Design and Fabrication of Shock Absorbing Bumper to Reduce Impact during Road Accident

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ABSTRACT

The technology of Hydraulic plays a major role in the field of automation and modern machine industries and space robots. The main aim of this project is to design and develop a control system based intelligent electronically controlled automotive bumper. In today’s world vehicle accident is a major problem. To avoid this we have developed an automatic impact reducing system in this project. Automatic Hydraulic bumper system uses infrared sensor (IR), which is used to sense the vehicle coming in front of our vehicle which is responsible for an accident. When a vehicle is close to obstacle the IR transmitted signal from the vehicle is reflected back from obstacle and received by detector and processed in the control unit. The control unit activates the solenoid valve which moves the bumper forward. During the working of Automatic Hydraulic Bumper system simultaneously the driver also try to stop the vehicle by applying brake pedal which somewhat slows down the vehicle. The compressed oil flowing through the solenoid valve will activate the cylinder which in turn activates the Bumper. This system provides pre-crash safety to the vehicle. As well as it improves the response time of vehicle braking to keep safe distance between the vehicles. By using this system we can obtain control over the speed of vehicle in short distance. The bumper system has been designed to satisfy the reduction of impact load during road accident.

1. INTRODUCTION

Car accidents are happening every day. Maximum car user are converted that they can avoid such troublesome situations. Nevertheless, we must take into account the statistics – ten thousand dead and hundreds of thousands to million wounded each year. Structure of bumper design to prevent or reduce physical damage to the front or rear ends of passenger motor vehicles in collision condition. Different countries have different performance standards for bumpers. Under the International safety regulations originally developed as European standards. In WHO says over 1.2 million people die each year on the roads accident, and between 20 and 50 million suffer non-fatal injuries. In most regions of the world this epidemic of road traffic injuries is still increasing. Street clatters are the leading cause of death among young people ages 15-29, and the second leading cause of death worldwide among young people ages 5-14. Every year comes under 400,000 people under 25 die on the world’s roads, on average over 1,000 a day. Because all the peoples are have more requirement. So we need to fulfill that requirement by using the transport vehicles. For that purpose number of transport vehicles are increased in now a days. If the vehicles are increased the level of accident also to be increased. But this kind of vehicles cannot be avoided. Accidents are cannot be avoided but impact of the accidents can be reduced by add the some parts in car body. At first due to road accident, force and vibration was created...
in between the vehicle. The shock absorber can absorb the shock energy only. So we are going to use this design to reduce vibration of force. Road crashes are the leading cause of death among young people ages 15-29 and the second leading cause of death worldwide among young people ages 5-14. Every year comes under 400,000 people under 25 die on the world's roads on average over 1,000 a day. Due to accident created force can be reduced means we can avoid the death and save the human life. In this purpose, we are planned to reduce the impact load by means of two hydraulic cylinders arranged horizontally and vertically to absorb the impact load during the road accident.

2. **THE WORK PROPOSED HERE BY FOLLOWING STEPS**

![Fig.1 Methodology](image)

3. **OBJECTIVES**

The future of any industry is more than just developing new technology. It is integrating the approach towards achieving safety. Impact Reducing System approach represents considerable shift from the traditional approach to safety, by considering safety in terms of avoiding the possibility of accidents, protecting occupants when a crash is unavoidable, prevent more accidents, save more lives, decrease material damage to vehicles and reduce medical costs.
Following are the main objectives of Impact Reduction System with Pneumatic Bumpers:

- To ensure the braking of vehicle in time
- To increase the crashing distance during accident
- To increase the safety during pre-crash
- To increase external safety to vehicle body
- To decrease the level of passenger injury by use of external vehicle safety device
- To reduce the requirement of internal safety devices like air bags

4. BLOCK DIAGRAM OF SHOCK ABSORBER

![Block Diagram Of Shock Absorber](Fig.2 Block Diagram Of Shock Absorber)

5. DESIGN OF BUMPER ARRANGEMENT

![Bumper Arrangement](Fig.3 Bumper Arrangement)
6. CALCULATIONS

The force, velocity and power of a double-acting cylinder can be calculated as below:

Let \( D \) and \( d \) = Diameters of the piston and piston rod respectively,
\( A_p \) and \( A_r \) = cross-sectional area of the piston and piston rod respectively,
\( F_{ext} \) and \( F_{ret} \) = Hydraulic force acting on piston during the extension and retraction strokes respectively,
\( V_{ext} \) and \( V_{ret} \) = Velocity of the piston during the extension and retraction strokes respectively,
\( Q_{in} \) = Cylinder input volume flow rate in \( m^3/s \),
\( P \) = Hydraulic pressure in N/m^2.

For extension stroke:
\[
F_{ext} (N) = P_{ext} (N/m^2) \times A_p (m^2)
\]
\[
V_{ext} (m/s) = \frac{Q_{in} (m^3/s)}{A_p (m^2)}
\]

Power (KW) = \( V_{ext} (m/s) \times F_{ext} (kN) = Q_{in} (m^3/s) \times P \text{ (kN/m}^2\text{)}

For retraction stroke:
\[
F_{ret} (N) = P_{ret} (N/m^2) \times (A_p-A_r) (m^2)
\]
\[
V_{ret} (m/s) = \frac{Q_{in} (m^3/s)}{(A_p-A_r) (m^2)}
\]

Power (KW) = \( V_{ret} (m/s) \times F_{ret} (kN) = Q_{in} (m^3/s) \times P_{ret} \text{ (kN/m}^2\text{)}

6.1 Calculation of actuator

We know that,
Diameter of the cylinder, \( D \) = 50mm
\[
= 0.05 \text{ m}
\]
Diameter of the rod, \( d \) = 20mm
\[
= 0.02 \text{ m}
\]

Load during the extension and retraction \( F = 6000N \)

a. Piston velocity during extension stroke \( V \),
\[
V = \frac{Q}{A_p}
\]
\[
= \frac{0.002}{\pi \times 0.05^2} \text{ } = 1 \text{ m/s}
\]
Piston velocity during retraction stroke \( V_R \),
\[
V_R = \frac{Q}{A_p-A_r}
\]
\[
\frac{0.002}{\frac{\pi}{4} \times (0.05^2 - 0.02^2)} = 1.2 \text{ m/s}
\]

Cylinder pressure during extension stroke \( P_E \),
\[
\frac{F}{A_P} = \frac{6000}{\frac{\pi}{4} \times 0.05^2}
\]
\[ P_E = 30.6 \text{ bar} \]

Cylinder pressure during retraction stroke \( P_R \),
\[
\frac{F}{A_P} = \frac{6000}{\frac{\pi}{4} \times (0.05^2 - 0.02^2)} = 36.4 \text{ bar}
\]

Cylinder power during extension stroke,
\[
P_E = \frac{P_E \times Q}{1000} = \frac{30.6 \times 10^5 \times 0.002}{1000} = 6.12 \text{ kW}
\]

Cylinder power during extension stroke,
\[
P_E = \frac{P_E \times Q}{1000} = \frac{36.4 \times 10^5 \times 0.002}{1000} = 7.28 \text{ kW}
\]

7. EXPERIMENTAL SETUP

7.1. Circuit Connection

Fig. 4 Pneumatic Circuit Connection
7.2. IR Sensor Unit

There are many kinds of sensors like Fire sensor, humidity sensor, motion sensor, temperature sensor, IR sensor etc. The IR transmitter transmits the signal from sensor. The IR Receiver after detecting any object sends signal to the control unit in order to activate the Solenoid Valve.

![Fig.5 IR Sensor Unit Connection](image)

8. FABRICATION AND ASSEMBLE OF ALL THE COMPONENTS

![Fig.5 Assembling of sensor components](image) ![Fig.6 Assembling of all the components](image)

9. CONCLUSION

By using this shock absorbing bumper, road accidents and also hazard from accidents like damage of vehicle, injury of humans are prevented. This project work has provided us an excellent opportunity to use our limited knowledge. We are feeling that we have completed the work within time successfully. This system can be installed in both heavy duty as well as medium duty vehicles. Hence by using this system the accidents and damage to the vehicles can be minimized.
REFERENCES


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