

# PNEUMATICALLY ACTUATED BUMPER SYSTEM

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## ABSTRACT

The technology of pneumatics has gained maximum importance in the field of automation from old-fashioned timber works and coal mines to modern machine shops and space robots. It is therefore important that technicians and engineers should have a good knowledge of pneumatic system, air operated valves and accessories. Our aim is to design and manufacture a control system based on smart electrically controlled automatic bumper activation system called "Smart Braking system with Pneumatic Bumper". This system consists of Infrared transmitter and Receiver circuit, Control Unit, Pneumatic bumper system and braking unit. The IR sensors are used to detect the obstacle coming in front of vehicle. If there is any obstacle closer to the vehicle, the control signal is given to the bumper activation system braking unit. The pneumatic bumper system is used to provide safety to the man and vehicle. Now a day's vehicle accidents are the major problem. This smart braking system is an innovative project for the purpose of preventing accidents or reduce the impact of frontal accident happens in the restricted roadways. The purpose of this system is based on smart electrically control automatic bumper and brake activation system known as "Smart braking system with pneumatic bumper". As well as this system improve the response time of vehicle braking to keep safe distance between two vehicles.

**Keywords:** Breaking unit, Double acting cylinder, UR Sensors Pneumatic bumper, Compressor.

## ARTICLE INFO

### Article History

Received: 19<sup>th</sup> April 2018

Received in revised form :  
19<sup>th</sup> April 2018

Accepted: 21<sup>st</sup> April 2018

**Published online :**  
22<sup>nd</sup> April 2018

## I. INTRODUCTION

Today India is the most important under developed country in the world. India is the largest country in the use of various types of vehicles. As the available resources to run these vehicles like quality of roads, and unavailability of new technologies in vehicles are causes for accidents. The number of peoples which are dead during the vehicle accidents is also very large as compared to the other causes of death. Though there are various causes of the accidents but proper technology of braking system and technology to reduce the damage during accident are mainly effects on the accident rates. So today implementation of proper braking system to prevent the accidents and pneumatic bumper system to reduce the damage is must for vehicles. To get this system implementation goal, we design this Smart

braking system with pneumatic bumper. It is the project which has been fully equipped and designed for auto vehicles.

In regular vehicles there are various mechanism operated for the braking system like use of hydraulic, pneumatic, or mechanical system. But all these braking mechanisms receive the input signal directly from the driver by application of force on brake pedal. Thus, braking of vehicles is totally manual operated. So, if the driver fails to see the obstacle in front of his driving vehicle or fails to apply proper braking force on the brake pedal, he may lose the control of his vehicle, leading to accident.

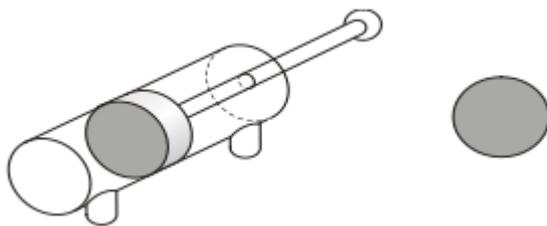
Also the driver may not able to pay complete attention when driving at night. So there are many chances of

accidents. Urgent application of brakes can result in veering of the vehicles due to skidding of tyre. Moreover, due to sudden application of brakes there are chances of other vehicles dashing from back. Hence, there is no provision to minimize the damage of vehicles. Thus, the current designed system only fairly reduces the damage of vehicle and/or passengers.

**II. CONSTRUCTION**

Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When the pneumatic system is being adopted for the first time, it should necessary to deal with the question of compressed air supply. The key part of any facility for supply of compressed air is by means of using reciprocating compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivered the air at a high pressure. The pneumatic systems consist of the following components, 1.Pneumatic single acting cylinder, 2.Solenoid valve, 3.Flow control valve, 4.IR sensor, 5.unit Wheel and brake arrangement, 6.PU connector, 7.Reducer, 8.Hose, 9.collar, 10.Stand, 11.Single phase induction motor.

**Pneumatic Cylinder**



Stroke length: Cylinder stoker length 140 mm = 0.14 m

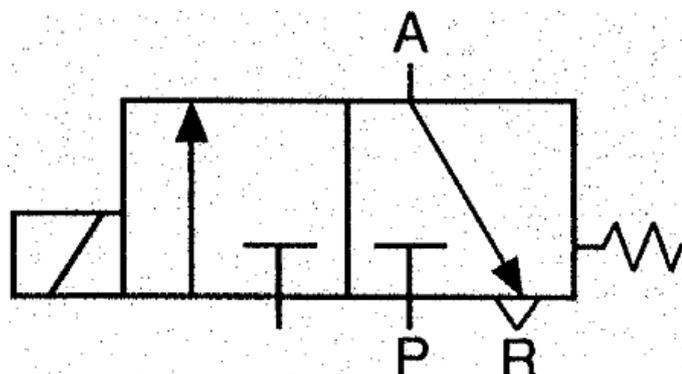
Pressure Range: 6-8 bar.

Rod Diameter: 15mm Seals: Nitride (Buna-N)

Elastomeric End covers: Cast iron,

Temperature Range: 0-85 °

**Solenoid Valve**



A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn

operates the valve mechanism. Size: 1/4” Pressure: 0 to 7kgf/cm<sup>2</sup> Applied Voltage: 230V A.C Frequency: 50Hz

**Braking System and Bumper**

Brakes are attached to the rear end of the vehicle. They are driven by pneumatic cylinder which operates on flow of compressed air. Assuming the weight of the whole setup not to exceed 30kgs, the bumpers that are installed are of extendable type. They have a stroke length of 140mm. Bumper is aimed for protecting the vehicle. On actuation of solenoid valves compressed air flows through the piston of pneumatic cylinder. The piston rod of the cylinder is welded to the midsection of the bumper.

**UR sensor unit**

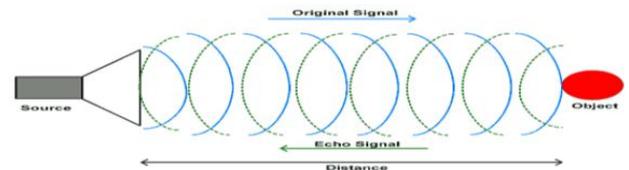
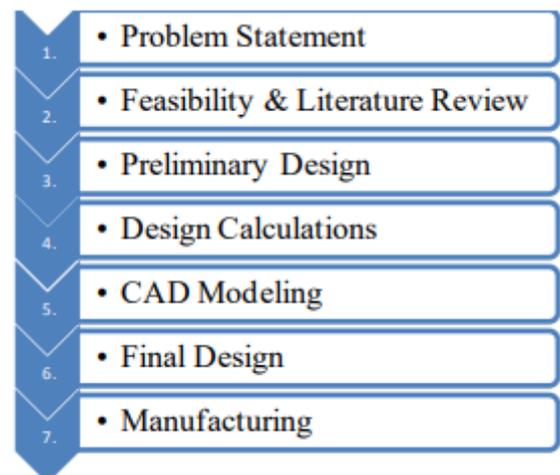


Fig No 1. UR Sensor

**Objectives**

- 1) To increase the sureness of braking Application.
- 2) To increase the response time of braking system.
- 3) To improve the pre-crash safety.
- 4) To avoid the percentage of passenger injury by using external vehicle safety.
- 5) To reduce the requirement of internal safety devices like air bags.

**III. METHODOLOGY**



**IV. EXPERIMENTAL SETUP**

The UR Transmitter circuit is to transmit the Ultrasonic rays. If any obstacle is there in a path, the Ultrasonic rays reflected. This reflected Ultrasonic rays are received by the receiver circuit is called “UR RECEIVER”. The UR receiver circuit receives the reflected UR rays and giving the control signal to the control circuit.



Fig No 2. Cart Frame

The control circuit is used to activate the solenoid valve. If the solenoid valve is activated, the compressed air activates the pneumatic cylinder and moves the piston rod forward. Thus the bumper is actuated. When the solenoid valve gets actuated the compressed air also goes to the small single acting pneumatic cylinder and actuates it. The control unit activates the pneumatic braking system, so the brake is applied.

## V. CALCULATIONS

Motor Calculations –

- Specifications- 30 RPM  
12 V  
18 W
- Torque of Motor –  

$$T = (P \times 60)/(2 \times 3.14 \times N)$$

$$= (12 \times 60)/(2 \times 3.14 \times 30)$$

$$= (1080)/(204)$$

$$T = 5.2941 \text{ Nm}$$

$$= 5.2941 \text{ K Nmm}$$

Calculations of Cylinder :

- Diameter of the Cylinder = 32 mm

$$\begin{aligned} \text{Area of the Cylinder} &= (\pi \times d^2) / 4 \\ &= (\pi \times 0.032 \times 0.032) / 4 \\ &= 0.0008042 \text{ m}^2 \end{aligned}$$

- Force acting on the rod (F)  

$$F = \text{Pressure (P)} \times \text{Area (A)}$$

$$\text{Pressure (P)} = 3 \text{ Bar}$$

$$= 3 \times 10^5 \text{ N/m}^2$$

$$\text{Area (A)} = 0.0008042 \text{ m}^2$$

$$F = 300000 \text{ N/m}^2 \times 0.0008042 \text{ m}^2$$

$$F = 241.2743 \text{ N}$$

- Impact Force Calculations –

Force,  $F = \text{mass (m)} \times \text{acceleration (a)}$

Mass of the vehicle  $m = 60 \text{ kg}$

By motion Equation,

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

Where,  $v = \text{Final velocity} = 3.14 \text{ m/s}$

$a = \text{acceleration, } s = \text{braking distance (} Db = 2.24 \text{m)}$

$u = \text{Initial velocity} = 0$

$$2 \times a \times 2.24 = 3.14 - 0 = 2.2008 \text{ m/sec}^2$$

Acceleration  $= a = 2.2008 \text{ m/s}^2$

Force,

$$\begin{aligned} F &= m \times a = 60 \times (2.2008) \\ &= 132.04 \text{ N} \end{aligned}$$

The Final impacting force value  $F = 132.04 \text{ N}$

## VI. ADVANTAGES

1. It able to Increase the sureness in braking system.
2. Braking system able to give fast response.
3. System able to increase the pre-crash safety.
4. System able to provide more safety to the passengers.
5. System plays an important role to save human
6. Life in road accidents.

## VII. LIMITATIONS

1. System has few limitations in densely traffic road.
2. System has no provision to prevent and cure the accidents from rear side of vehicle.
3. Hard and thick materials cannot be riveted.
4. Due to the linkages there will be frictional losses.
5. Maintenance will be more due to the number of moving parts.
6. Stroke length is fixed.

## VIII. APPLICATIONS

1. This system may be applicable in all types of light vehicles like cars, Rickshaws, Tempos.
2. This system also successfully installed in the heavy vehicles like buses, trucks, trailers, etc.

## IX. CONCLUSION

Our main aim behind the designing of this system is reached successfully which is having some limitations. We observed that our system can able to achieve all the objectives which we have determined. The system can be disconnected with a switch thus the driving is comfortable in traffic situation. In

future this project can be modified by using the retarded braking system.

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