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Review on seat suspension system

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ABSTRACT

This review will focus on seat suspension systems, it has a basic requirements in automobile sectors in order to ensure safety and as well as to provide comfort to the user. it is consider more as in the commercial vehicles like in truck ,public buses and as well as also in the type of vehicles like which are compact in size or family vehicle or for the luxurious car where comfort matters in travelling a little more. Considering such vibration can affect the driver health on a long term. Many investigations have been carried out and researchers have proposed various methods for estimating stability and discomfort of the driver. Active, passive and semi active suspension are employed so to reduce the harmful and unwanted vibrations. Nowadays more research is going on to make the seat shock less.

Fig 1: passive seat suspension

Fig 2: active seat suspension

Keywords

Seat suspension control, shock less seat, passive suspension, active suspension, semi active suspension

1. INTRODUCTION

All the greatest achievements of the history, Automobile is most probably the one which significantly changed human life. The periodical improvement in the technology gives human race a new height. In the later years after independence the number of vehicles subsequently increased but in the last two decades it spreads drastically in every level of the society hence safety becomes the main concern. Injuries resulting due to shocks account a severe threat to the lives in both ways physical as well as financial, even after digital control of the vehicle. However, due to human avoidance, circumstantial error and negligence injuries occur. Many people acquire a major problems or injuries in their life every year in vehicle due to the major shocks which are travelling to the body due to bumps, high speed cornering, sudden slowdown or sudden acceleration and in the places where vehicles are moving in continuous vibration while driving and in traffic condition. Where major cases of shock can be associated with heart problems, inadequate blood volume, allergic reaction, infection, and damage to the nervous system.

Life-threatening shock from a car is often associated with heavy internal or external bleeding from a serious injury or damage to the spine. Automotive seats should provide a broad sitting and comfort over long distances and isolate vehicle vibrations and shocks transmitted to it. three methods of vibration isolation method namely passive, active ,semi active. Active vibration control is a method to isolate vibration with the help of sensors to measure motion, acceleration, force and other parameter. Passive vibration uses mechanical parts such as spring blade shock absorber to damp vibrations. Researchers say that active vibration damping is

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the best way to damp vibrations and shocks. To isolate any shock we have to isolate three motions namely roll, pitch, yaw .from the picture it is clear that in automotive vehicles major focus is to damp roll and yaw motion as major vibrations are created due to these motions.

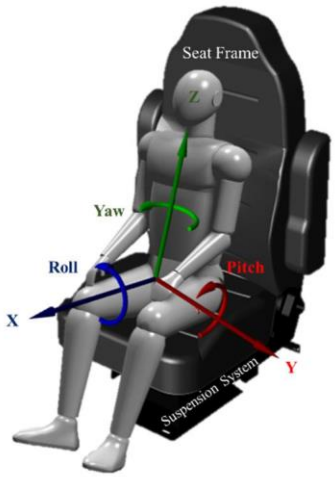

Fig 3: whole body vibration for the seated human body

2. TYPE OF SEAT SUSPENSION SYSTEM

2.1 Passive seat suspension

Most of the seat suspension uses passive suspension system to damp vibration reaching the seats. The passive system contains a sprung mass connected to a damping shock absorber to damp unwanted vibrations. The basic of passive suspension system is shown in fig.4. It absorbs structural vibration and removes energy from the dynamic system without n external energy force.

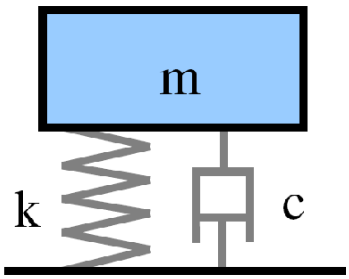

Fig 4: single degree of freedom system

A seat suspension was developed by maciejewski et al which had a shear guidance mechanism, air spring, buffers and hydraulic shock absorbers. The geometry is shown in fig.5.the damped vibration effect is given by shock absorber force coupled with spring force. At greater frequencies the suspensions was tested and it gave desirable results.

By regulating the air pressure in the air suspension the stiffness will change .therefore it can be adjusted according to the condition. Air suspension provides very less damping therefore shock absorber was attached to it.

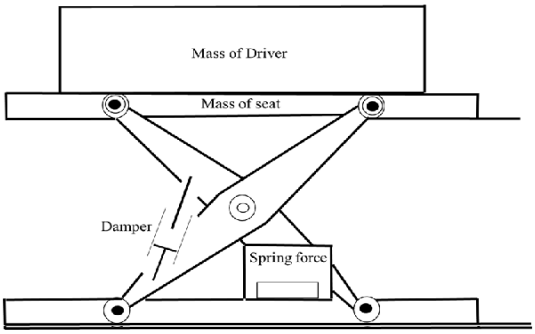

Fig 5: passive seat suspension

2.2 Semi active suspension system

The damping traits of the passive seat suspension system is low is lower frequencies. Therefore semi active seat suspension came into play. They measures stiffness and damping characteristics and make it possible to perform better at a wide variety of range. Semi active systems are more stable as they require low power than active systems. Adjustable damping and stiffness feature allowed it to be applied in vast areas such as helicopters, automotive engines etc. with the advancement with magneto rheological (MR) or electro rheological (ER) dampers, semi active control of seat suspension has been develop to enable various damping force.

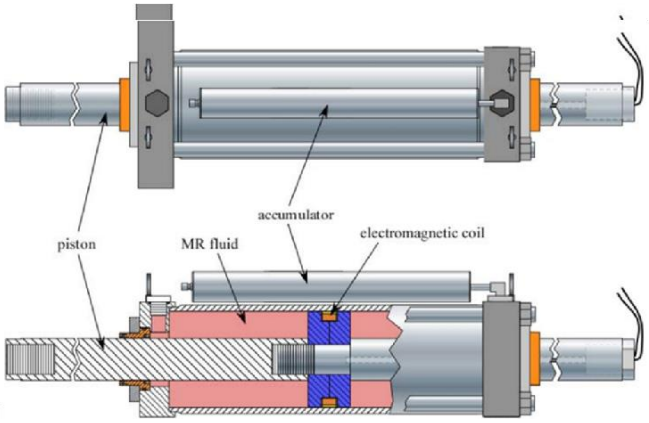

Fig 6: schematic diagram of magneto rheological (MR) damper

Oil and ferrous particles are the main components are the main part of the MR fluid as shown in fig.6. When MR fluid is held in magnetic field their characteristic changes to damp the forces. Advantage of using MR dampers is their quick response to force variation. There is no moving part in this damper and the only disadvantage is its cost.

2.3 Active seat suspension

Active suspension uses external energy to power the system to reduce unwanted vibration through constant control. The main goal of the active suspension is to isolate vibration coming to the seats with electronic aid. The active suspension is the more vibro isolation suspension system but due to its high cost and complexity it is used infrequently. There are various methods of applying active suspension system to reduce shock with the help of pneumatic actuator, linear motors, rotary motors etc. a system having active system has the opportunity to add or eliminate energy from the system through the

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actuator that apply force and torque to the structure. They are more robust and efficient as compared to other systems.

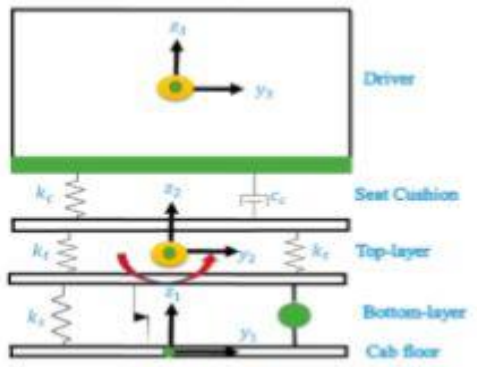

Fig 7: schematic diagram of two layer multiple degree of freedom

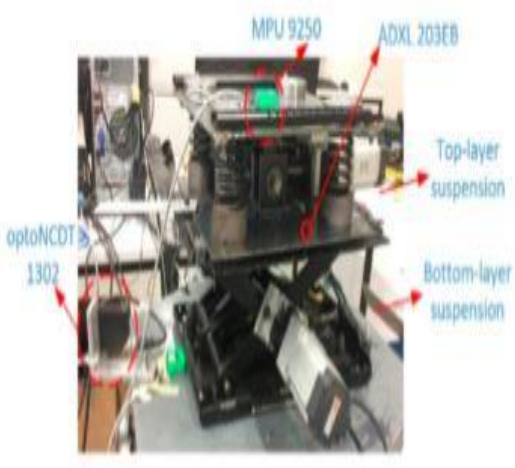

Fig 8: multiple DOF seat suspension system

In 2018 ning et al, innovated a suspension system that overcome the whole body vibration in vehicles. In fig.7 the seat suspension design is shown and in fig.8 prototype os the suspension is shown. There are two main sections in this suspension i.e. top layer consisting two separately controlled degree of freedom and bottom layer to reduce heavy vertical motion. This vibration system significantly reduced 29.8 % vibration to the seat.

3. OUR CONTRIBUTION

Our team has designed a three degree freedom suspension system that will balance the roll and pitch, bump vibration coming to the seats. It is an active seat suspension. Our suspension can be used in various vehicles for a safe and comfortable ride. We have used the technology of gimbal to stabilize our seat. gimbal suspension system is shown in fig.9. the blue mechanism is the roll axis and the red circles are the pitch axis and the yaw axis is fixed . As the vehicle face any roll motion the servo motor attached in blue region with the seats will create opposite movement and will make the seat stable. As the car experience any down or pitch movement the servo motors in red circles will start creating opposite movement making the seat stable. To make it more efficient sarbothane material which is a great vibration absorber will be attached between the seat mounting and chassis to damp low frequency vibrations.

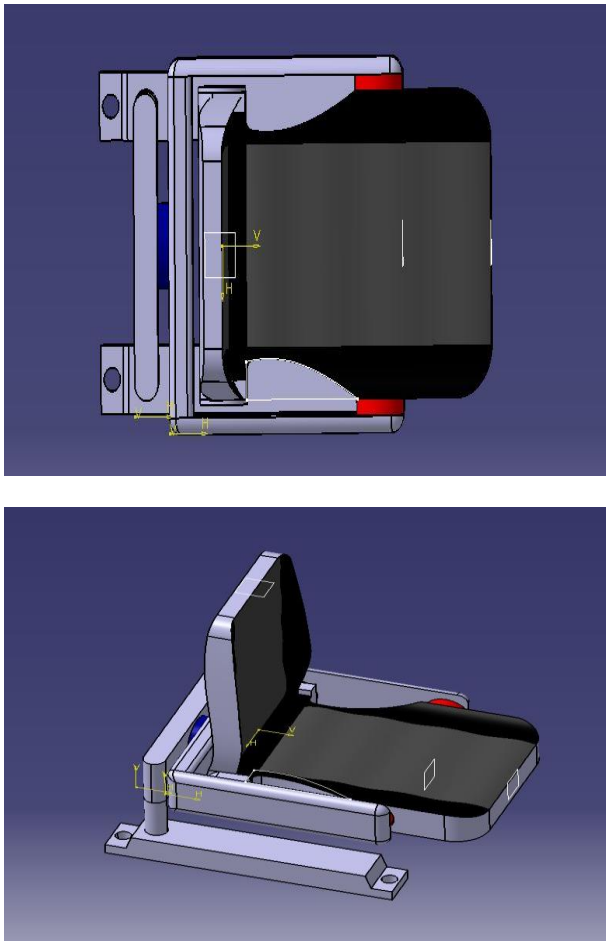

Fig 9: Gimbal seat suspension system

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4. CONCLUSION

This paper presented a review on different types of seat suspension system and discussed some of the developments happened in each type. Designing a safe and comfortable seat has become a need of today to enjoy long rides and to reduce medical problems happening due to the vibrations. Each suspension has their pros and cons. To choose a suspension system depends on various characters

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