Design of A Driver's Seat with Magnetic Dampers

Varun Wadekar, Akshay Thube, Parth Patel, Nitin Sall

Abstract— In today's world, ergonomics has huge value in automobile industry. Better comfort level is one of the top priorities for consumers in passenger car segment. With increasing the comfort for driving, long distance road traveling has become possible. Now a day, vehicles travel from one state to another and even from one country to another. Driving a vehicle is a physical as well as mental task for a driver and it requires higher amount of concentration on road. During long distance traveling in a car, driver has to deal with neck pain, back pain and discomfort in sitting on driver seat for long time. It is due to continuous vibration from the vehicle and impacts on car due to bumps, uneven roads and potholes. It increases physical and mental stresses and anxiety which increases with increase in distance to travel. It causes depression, lack of interest and discomfort while driving. It may also cause long term or permanent physical injuries. Our aim of this project is to design a seat that will absorb vibrations effectively more than a conventional driving seat. By achieving less vibration to the driver's seat, it will improve overall ergonomics of that vehicle. The research project introduces arrangement of multiple magnets underneath the driver seat with similar poles between two magnets facing each other to avoid physical contact between them due to magnetic flux.

Index Terms— Magnetic Dampers, vibration reduction, driver seat ergonomics

1 INTRODUCTION

An impact of a bump gets filtered through different car bodies before it reaches to the driver. It is reduced first by car then absorbed by suspensions then gets filtered through chassis floor and its insulations and then passes through car seat. Even after then, the amount of impact reaches to the driver leads to a long-term issues to the driver if he or she continues to drive that vehicle for long period of time.

To reduce the vibrations and impact of jerks there few possible methods, one can increase the length of the suspension spring which increases spring travel over the bump, but it will raise car height which increase lift drag force acting on it. Increase stiffness of the spring is also possible by which large impact will be opposed better but small undulations and uneven patches will not be filtered at all. Driver seat can made with thicker foam sponge, but it won't make much of a difference and seating posture will be awkward.

All these changes have some drawbacks and causes changes in driving dynamics and driver ergonomics. Hence the purpose of this project is to reduce vibrations reaching the driver without changing the original driving experience.

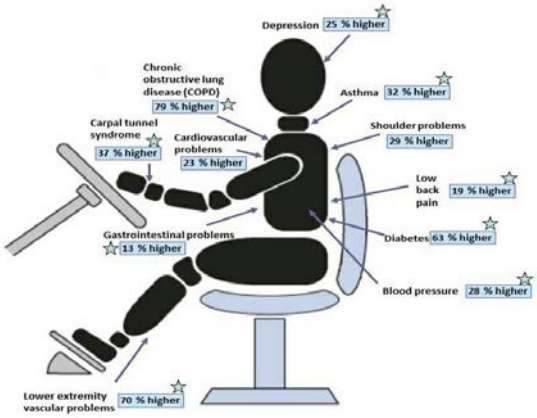
A set of magnets can be used underneath the driver seat in such a way that flux between two magnets facing same poles will cause vacant space which will absorb maximum amount of vibration. When two magnets facing each other with similar poles (i.e. north to north pole or south to south pole), they oppose each other which creates hollow space. High speed bullet train is a perfect practical example of such technology. The motion of the seat is restricted to only vertical directions for the limited space, hence turning acceleration, braking, pitching or bouncing of the car will not affect the seat to move to any other direction. The entire concept doesn't involve any electronic component, it doesn't require electrical or any other power supply to operate. Unlike fluid or air dampers it does not require regular check up or maintenance. It also does not many frictional surfaces, which indicates that it will not increase NVH levels (Noise Vibration Harshness). The numbers of parts used are also few which makes it very economical invention.

2 PROBLEMS

The conventional driver seat is made up of different layers of hard and soft sponge. A wire spring is attached at the base, and a complete setup is attached to a metal frame which is hinged to the car floor. As the driver weight is applied on a seat, sponge deforms its shape accordingly. Hence, when impact arrives, it is transferred from floor to seat frame to the driver. Very little amount of impact is reduced due to seat sponge.

3 PROPOSED METHODOLOGY

In order to overcome the problem definition discussed above a driver seat with magnetic field underneath can be introduce.



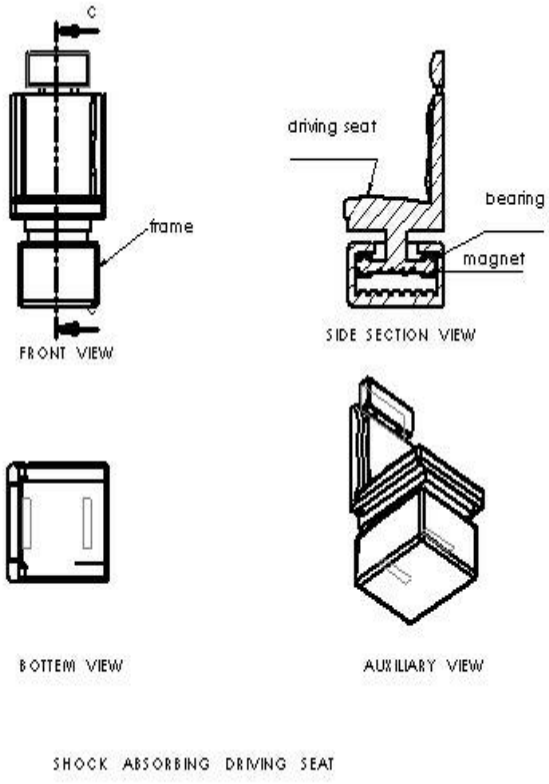
A set of magnets are arranged in such a way that similar poles opposing each other can create a hollow space between seat and frame. This gap will absorb the impact coming from the floor. The motion of seat will be restricted to move only in vertical direction; hence acceleration and deceleration won't affect seat ergonomics. Due to absence of heavy mechanical process as well as electronic components, its working process is very simplified. Its chances of failure are also very less. Wear and tear is only possible between rolling bearings and wall. Hence periodic check-up or maintenance is not required.

4 PROJECT COMPONENTS

- Two driver seats
- Set of 24 magnets
- Rolling bearing rings
- Customize seat frame (neutral to magnetic field)
- Rubber stopper pads

5 PROJECT APPLICATION

- Comfort feature in luxury vehicles
- Driver's seat for state transport trucks and long-distance buses
- Conversion into bed for ambulance
- Driving seat for off-roading vehicle
- Driver seat in military vehicles
- Driver and passenger seat for airplanes



SHOCK ABSORBING DRIVING SEAT

6 CONCLUSION

Shock absorber driver seat will enhance driving comfort and experience. Driver will be physically and mentally more focused on long distance travelling. The continuous traveling causes lumbar and neck pain or else injury due to continuous shocks and road surface impacts. This could be reduced with shock absorber seat. With further enhancement and addition of sensors and actuators, it can display allowable and acting loads on seat. It is a simple innovation, which will have significant effect in improving driving experience. The concept has no wrong effects on vehicle, driver or the driving dynamics, even the overall increase in weight due to the magnetic damping is negligible considering overall weight of the car. With economical benefits in building and negligible maintenance, it will very easy, attractive and important concept for adaptation for vehicle manufacturers in the future.

7 ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of any task would be incomplete without the mention of people whose ceaseless cooperation made it possible, whose constant guidance and encouragement helped us throughout. We sincerely express deep sense of gratitude to our guide Mr. Nitin Sall and also Head of Department Mr. Wasim Khan for their valuable guidance, inspiration and constructive suggestions that helped us in the preparation of this project. We express our sincere gratitude to our respected principal Dr. N. K. Rana for encouragement and facilities provided to us. We would also like to take the opportunity to thank our professors for their creative inputs and support. All of the aforementioned people have a big part in clearing our doubts about the project and giving us confidence to go about for the project.

8 REFERENCES

[1] Molecule-Based Magnets—An Overview Joel S. Miller and Arthur J. Epstein https://doi.org/10.1557/mrs2000.221 Published online: 01 January 2011

[2] Research Issues on the Biomechanics of Seating Discomfort: An Overview with Focus on Issues of the Elderly and Low-Back Pain Published:1992-02-01 https://doi.org/10.4271/920130 Analytical Modelling and Occupant Protection Technologies - SP-0906 SAE 1992 Transactions: Journal of Passenger Cars - V101-6

[3] Research Status and Development of Permanent Magnet Biased Magnetic Bearings Zhao Xusheng1,2 Deng Zhiquan1 Wang Xiaolin1 Mei Lei1 (1. Nanjing University of Aeronautics and Astronautics Nanjing 210016 China 2. Nanjing College of Chemical Technology Nanjing 210048 China)

[4] Impedance Methods (Apparent Mass, Driving Point Mechanical Impedance and Absorbed Power) for Assessment of the Biomechanical Response of the Seated Person to Whole-body Vibration Neil J. MANSFIELD1) Department of Human Sciences, Loughborough University Released 2006/03/17

[5] Transportation Research Part F: Traffic Psychology and Behaviour - , March 2006, John L.M.Tse KathrynMearns https://doi.org/10.1016/j.trf.2005.10.002Get rights and content

[6] Sitting biomechanics, Part II: Optimal car driver's seat and optimal driver's spinal model Author links open overlay panel Donald D.HarrisonDC, PhDaStephan J.TroyanovichDCd https://doi.org/10.1016/S0161-4754(00)90112-X