspension, it is very long lasting and reduce the effect of shock forces.

When a changing current passes through a wire, an electromagnetic field around that wire is generated. Two electromagnets with good strength and durability is used. When the current through the wire stops changing, so does the previously generated magnetic field. The strength of the generated electromagnetic field is proportional to the rate of change in current through the wire. When a wire is coiled, this generated electromagnetic field is concentrated through the center of the coil. The strength of this field can be greatly increased by placing another electromagnet material in the center of the coil. Although a continuous change of electric current is required to maintain a magnetic field in an electromagnet, this field is easily manipulated by passing a varying current, such as AC current, in the wire. Therefore, electromagnets are much more practical than permanent magnets for levitation purposes. To reduce average power requirements, often the electromagnetic suspension is used only to stabilize the levitation, and the static lift against gravity is provided by a electromagnet system. Electromagnetic suspension reduces vibrations, bouncing, noise and body roll very effectively on all road surfaces and at any speed that the vehicle could travel.

2. LITERATURE REVIEW

2.1. REVIEW ON DESIGN AND FABRICATION OF MAGNETIC SUSPENSION - In conventional system hydraulic damper is used for damping purpose, in this system same magnetic poles follows same function that means here the damper and oil cost is eliminated due to that overall cost of the system is reduced. In this work spring is inside the cylinder so that there is no contact with dust particle, moisture of atmosphere, hence corrosion is reduced and spring life is increased. In this study magnetic suspension system and their types are discussed. As we have seen the magnetic suspension is a revolutionary idea which will provide a comfortable ride by minimizing the vibrations and other factors. It would also allow to set the suspension stiffness as per requirement. Thereby magnetic suspension will be a best substitute for current problems and providing ultimate vehicle dynamics.

2.2. DESIGN AND FABRICATION OF MAGNETIC SHOCK ABSORBER - This system has provided us an excellent opportunity and experience to use our limited knowledge. And gained a lot of practical knowledge regarding planning, purchasing assembling and machining while doing our project work. The MAGNETIC SHOCK ABSORBER is working well. We are also able to understand the difficulties in maintaining the tolerances and also quality.

2.3. MAGNETIC SUSPENSION IN AUTOMOBILES - The magnetic suspension is a revolutionary idea which will provide a comfortable ride by minimizing the vibrations and other factors. It would also allow to set the suspension stiffness as per requirement. Thereby magnetic suspension will be a best substitute for current problems and providing ultimate vehicle dynamics.

2.4. FINITE ELEMENT ANALYSIS OF HELICAL COMPRESSION SPRING FOR TWO WHEELER AUTOMATIVE FRONT SUSPENSION - The equivalent stress of chrome vanadium steel spring has more with compare to Stainless steel spring. The deflection pattern of the chrome vanadium steel spring less at specified weight with compare to the Stainless steel spring. It is observed that 95% of the similarity in deflection pattern and 97% similarity in stress pattern between Theoretical values to the analytical values. Helical Compression Spring possesses less deformation and more stresses when compared with different material.

3. PROPOSED MODEL AND WORKING

Electromagnetic Shock Absorber which is mainly based on the principle of electromagnetic 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 electromagnets are mounted in this way that one is mounted below and other is on upper side. Poles of these electromagnets 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 electromagnets is reduced and then shocks and variations present in the vehicle absorbed by repulsion property of the electromagnet.

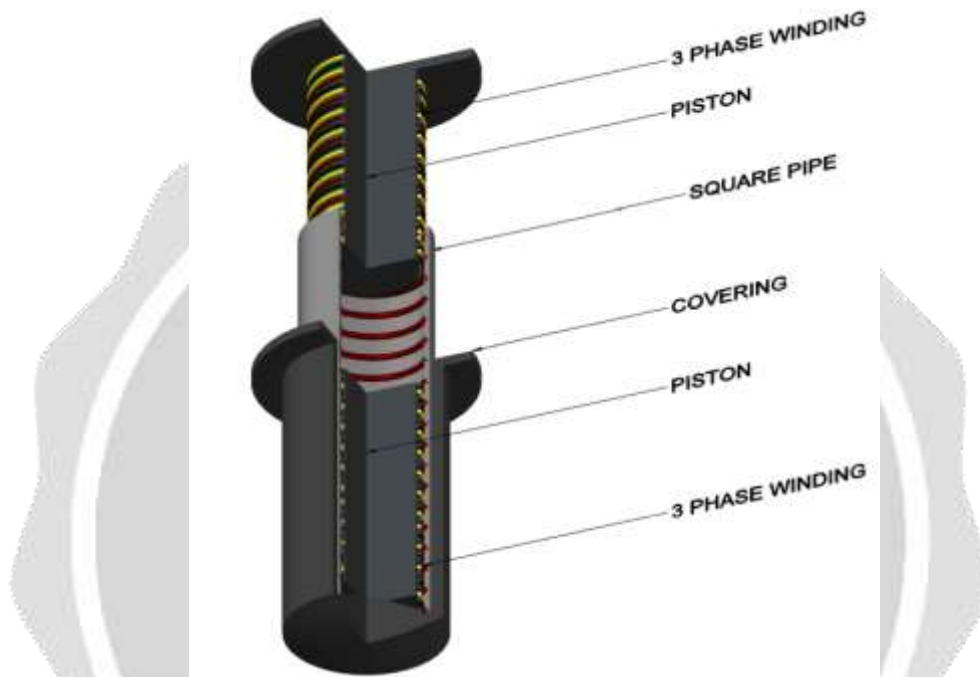


Fig-1: Electromagnetic suspension model

Electromagnetic 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. Electromagnetic suspension is described as the fastest reacting suspension in the world as sensors monitor the road surface up to 1000 times per second and a microcontrol unit which consist of Arduino , LM2596 and MOSFET can make variations within a few milliseconds resulting in the possibility of multiple damping variations being made in a second. The ultrasonic sensor which sense the variation in the road then the Arduino with the help of LM2596 and MOSFET adjust the current passed in to the magnetic force in each electromagnet then the suspension action carried out by the repulsive force in the electromagnet according to the variations in the road.

Electromagnetic 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. 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.

4. HARDWARE SPECIFICATION

4.1. Electromagnet

An electromagnet is a temporary magnet in which a long insulated copper wire is wrapped on a soft iron core in the form of a helix. Thus, an electromagnet is a solenoid having a core of soft iron core at its centre. When electric current is passed through it, it behaves as a magnet because a strong magnetic field is produced in it. An electromagnet is a temporary magnet because it behaves as magnet as long as the current is passed through it. Both the ends of electromagnet behave as north and south pole respectively. The polarity of an electromagnet can be reversed by reversing the flow of current through the coil. When the supply of current is stopped, the magnetism of electromagnet also disappears.

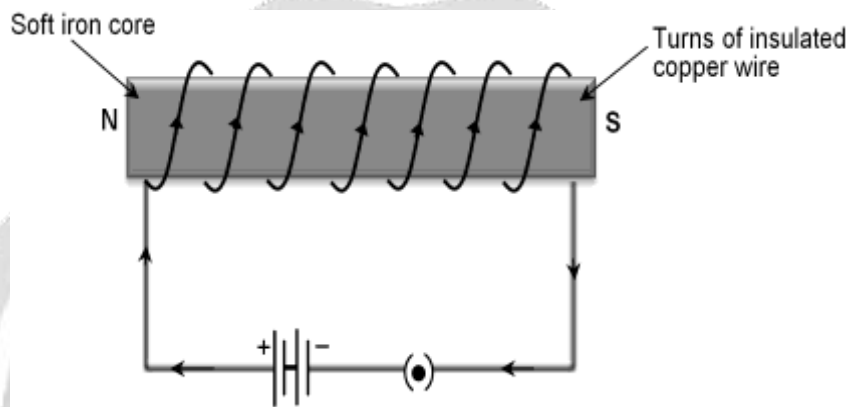


Fig-2: Electromagnet

4.2. Arduino Uno R3

Arduino is an open-source electronic platform that is based on connection between hardware and software and it is easy to use and implement. They are designed in such a way that it read the input – water reaches a certain threshold and turn it into an output – sending the alert . The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features an ATmega16U2 programmed as a USB-to-serial converter. This auxiliary microcontroller has its own USB boot loader, which allows advanced users to reprogram it. The Arduino has a large support community and an extensive set of support libraries and hardware add-on shields making it a great introductory platform for embedded electronics

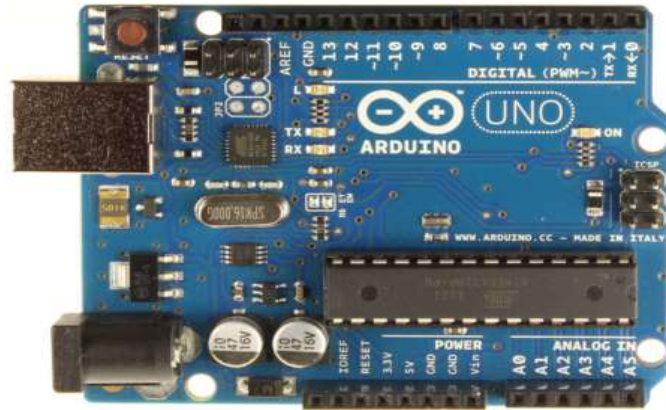


Fig-3: Arduino uno

4.3. Ultrasonic sensor

At its core, the HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signal into 40 KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses. If it receives them it produces an output pulse whose width can be used to determine the distance the pulse travelled. As simple as pie. The sensor is small, easy to use in any robotics project and offers excellent non-contact range detection between 2 cm to 400 cm (that's about an inch to 13 feet) with an accuracy of 3mm. Since it operates on 5 volts, it can be hooked directly to an Arduino or any other 5V logic microcontrollers.

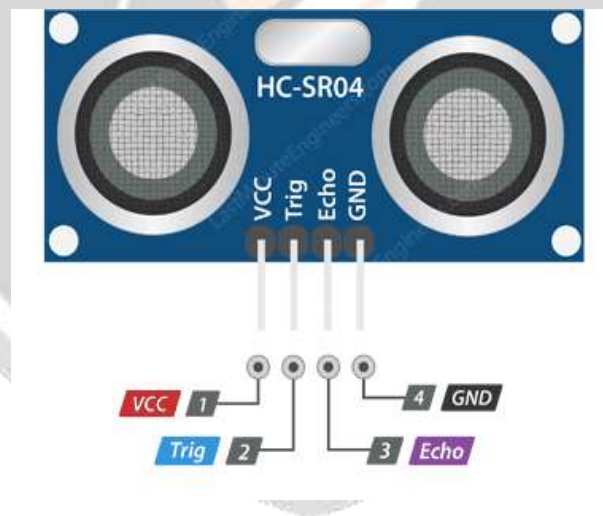


Fig-4: HC-SR04 Ultrasonic Sensor

4.5. MOSFET

The MOSFET (Metal Oxide Semiconductor Field Effect Transistor) transistor is a semiconductor device which is widely used for switching and amplifying electronic signals in the electronic devices. The MOSFET is a core of integrated circuit and it can be designed and fabricated in a single chip because of these very small sizes. The MOSFET is a four terminal device with source(S), gate (G), drain (D) and body (B) terminals. The body of the MOSFET is frequently connected to the source terminal so making it a three terminal device like field effect transistor. The MOSFET is very far the most common transistor and can be used in both analog and digital circuits.

The MOSFET works by electronically varying the width of a channel along which charge carriers flow (electrons or holes). The charge carriers enter the channel at source and exit via the drain. The width of the channel is controlled by the voltage on an electrode is called gate which is located between source and drain. It is insulated from the channel near an extremely thin layer of metal oxide. The MOS capacity present in the device is the main part

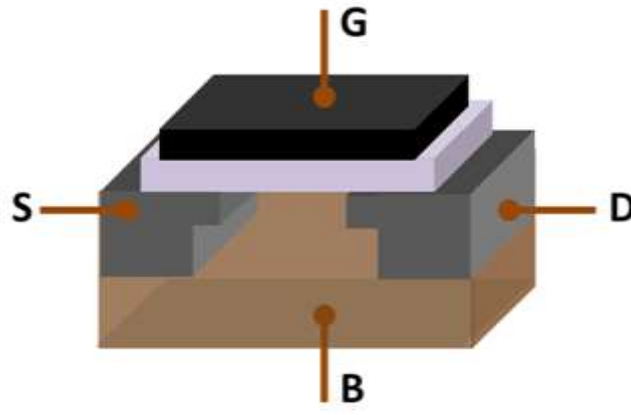


Fig-5:MOSFET

4.5.LM2596

The LM2596 regulator is monolithic integrated circuit ideally suited for easy and convenient design of a step-down switching regulator (buck converter). It is capable of driving a 3.0 A load with excellent line and load regulation. This device is available in adjustable output version and it is internally compensated to minimize the number of external components to simplify the power supply design. Since LM2596 converter is a switch-mode power supply, its efficiency is significantly higher in comparison with popular three-terminal linear regulators, especially with higher input voltages. The LM2596 operates at a switching frequency of 150 kHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in a standard 5-lead TO-220 package with several different lead bend options, and D2PAK surface mount package.

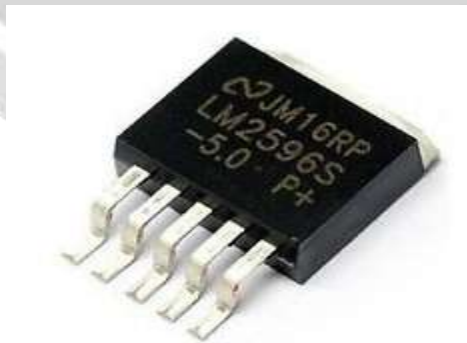


Fig-6:LM2596

5. CONCLUSION AND FUTURE SCOPE

As we have seen the electromagnetic suspension is a revolutionary idea which will provide a comfortable ride by minimizing the vibrations and other factors .It would also allow to set the suspension stiffness as per requirement. Thereby electromagnetic suspension will be a best substitute for current problems and providing ultimate vehicle dynamics.

In addition to the developed system , the system can be enhanced by , Maglev technology could be incorporated in the motorcycles along with electromagnetic suspension system to provide for better ride on the irregular surfaces as well as on well paved roads . And better control of the damping could be provided by using an independent control unit for magnetic suspension. And the efficiency improvement can be carried out by making use of lightweight materials for the production of the suspension.

6. REFERENCE

- [1]. Magnetic Suspension for Motorcycles by Aniket Bharambe
- [2]. A Review on Electromagnetic Shock Absorber , by Mr. V.V.Borole, Prof. K.K.Chaudhari,
- [3].Sms based flood monitoring and early warning system , Sheikh Azid, Bibhya Sharma, Krishna Raghuwaiya, Abinendra Chand, Sumeet Prasad, A Jacquier
- [4]. Analysis for Suspension Spring to determine and Improve Its Fatigue Life Using Finite Element Methodology, by Chandrakant Chavan, G.M.Kakandikar, Swapnil S.Kulkarni
- [5]. Design and fabrication of magnetic shock absorber,by S.Gopinath, R.J. Golden Renjith, J.Dineshkumar
- [6]. Dr. Kirpal singh, (2011) “Automobile Engineering”, Standard Publishers distributors, Vol-1,12th edition.
- [7]. John C. Dixon, (1999) “The Shock Absorber Handbook”, SAE International, Sae Order no.-176.
- [8]. <https://store.arduino.cc/usa/arduino-uno-rev3>
- [9]. <https://www.maxbotix.com/articles/how-ultrasonic-sensors-work.htm>
- [10].<http://www.funscience.in/studyzone/Physics/MagneticEffectOfElectricCurrent/Electromagnet.php#sthash.7g2YeTJV.dpbs>
- [11]. <https://www.elprocus.com/mosfet-as-a-switch-circuit-diagram-free-circuits/>
- [12]. <https://www.onsemi.com/pub/Collateral/LM2596-D.PDF>