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Research Article

Vibration Reducer for Two wheeler by Magnetic Absorbing System

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Abstract: Vibration is a most and common issue for all automobile sectors in post the spring, hydraulic system is used to reduce the vibration. For that the magnetic shock absorbing system has been used to reduce the vibration. Magnetic shock absorber is used to reduce the vibration with the help of magnetic field. Repulsion of the magnet plays a vital role in an intermediate system between two magnets in same pole.
Keywords: Magnet, Repulsion, Shock, Spring

INTRODUCTION

Shock absorber is important component of automobile. Nowadays many type of shock absorber used. Magnetic shock absorbers the idea for a magnetic shock absorber (for automobiles and two-wheelers), makes use of the magnetic repulsion between dipoles to achieve shock absorption. Often when riding on her two-wheeler we used to face some problems while moving on the bumpy road due to its unevenness. It observed that the like poles of two magnets of the same properties and strength repulse each other and they keep a constant distance between each other because of their magnetic fields. This made her think that if the shock absorbers are made of magnets with similar poles facing each other, it may give better performance and no maintenance would be required for the same. The unit comprises of two circular magnets and a rod (straight cylindrical rod which can be used as axle). One magnet is attached at the bottom of the rod and is the base magnet. The other magnet is free, with a float and has the similar pole placed towards the base magnet. The similarity of poles creates repulsion and a certain distance is maintained. As per load condition, the floating magnet moves and closes the gap until the magnetic repulsion is strong enough to create the damping action. In this manner a shock absorber without springs working on the basic law of magnets - opposite poles attract and similar poles repel- is prepared. As a component of a semi-active suspension system, the role of a controllable shock absorber is to have the capacity of producing variable damping proportionally reactive to the input motion. Semi-active, controllable dampers are increasingly being investigated for various applications [1].

Shock Absorbers Function

A shock absorber in common parlance is a mechanical device designed to smooth out or damp sudden shock impulse and dissipate kinetic energy. It is analogous to a resistor in an electric RLC circuit. Shock absorbers must absorb or dissipate energy. 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 [8].

In a fully active suspension there are no passive elements, such as dampers and springs. The interaction between vehicle body and wheel is regulated by an actuator of variable length. The actuator is usually hydraulically controlled and applies between body and wheel a force that represents the control action generally determined with an optimization procedure. Active suspensions [2, 3, and 7] have better performance than passive suspensions with regard to comfort, road holding, and ride ability. However, active suspension systems are rather complex, since they require several components such as actuators, servo valves, high-pressure tanks for the control fluid, either sensors for detecting the system state or appropriate system state observers, etc.

EXPERIMENTAL SETUP

Magnetic Shock Absorber

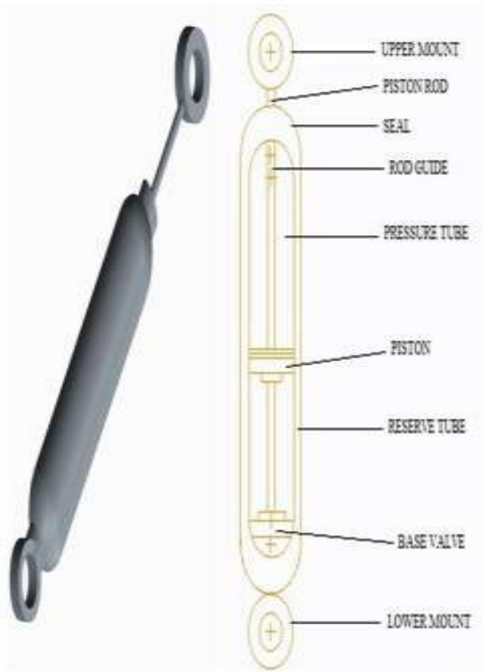

Fig. 1 (Experimental setup of Magnetic shock absorber)

The figure 1 shows the experimental setup of the magnetic shock absorber. Shock absorbers are a key component of all automobiles. They control the vehicle's suspension movement to provide a stable, comfortable ride. Since they were installed on the first automobiles, the principle of shock absorber operation has remained essentially the same. Now a new type of shock absorber is entering the market, and it may change the way suspensions are controlled. They are called the magnetic shock absorbers or the new magneride shock system. Magnetic shock absorber is a continuously variable shock absorber that uses simple magnetic principles but very high technology to control suspensions. Conventional shock absorbers (or struts on many cars) use oil passing through orifices to dampen suspension movement. When a tire hits a bump, the suspension moves up, moving the body of the shock absorber up too. A rod, connected to the top of the shock and mounted to the body or frame, passes through a seal in the top of the shock and has a piston mounted on the bottom end. This piston has small ports in it that allow oil contained in the shock body to flow from one side of the piston to the other. Different size ports allow different flow rates, so larger ports allow the suspension to move easier and smaller ports slow the movement. Conventional shock absorbers use check valves on the ports so that fluid can pass easier one way than the other. Typically, the wheel is allowed to move up quickly, but let back down slower. This prevents the suspension from bouncing; the effect you get when the shocks are badly worn. Gas-filled shocks use pressure inside the shock to reduce oil foaming as it passes through the ports. Suspension control becomes very erratic with foamy oil inside the shock [11]. Vehicles with selectable shock dampening vary the size of ports by turning a shaft inside the piston rod that changes port size to change vehicle handling. Magnetic shock absorber makes mechanically varied systems obsolete. The heart of a magnetic shock absorber is the magneto-rheological fluid. It is a suspension of magnetically soft particles such as iron microspheres in a synthetic hydrocarbon base fluid. Place a magnet near the fluid and the particles form a fibrous structure, increasing its shear factor. In simple terms, the fluid gets thicker so it doesn't flow through the shock's piston ports as easy. By using an magnet placed in the shock piston, the MR fluid only changes viscosity where it passes through the ports. Wires run down the hollow piston rod so a computer module can vary the strength of the magnet and the dampening of the shock continuously. The system is five times faster than mechanical ride control systems. Several sensors provide input to the magneride computer. Wheel to body sensors are used at each wheel to determine wheel travel and vertical acceleration. Vehicle speed and outside temperature come via data communication from other vehicle computers. The temperature data is used so the computer can compensate for fluid viscosity variations due to temperature. Magneride also improves vehicle stability control systems and uses a steering wheel angle sensor, yaw rate sensor and lateral acceleration sensor for accurate vehicle control. for the auto engineers, magneride allows quicker calibration and suspension tuning for new vehicles. For drivers, magneride offers a flatter, smoother ride, enhanced lateral and longitudinal control of body movement, and better road isolation from the passenger compartment.

Operation and Working

Operation

Magneto-Rheological Fluid

Rheology is a science that studies the deformation and flow of materials. Rheological fluids have flow characteristics that can be changed in a controllable way using electrical current or a magnetic field. Depending on the base fluid and the strength of the electrical current or magnet, the fluid's viscosity can be varied from thinner-than-water to almost-solid and any stage in between. The fluid's response is instantaneous, completely reversible and extremely controllable, but there are some limits. Electro-rheological (ER) fluid changes viscosity when an electric current is applied directly to the fluid itself. It has been tested in a wide range of applications, from torque converters, clutches and dampers to synthetic muscles and dampers in powered prosthetic arms and legs. It works, but its shear strength – that is, its resistance to shearing movement – is limited. Despite huge investments in research and development, ER fluid is still far from ready for any practical applications. Magneto-rheological (MR) fluid has shear strength about 10 times stronger than ER fluid. Invented at the same time as ER fluid, the two have many similarities. Both can use oil, silicone, water or glycol as the base fluid, and both contain polarizable particles suspended in the fluid. Polarizable means the particles can be forced to align in a specific way [9]. These suspended polarizable particles are the basic difference between ER and MR fluids. ER fluid uses particles that polarize when directly exposed to an electric current. MR fluid uses somewhat larger particles of iron that polarize when surrounded by a magnetic field. The typical MR fluid particles are soft iron spheres measuring 3 to 5 microns (3 to 5 thousandths of a millimeter) in diameter. Depending on the application, the fluid will be 20 to 40 percent saturated with the iron particles, and other additives will be used to control particle settling and mixing, fluid friction and fluid viscosity. Specific gravity is generally between 3 and 4; for reference, water's specific gravity is 1. Thus, a 55-gallon drum of MR fluid can weigh almost a full ton. MR fluids are developed specifically for the application. For instance, in addition to automotive uses, MR fluids have been developed for use in dampers that protect buildings and other structures from earthquake damage. These dampers sit still for long periods, so different additives are needed to keep the particles in suspension. One class of controllable, semi-active dampers uses a magnetorheological fluid (MRF) as the working fluid. Magneto-rheological (MR) fluids typically consist of a base carrier fluid with small iron particles in suspension [6]. The application of a magnetic field to a MR fluid causes particles to align in a "chain-like" formation along the lines of the applied magnetic flux. The chains, in turn, cause a resistance to the fluid flow. This behavior is referred to as "MR valving effect", which can be regarded as a controllable increase in the apparent viscosity of the MR fluid [5]. In the operation of Magneto-Rheological Fluid having the following principles. They are ferrous particle chains resist fluid flow, MRfluid in pressure driven flow (valve) mode, MR fluid in direct-shear mode, MR fluid in squeeze-film mode and also they shown in the following figures (Fig-2 to Fig-5).

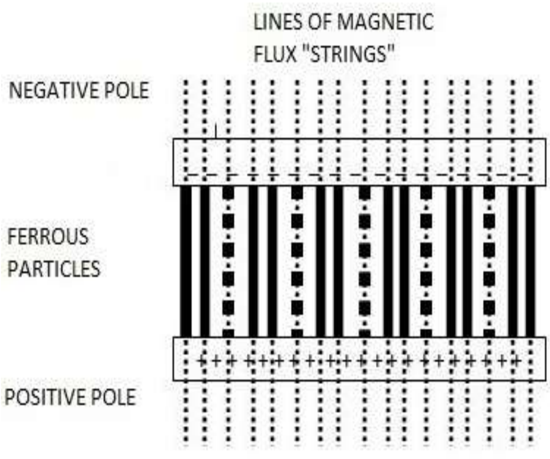

Fig. 2 (Ferrous particle chains resist fluid flow)

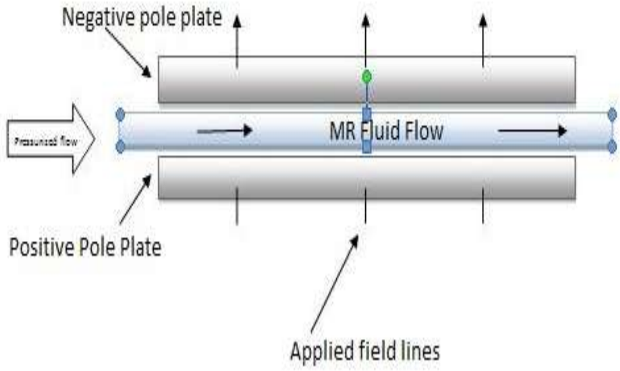

Fig. 3 (MR fluid in pressure driven flow (valve) mode)

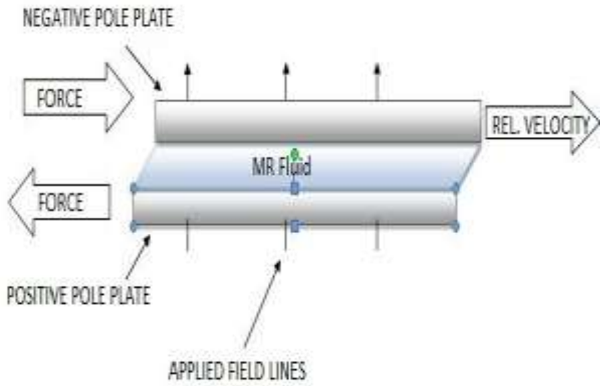

Fig. 4 (MR fluid in direct-shear mode)

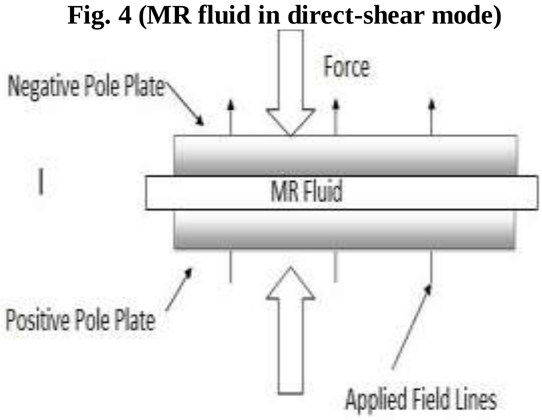

Fig. 5 (MR fluid in squeeze-film mode)

Pressure driven flow mode, commonly known as valve mode, has two fixed magnetic poles through which pressurized MR fluid flows, as shown in Figure 2. Upon application of a magnetic field, the MR particles align parallel to the applied field lines and resist the flow of the pressurized MR fluid. The name "valve mode" is commonly used since, in the essence, this mode resembles the operation of a valve. Via the application of higher intensity fields, the flow resistance increases, much like closing a sink faucet valve. The pressure driven flow mode is probably the most common mode used in MR dampers, such as Lord

Corporation's "MR Damper" (RD-1005-3), but can be other applications in which a variable flow resistance is required.

The adjustability of the MR fluid is heavily dependent on the size of the fluid gap in each of the fluid's operation modes. The fluid gap for the direct-shear and squeeze film modes should be in the range of 0.005 inch to 0.025 inch, for most vehicle damper applications. The fluid gap for pressure driven flow mode depicted in Figure 3 should also be between 0.005 inch and 0.025 inch; however, a different orifice type (i.e., circular orifice) would have to be designed around the volume of the fluid being activated. A smaller fluid gap requires less field intensity and therefore less power to operate. This aspect is an important part of designing MR fluid devices.

Operation in direct-shear mode requires that the two magnetic pole plates move relative to each other, thus "shearing" the fluid between them, as depicted in Figure 4. An applied magnetic field aligns MR particles perpendicular to the pole plates while the shearing motion attempts to bend the particle chains along the flux lines. Again, as the field intensity increases, the MR fluid's resistance to shearing increases. The direct shear mode of MR fluids can be used in low force dampers, and has also found uses as magnetic brakes and clutches, such as Lord Corporation's "MR Rotary Brake" (MRB-2107-3).

Squeeze-film mode, the third mode of MR fluid use, is used via squeezing the two magnetic pole plates together on a thin film of MR fluid, as shown in Figure 5. The application of force on the plates parallel to the direction of flux lines pressurizes the chain-like structures of MR fluid particles. The intensity of the induced field determines the ability of the MR fluid particle columns to resist buckling.

Working

A conventional automotive shock absorber dampens suspension movement to produce a controlled action that keeps the tire firmly on the road. This is done by converting the kinetic energy into heat energy, which is then absorbed by the shock's oil. The power-generating shock absorber (pgsa) converts this kinetic energy into electricity instead of heat through the use of a linear motion electromagnetic system (lmes). The lmes uses a dense permanent magnet stack embedded in the main piston, a switchable series of stator coil windings, a rectifier, and an electronic control system to manage the varying electrical output and dampening load. The bottom shaft of the pgsa mounts to the moving suspension member and forces the magnet stack to reciprocate within the annular array of stator windings, producing alternating current electricity. That electricity is then converted into direct current through a full-wave rectifier and stored in the vehicle's batteries. The electricity generated by each pgsa can then be combined with electricity from other power generation systems (e.g. regenerative braking) and stored in the vehicle's batteries [10]. The figure 6 shows the working of magnetic fields.

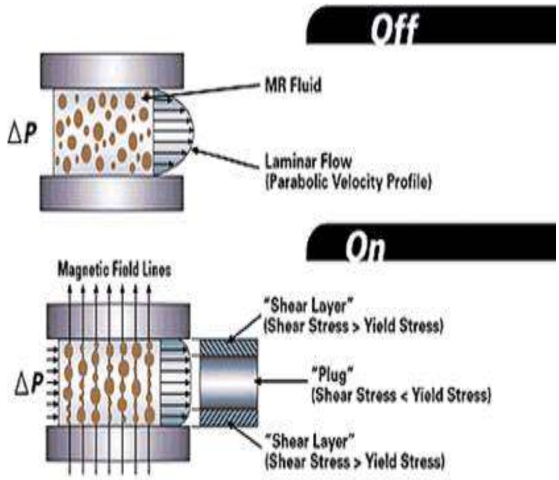

Fig. 6 (Working of magnetic fields)

Shock absorbers work in two cycles -- the compression cycle and the extension cycle. The compression cycle occurs as the piston moves downward, compressing the hydraulic fluid in the chamber below the piston. The extension cycle occurs as the piston moves toward the top of the pressure tube, compressing the fluid in the chamber above the piston. a typical car or light truck will have more resistance during its extension cycle than its compression cycle. With that in mind, the compression cycle controls the motion of the vehicle's unsprung weight, while extension controls the heavier, sprung weight [11].

Compression Cycle

During the compression stroke or downward movement, some fluid flows through the piston from chamber b to chamber and some through the compression valve into the reserve tube. To control the flow, there are three valving stages each in the piston and in the compression valve.

At the piston, oil flows through the oil ports, and at slow piston speeds, the first stage bleeds come into play and restrict the amount of oil flow. This allows a controlled flow of fluid from chamber b to chamber a.

At faster piston speeds, the increase in fluid pressure below the piston in chamber b causes the discs to open up away from the valve seat. At high speeds, the limit of the second stage discs phases into the third stage orifice restrictions. Compression control, then, is the force that results from a higher pressure present in chamber b, which acts on the bottom of the piston and the piston rod area.

Extension Cycle

As the piston and rod move upward toward the top of the pressure tube, the volume of chamber a is reduced and thus is at a higher pressure than chamber b. Because of this higher pressure, fluid flows down through the piston's 3-stage extension valve into chamber b.

However, the piston rod volume has been withdrawn from chamber b greatly increasing its volume. thus the volume of fluid from chamber a is insufficient to fill chamber b. the pressure in the reserve tube is now greater than that in chamber b, forcing the compression intake valve to unseat. Fluid then flows from the reserve tube into chamber b, keeping the pressure tube full.

Extension control is a force present as a result of the higher pressure in chamber a, acting on the topside of the piston area.

CONCLUSION

From the above concepts, shock absorbing of the magnet at same pole has given a smoother suspension for a two wheeler. It reduces a vibrating element that is in then automobiles. The comparison of hydraulic system with magnetic system gives more comfortable to the handling and also increasing the performance with low cost.

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