INTERNATIONAL JOURNAL OF RESEARCH IN AERONAUTICAL AND MECHANICAL ENGINEERING
WWW.IJRAME.COM
ISSN (ONLINE): 2321-3051
Vol.5 Issue.4,
April 2017
Pg: 59-68

NEODYMIUM MAGNETIC SHOCK ABSORBER

A.Raja[a],R.Rathish[b],N.Balakrishnan[c] ,A.Karthick[d] ,V.Jinesh Krishna[e]

[a,b] Assistant Professor, professor [c],Department of Mechanical Engineering ,Gnanamani College Of Technology,Namakkal

[d,e]UG Scholars, Department Of Mechanical Engineering,Gnanamani College Of Technology,Namakkal

ABSTRACT

Magnetic suspension is the technology for supporting an object without contact by means of a magnetic force. Magnetic suspension systems have many advantages, which are the realization of high speed due to no friction, the applications in clean rooms because of no generation of the dirt, and the applications in the cosmos because of the lubrication free. So far, many kinds of magnetic levitation systems have been proposed and developed. These magnetic levitation systems use various methods to control the suspension force. Two types of systems are electromagnetic suspension systems, which control the coil current so as to change the magnetic force in order to levitate an object stably; and mechanical magnetic suspension systems, which use permanent magnets and control the magnetic reluctance so as to vary the suspension force in order to achieve stable suspension. This thesis concentrates on the mechanism magnetic suspension systems, and proposes a zero power control method for a mechanism magnetic suspension system, a noncontact spinning system using permanent magnets and rotary actuators, a novel magnetic suspension system using the variable flux path control method, and the simultaneous suspension of two iron balls using the variable flux path control mechanism.

1. INTRODUCTION

First, this zero power control method is examined on a hanging type magnetic suspension system using a permanent magnet and a linear actuator. In this suspension system, a ferromagnetic ceiling is seemed as a track, and a magnetic suspension device is hanging from the ferromagnetic ceiling without contact. The suspension direction of this system is vertical (both the suspension device and the permanent magnet are only moving in the vertical direction). The suspension principle of this hanging type suspension system is that the suspension device is suspended by an attractive force of a permanent magnet that is driven by a linear actuator (that is voice coil motor (VCM) in this prototype.) and positioned from the ferromagnetic ceiling. This suspension system has two parts: the magnet part including a permanent magnet, a slider of VCM and a sensor target; and the frame part including the VCM stator, the three sensors and the frame, which are the remainders of the device except the magnet part. Due to the construction of the suspension device, the VCM has to maintain the gravitational force of the frame part in the stable suspension state, and the frame part holds the most weight of the device and the load has to add on the frame part. Consequently, the VCM must cost a lot of energy for the gravitational force of the frame part and the load in the stable suspension state. In order to reduce the energy cost in the stable suspension state, a spring is installed between the magnet part and the frame part, and the spring and the VCM sustain the gravitational force of the frame part and the load together. As a result, the zero power control is realized in the device by means of the spring and in the control system by means of the integral feedback loop. The model of the suspension system is created and the feasibility of suspension is analysed theoretically.

Fig1. Suspension System

1.1MAGNETIC SHOCK ABSORBER

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 repels 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. The non-magnetic material will hold the magnet in both the sides. By using this type of shock absorbers the suspension will be more and the impact of vibration is very less compared with the spring loaded shock absorbers. Thus the magnetic shock absorber works. When the weight of the vehicle increases or vehicle climbs irregular surface, the wheel goes upwards and shock absorber is compressed, at this time the piston moves downwards. The magnets are made closer to each other, due to the increase of weight, the piston rod containing magnet is made to compress to certain extent. At the same time, the stainless steel spring provided is freely inside the shock absorber.The additional support for magnetic shock absorber is provided by a helical coil spring, which was compressed at this stage. So the shocks and vibrations are prevented. When the weight of the vehicle is decreased or it returns to its original position, the shock absorber gets expanded. In this position the piston moves from the bottom to top due to the magnetic flux power of the magnet. The stainless steel spring provided inside the shock absorber made the magnets inside the piston rod to return to its original position slowly. The coil spring return to its original position. Thus the magnetic shock absorber absorbs the shock and vibrations produced while running a vehicle on a irregular road surface.

1.2 SHOCK ABSORBER

A shock absorber in common parlance (or damper in technical use) is a mechanical device designed to smooth out or damp sudden shock impulse and dissipate kinetic energy. absorbers must absorb or dissipate energy. One design consideration, when designing or choosing a shock absorber is where that energy will go. In most dashpots, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid will heat up. In air cylinders, the hot air is usually exhausted to the atmosphere. In other types of dashpots, such as electromagnetic ones, the dissipated energy can be stored and used later.Shock absorbers are an important part of automobile and motorcycle suspensions, aircraft landing gear, and the supports for many industrial machines. Large shock absorbers have also been used in structural engineering to reduce the susceptibility of structures to earthquake damage and resonance.Shock absorbers, linear dampers, and dashpots are devices designed to provide absorption of shock and smooth deceleration in linear motion applications. They may be mechanical (e.g., elastomeric or coil spring) or rely on a fluid (gas, air, hydraulic), which absorbs shock by allowing controlled flow from outer to inner chamber of a cylinder during piston actuation. In conventional shock absorbers the piston rod is typically returned to the unloaded position with a spring. Shock absorbers typically contain either a fluid or mechanical dampening system and a return mechanism to the unengaged position. They vary from small device application to large industrial and civil engineering uses. Linear dampers are an inclusive term that can be applied to many forms of dashpots and shock absorbers; Typically used for devices designed primarily for reciprocating motion attenuation rather than absorption of large shock loads. Dashpots are typically distinct in that while they use controlled fluid flow to dampen and decelerate motion, they do not necessarily incorporate an integral return mechanism such as a spring. Dashpots are often relatively small, precise devices used for applications such as instrumentation and precision manufacturing. Shock absorbers or damper types for shock absorbers, linear dampers and dashpots can be hydraulic, air, gas spring, or elastomeric. The absorption or damping action can be compression or extension. Important parameters to consider when searching for shock absorbers, linear dampers and dashpots include absorber stroke, compressed length, extended length, maximum force (p1), and maximum cycles per minute. Absorber or spring stroke is difference between fully extended and fully compressed position. Compressed length is the minimum length of shock (compressed position). Extended length is the maximum length of shock (extended position). Important physical specifications to consider when searching shock absorbers, linear dampers and dashpots include the cylinder diameter or maximum width, the rod diameter, mounting, and body material. The cylinder diameter or maximum width refers to the desired diameter of housing cylinder. The rod diameter refers to the desired diameter of extending rod. Mounting choices include ball and socket, rod end, clevis, eyelet, tapered end, threaded, and bumper or rod end unattached. Choices for body materials include aluminum, steel, stainless steel, and thermoplastic. Common features for shock absorbers, linear dampers and dashpots include adjustable configuration, reducible, locking, and valve. An adjustable configuration allows the user to fine tune desired damping, either continuously or at discrete settings. A reducible shock absorber, linear damper or dashpot has an adjustment style for gas shocks in which gas is let out to permanently reduce force capacity. In a locking configuration the position can be locked at ends or in the middle of stroke. Valves can be included for fluid absorbers, a valve or port, which can be used to increase or decrease fluid volume or pressure.

1.3 DESCRIPTION

Pneumatic and hydraulic shock absorbers are used in conjunction with cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston (see below).One design consideration, when designing or choosing a shock absorber, is where that energy will go. In most shock absorbers, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid heats up, while in air cylinders, the hot air is usually exhausted to the atmosphere. In other types of shock absorbers, such as electromagnetic types, the dissipated energy can be stored and used later. In general terms, shock absorbers help cushion vehicles on uneven roads.

1.4 VEHICLE SUSPENSION

In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. While shock absorbers serve the purpose of limiting excessive suspension movement, their intended sole purpose is to damp spring oscillations.

Vol.5 Issue.4,
April 2017
Pg: 59-68

Fig1.1 Vehicle Suspension

Shock absorbers use valuing of oil and gasses to absorb excess energy from the springs. Spring rates are chosen by the manufacturer based on the weight of the vehicle, loaded and unloaded. Some people use shocks to modify spring rates but this is not the correct use. Along with hysteresis in the tire itself, they damp the energy stored in the motion of the unsprung weight up and down. Effective wheel bounce damping may require tuning shocks to an optimal resistance.Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars are used in torsional shocks as well. Ideal springs alone, however, are not shock absorbers, as springs only store and do not dissipate or absorb energy. Vehicles typically employ both hydraulic shock absorbers and springs or torsion bars. In this combination, "shock absorber" refers specifically to the hydraulic piston that absorbs and dissipates vibration. Now, composite suspension systems are used mainly in 2 wheelers and also leaf spring are made up of composite material in 4 wheelers.

2. COMPONENTS

- Supporting Frame
- Neodymium Magnet
- Hollow Structural Section

Vol.5 Issue.4,
April 2017
Pg: 59-68

2.1 SUPPORTING FRAME

Supporting Frame can be used with Frame Motor to move smaller structures and even build airships or similar flying 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 (such as deplorers or block breakers) facing the support frame.

To place things like solar panels or bundled cables on a support frame and not have they dislodged when the support frame moves, use Panels. While items like these can be placed on a cover, they will not stick when the support frame is moved.

Fig2.1 Supporting Frame

2.2. NEODYMIUM MAGNET

A neodymium magnet (also known as NdFeB, NIB or Neo magnet), the most widely used type of rare-earth magnet, is a permanent magnet made from an alloy of neodymium, iron and boron to form the $Nd_2Fe_{14}B$ tetragonal crystalline structure. Developed in 1982 by General Motors and Sumitomo Special Metals, neodymium magnets are the strongest type of permanent magnet commercially available. They have replaced other types of magnets in the many applications in modern products that require strong permanent magnets, such as motors in cordless tools, hard disk drives and magnetic fasteners.

Vol.5 Issue.4,
April 2017
Pg: 59-68

2.3. HOLLOW STRUCTURAL SECTION

Fig2.3 Hollow Structural Section

A hollow structural section (HSS) is a type of metal profile with a hollow tubular cross section. The term is used predominantly in USA, or other countries which follow US construction or engineering terminology.HSS members can be circular, square, or rectangular sections, although other shapes are available, such as elliptical. HSS is only composed of structural steel per codHSS is sometimes mistakenly referenced as hollow structural steel. Rectangular and square HSS are also commonly called tube steel or structural tubing. Circular HSS are sometimes mistakenly called steel pipe though true steel pipe is actually dimensioned and classed differently from HSS. The corners of HSS are heavily rounded, having a radius which is approximately twice the wall thickness. The wall thickness is uniform around the section.In the UK, or other countries which follow British construction or engineering terminology, the term HSS is not used. Rather, the three basic shapes are referenced as CHS, SHS, and RHS, being circular, square, and rectangular hollow sections. Typically, these designations will also relate to metric sizes, thus the dimensions and tolerances differ slightly from HSS.HSS, especially rectangular sections, are commonly used in welded steel frames where members experience loading in multiple directions. Square and circular HSS have very efficient shapes for this multiple-axis loading as they have uniform geometry along two or more cross-sectional axes, and thus uniform strength characteristics. This makes them good choices for columns. They also have excellent resistance to torsion.HSS can also be used as beams, although wide flange or I-beam shapes are in many cases a more efficient structural shape for this application. However, the HSS has superior resistance to lateral torsional buckling.Square HSS is made the same way as pipe. During the manufacturing process flat steel plate is gradually changed in shape to become round where the edges are presented ready to weld. The edges are then welded together to form the mother tube. During the manufacturing process the mother tube goes through a series of shaping stands which form the round HSS (mother tube) into the final square or rectangular shape. Most American manufacturers adhere to the ASTM A500 or newly adopted ASTM A1085 standards, while Canadian manufacturers follow both ASTM A500 and CSA G40.21. European hollow sections are generally in accordance with the EN 10210 standard.

Vol.5 Issue.4,
April 2017
Pg: 59-68

3. EXPERIMENTAL SETUP

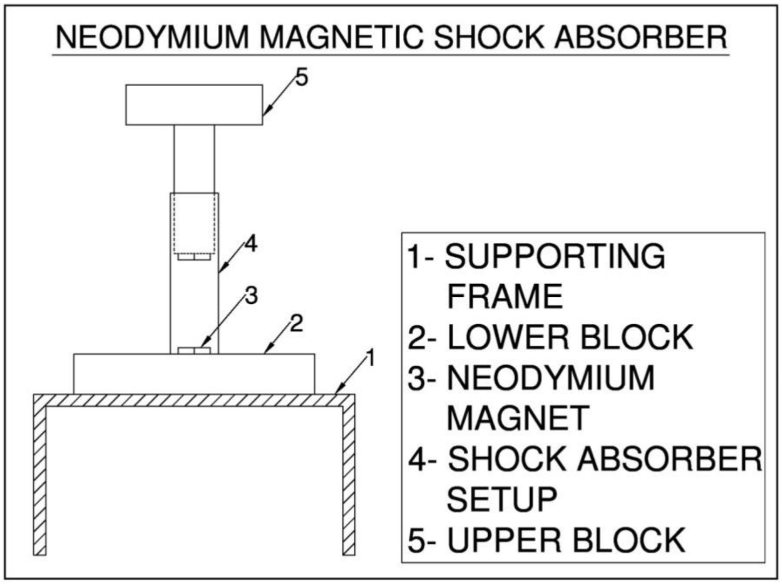

Fig3.1 Experimental setup

First, this zero power control method is examined on a hanging type magnetic suspension system using a permanent magnet and a linear actuator. In this suspension system, a ferromagnetic ceiling is seemed as a track, and a magnetic suspension device is hanging from the ferromagnetic ceiling without contact. The suspension direction of this system is vertical (both the suspension device and the permanent magnet are only moving in the vertical direction). The suspension principle of this hanging type suspension system is that the suspension device is suspended by an attractive force of a permanent magnet that is driven by a linear actuator (that is voice coil motor (VCM) in this prototype.) and positioned from the ferromagnetic ceiling. This suspension system has two parts: the magnet part including a permanent magnet, a slider of VCM and a sensor target; and the frame part including the VCM stator, the three sensors and the frame, which are the remainders of the device except the magnet part. Due to the construction of the suspension device, the VCM has to maintain the gravitational force of the frame part in the stable suspension state, and the frame part holds the most weight of the device and the load has to add on the frame part. Consequently, the VCM must cost a lot of energy for the gravitational force of the frame part and the load in the stable suspension state. In order to reduce the energy cost in the stable suspension state, a spring is installed between the magnet part and the frame part, and the spring and the VCM sustain the gravitational force of the frame part and the load together. In the control system, two PD feedback loops realize the stable suspension of the device, and a local integral feedback loop makes the VCM current converge to zero in the stable suspension state.

As a result, the zero power control is realized in the device by means of the spring and in the control system by means of the integral feedback loop. The model of the suspension system is created and the feasibility of suspension is analyzed theoretically.

4.ADVANTAGES AND APPLICATIONS

- Shock absorber cost will be less.
- Free from wear adjustment.
- Less power consumption
- Less skill technicians is sufficient to operate.
- It gives simplified very operation.
- Installation is simplified very much.
- Less time and more profit.

APPLICATIONS

- For automobile application
- Industrial application

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 NEODYMIUM MAGNETIC SHOCK ABSORBER 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 "NEODYMIUM MAGNETIC SHOCK ABSORBER" which helps to know how to achieve low cost and minimize the size.

Vol.5 Issue.4,
April 2017
Pg: 59-68

REFERENCES

- Dr. Kirpal singh, (2011) “Automobile Engineering”, Standard Publishers distributors, Vol-1,12th edition.
- John C. Dixon, (1999) “The Shock Absorber Handbook", SAE International, Sae Order no.-176.
- Wolfgang Matschinsky, (1998)" Road Vehicle Suspensions" Professional Engineering Publishing Limited.
- International Journal of Engineering & Technology 211
- M.D. Rao, S. Gruenberg, (2002) “Measurement of Equivalent Stiffness and Damping of Shock Absorbers”, Experimental Techniques, Vol.26, No.2, pp.39-42. S.Duym, R.Stiens, and K.Reybrouck (1997), “Evaluation of shock absorber models,”Vehicle System Dynamics, vol. 27, no. 2, pp. 109 – 127.
- Y.Goh, J. Booker, and C. McMahon (2005), “Uncertainty modelling of a suspension unit,” Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, vol. 219, no. 6, pp. 755 – 771.
- A.Simms and D.Crolla (2002), “The influence of damper properties on vehicle dynamic behaviour,” SAE Technical Paper Series, 2002-010319.
- W. Matschinsky (1998), Road Vehicle Suspensions. London, UK: Professional Engineering Publishing.