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Automatic Pneumatic Bumper Shock Absorber and Breaking System

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Abstract: *In Today's world Vehicle is used everywhere, so vehicle Accident is major problem.to avoid this we have developed automatic impact reducing and speed minimizing technique in our project. This system is based upon electrically control system called as "AUTOMATIC PNEUMATIC BUMPER SHOCK ABSORBER AND BREACKING SYSTEM".*

Automatic Bumper Shock Absorber system provides pre-crash safety to vehicle as well as improves response time of vehicle breaking to keep safe distance between two vehicles. Therefore, our aim is to design and develop electronically operated breaking system which can automatically sense the object in front of vehicles and applies break automatically. This bumper may extract or retract by using pneumatic system depends upon connection of pneumatic cylinder used. The ultrasonic sensor senses the obstacle closer to vehicle (within range 1.5m) and control signal are given to bumper activation and automatic breaking system which control the speed, alerts the driver and reduces chances of accident.

Key Words: *pre-crash safety, speed control, alert driver, reduce accident.*

1. INTRODUCTION

India is the developing country and it is also densely populated country with maximum uses of vehicles. The number of people expire during accident is very large as compare to other causes of death. Though there are different causes of accidents but proper technology of breaking system and technology to reduce damage during accident should be developed. Hence there is need to impact reducing system to prevent accident and damage to vehicle and driver. To achieve the goal, we design this Automatic Pneumatic Bumper System. Our aim is to design and develop automatic control system intelligent electronic control automotive bumper activation system called "AUTOMATIC BUMPER SHOCK ABSORPTION"

In traffic vehicle has to move step by step very slowly. In this situation this system plays important role. It becomes very necessary to driver to keep proper distance between two vehicles. By using system driver will directly get distance between two vehicles on speedo meter in front of driver in digital form main aim is to design and develop a control system based on electronic to control mechanical components for efficient and effective working. This system consists of ultrasonic transmitter and receiver circuit, control unit, pneumatic bumper system and ultrasonic sensor.

Keywords: reduce damage, control unit, pneumatic system and ultra-sonic sensor.

2. LITERATURE REVIEW

A Literature review of the recently published research work on Optimization of Automatic Pneumatic Bumper Shock Absorber and Breaking System is carried out to Understand the research issues involved and presented here,

Mr. Umesh B. [1] A Characterization of Dynamic Human Braking Behavior with Implications for ACC Design: Skilled driving behavior can be characterized as tracking, control, and regulation of appropriate perceptual cues. Be- cause of environmental complexity, drivers must restrict attention to appropriate perceptual' cues and act to cause their vehicle to be in an acceptable perceptual state space. From experiments and supporting literature, we identify time head- way and time-to-collision as plausible perceptual cues, and characterize skilled braking behavior as a trajectory through the resulting perceptual state space. This trajectory, which terminates at a desired time headway value and infinite time to collision value, evolves in a smooth counterclockwise direction in the perceptual space spanned by time headway and inverse time to collision.

Mr. Aayush Chawla, [2] A Deceleration Control Method of Automobile for Collision Avoidance: Driver assistance systems such as warning system and pre-crash safety system have been developed to reduce and mitigate crashes in road traffic. In the view point of preventive safety, deceleration assistance control is effective when collision risk is high and it is difficult for the driver to avoid it. On the other hand, driver can feel anxiety or nuisance against the system if the initiation timing of automatic brake and/or deceleration profile is not appropriate and it may make the system inefficient. Thus, in order to realize an acceptable and efficient system, it is important to know characteristics of comfortable deceleration behavior and apply them to deceleration assistance system.

Mr. Srinivasan Chari, [3] Automatic Breaking with Pneumatic Bumper System: This system is assembled on four-wheeler vehicle. Generally, this system consists of two mechanisms and these are automatic braking system and pneumatic bumper system. Automatic braking system uses the infrared sensor (IR) which senses the vehicle which comes in front of our system and which may be cause for accident. Then sensor gives feedback to engine through relay to stop the working of engine.

Mr. Aditya Gandhi, [4] Automobile vehicles have become integral part of our lives. With growing number of vehicles on road, the numbers of traffic accidents are also increasing. It is important to prevent the chances of accidents and to protect the passengers when accidents occur. Air bags provide safety, but they are costly. Safety, being a matter of prime importance, cannot be compromised for cost. Hence our attempt is to provide a reliable and safe system at low cost. Though there are different causes for these accidents but proper technology of braking system and technology to reduce the damage (such as pneumatic bumper system) during accident can be effective on the accident rates. So, in today's world, implementation of proper (automatic) braking system to prevent the accidents is a must for vehicles. Therefore, pre-crashing system is demanded. Such a system will prevent accidents on roads with poor visibility by using proximity sensors to detect other vehicles, or any other obstacle in the path.

3. IMPORTANT COMPONENT

3.1 Pneumatic Cylinder:

The pneumatic cylinder used is double acting cylinder. The working fluid act alternatively on both side of piston. For connecting rod to the piston with external mechanism holes are provided on the both side of the cylinder. Cylinder is double acting cylinder which means that air pressure operates forward and backward strokes pneumatic cylinder is used to carry out mechanical work.

3.2 Ultrasonic Sensor:

Ultrasonic sensor works on principle of SONAR & RADAR system which is used to determine distance of an object. Ultrasonic sensor generates high frequency sound waves. When this sound wave hit the object, it reflects as an echo which is sensed by receiver unit of some sensor.

3.2 **Direction Control Valve**:

A solenoid operated DCV is used in this system. The 2-way solenoid valves have one inlet & one outlet port. It controls the direction of air flow to give motion to cylinder.

3.4 Control Valve:

The Arduino-Uno is a micro controller board based on the AT mega 328. It has 14 digital input/output pins (which 6 can be used as PWM outputs), 6analog input, 16 MHz ceramic resonator, USB Connections, power jack & reset button, and digital display board is controlled by this microcontroller.

3.5 Air Compressor:

The air compressor used in car, the same compressor is used for this system. The work produced by compressor is not fully utilized in car. Just up to 40 to 45% is used & remaining is wasted. Hence the same compressor is used for this system.

4. WORKING AND BLOCK DIAGRAM

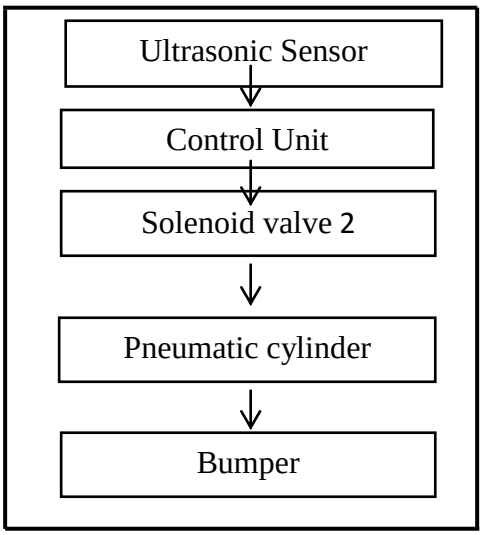

Fig -1: Constructional Block Diagram of Automatic Bumper

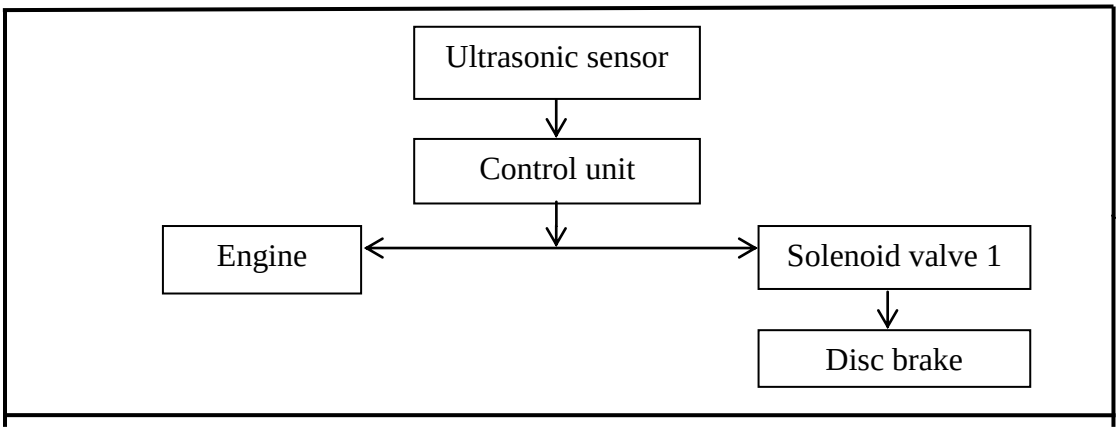

Fig -2: Constructional Block Diagram of Automatic Breaking System

As this system is used at the time of emergency during work. In normal travelling of vehicle this system is off and it never impact on the normal working. When any obstacle, humans, animals or vehicle is coming in front of the vehicle then the installed sensor senses that obstacle. The range of distance between the vehicle and obstacle is variable. This range is varied according to the density of vehicles or humans on road. The received signal by ultrasonic sensor is provided to the control unit. This control unit operates the relay according to the input signal. The relay operated by control unit cut off the electric power supply given to the engine so the working of engine is stop. When the engine stops the working the motion of vehicle suddenly reduces. At the same time of working of ultrasonic sensor the driver also applied the brake so braking system works by two methods. There is some incidence when the working of automatic braking works and engine running is also stop but due to the moment of inertia on vehicle tries to forward motion of the vehicle. This inertia motion cause for accident. During such incidence the driver also uses manual braking system. In this manual braking system limit switch is also installed below the brake pedal. By receiving the foot force of driver, the limit switch activates and provides the signal to the solenoid control valve. Solenoid control valve opens port going towards the bumper system and brake shoes. This pneumatic force used to forward motion of the bumper. By receiving the impact of accidental force bumper try to deflects. The flexible nature of the bumper able to sustain the force and so the impact of this force on vehicle is reduces. When the external body is kept safe then there is no chance of inner damage.

5. IMPORTANT CALCULATIONS

5.1 Stopping Distance Calculations,

The total stopping distance = Human perception distance human reaction distance + Breaking distance

+ Distance curved in 1msec

Breaking distance,

$D_{breaking} = V^2 / 2\mu g$

Where,

v=velocity before applying break

μ=coefficient of friction, μ=0.7

g=Acceleration due to Gravity, 9.81m/s

$D_{breaking} = (4.167)^2/2*0.7*9.81 = 1.26m$

Here, Human perception time=0, because it is automatic breaking system.

Total stopping Distance= 1.26+bumper actuation length

=1.26+0.100m

=1.36m

Hence the sensor range is set at 1.5meter.

5.2 Assumption regarding Vehicle (According to standards)

- Weight of Vehicle=1500kg
- Frictional coefficient of wheel=0.6
- Wheel base=2meter
- Center of Gravity of vehicles from ground=0.508m
- Diameter of tire=0.5m
- Inner Diameter of Disc (D_i)=100mm
- outer Diameter of Disc (D_o)=200mm

5.3 Load distribution Analysis

40% of total load on front two tire

60% of total load on rear two tire

Load on each wheel,

On front wheel=300kg

On rear wheel=450kg

5.4 Breaking force & pressure analysis

Static load on wheel,

$(F_s)=\mu f*R_n$

$=0.6*300*9.81$

$(F_s) =1765.8N$

Dynamic Weight transfer,

$(F_d)= [(m*a*h)/W]$

$= [(450*0.5*9.81*0.508)/2*2]$ …… {For a=0.5g}

$(F_d) = 280.32N$

Total Load,

$F_T = F_S + F_d$

$=1765.8 + 280.32$

$F_T = 2046.12N.$

Table -1: Total Load Analysis

Sr. No	Acceleration	Dynamic Weight Transfer (N)	Total Load (N)
1	0.5	280.32	2046.12
2	1.2	672.76	2438.56
3	2.0	1121.28	2887.08
4	3.7	2074.37	3840.17

5.5 **Impact force calculations**:

{Ref.: International Journal of Eng. Science and Computing, April 2017}

Velocity = 4.167 m/s

By equation of motion,

$$2as=v^2-u^2$$

Where, s= Breaking distance

v=Final velocity

u= Initial velocity

$2*a*1.36=0^2-(4.167)^2$

a= 6.383 m/s^2

Now,

Impact force, F= m*a

=1500*6.383

Impact force = 9574.5 N

Table -2: Impact Load Analysis

Sr. No	Initial velocity (u)	Acceleration (m/s^2)	Impact Force(N)
1	2	1.470	2205.88
2	4.167	6.383	9574.5
3	6.52	15.62	23443.23

6. CONCLUSIONS

1) Behind the designing of this system, our main aim is to improve the technique of prevention of accidents and also reducing the hazard from accidents like damage of vehicle, injury of humans, etc.

2) In conclusion remarks of our project work; we have developed an "ACCIDENT PREVENTION SYSTEM BY AUTOMATIC PNEUMATIC BUMPER" which helps to achieve low Impact damage.

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