A Spring Loaded Flexible Bumper Controlled Automotive Braking

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Abstract – *In almost all of the cases of vehicle accidents, the basic reason cited is failure to apply the brakes at the right time. Considering this failure, a mechanical system having spring loaded flexible bumper is designed. During obstacle, the spring is compressed to apply clutch and brake. A system consists of sensor, pneumatic bumper system and intelligent braking system, increases complications and its cost [1]. Proposed hardware system is simple and does not require any of these components. Through the testing, accuracy for the compression of spring is obtained. This paper presents well designed prototype of spring loaded flexible bumper controlled automotive braking system.*

Key Words: Mechanical spring, bumper, automotive braking system

1. INTRODUCTION

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 during accident can be effective on the accident rates. In today's world to prevent the accidents by vehicles, implementation of automatic braking system is must [2]. Therefore, pre-crashing system is demanded. Such a system will prevent accidents on road.

In conventional vehicles there are different mechanism operated for braking system like use of hydraulic, pneumatic, or mechanical system. But all these braking mechanisms get 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 [3]. Also the driver may not able to pay complete attention when driving at night. So there are many chances of accidents. 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 [4].

2. MECHANICAL SPRING

Springs are mechanical elements that exert forces or torques and absorb energy. The stored absorbed energy is released later. Springs are made up of metal. Metal springs can be replaced by plastic springs in case of light loads. Structural composite materials are used by some applications which require minimum spring mass. Blocks of rubber can be used as springs, in bumpers and vibration mountings of electric or combustion motors. Figure 1 shows mechanical spring.

Fig -1: Mechanical spring

3. WORKING PRINCIPLE DESIGN & ANALYSIS

1.1 Construction of Project

Figure 2 shows actual diagram of project. The aim is to design and develop a spring controlled automotive braking system. Here flexible bumper is attached to the chassis of the vehicle by means of spring. Hence bumper gets compressed against spring force on the application of external force. Hence this bumper is called as flexible bumper because it gets pressed under the application of external force. Hence this bumper is pressed due to obstacle coming front of the vehicle. A link is used which is pivoted to the chassis and connected to the flexible bumper and link of brake pedal. In this prototype, the components such as sensor, pneumatic bumper system and intelligent braking system are replaced by a single spring. When obstacle comes in front of vehicle then it compresses the spring loaded flexible bumper first and take some time to reach the actual chassis of vehicle. During this time interval, flexible bumper rod drags the brake and clutch pedal by means of spring and it actuate clutch and brake of the vehicle.

Fig -2: Construction of project

In this way, vehicle stops without actual contact with chassis. Hence collision is reduced by stopping the vehicle.

4. DESIGN & ANALYSIS

4.1 Spring

Our braking action can possible if bumper is moving 20 to 25 mm in the direction of chassis [5]. Hence for maximum displacement of spring (shown in figure 3) i.e. for $\delta max=25mm$
Fmax=1200N can be generated by impact of human
Assuming Spring Index=C=5;
Spring Material:
τ = 400 N/mm2
G=85 X 103 N/mm2
Wire diameter:
Wahl factor Kw= (4C-1)/ (4C-4) + (0.615/C)
= [(4X5)-1]/ [(4X5)-4] + (0.615/5)
=1.3105
Shear Stress Induced:
τ = Kw [8 Fmax C/πd2]
400= [1.3105 X 8 X 1200 X 5]/ πd2
d=7.1mm
Mean Coil Diameter:
D=Cd
=5 x 7.1
=35.5 mm
Taken D=40mm
No. of coil turns:
Spring Stiffness, K=Fmax/δmax
= 1200/25 =48N/mm
Now, K=Gd/8C3n
48= (85 X 103X 7)/ (8 X n X 53)
n=12.6
Assuming square & ground ends,
Total no. of coils,
n'= n +2 =14.6

Spring length & pitch
Solid Length, Ls= (n+2) d
= (12.6+2)7.1
=103.66 mm
Free length= Solid length + Max. Deflection+ Total Clearance
= Ls + δmax + (n'-1)1
= 103.66+25+ (14.6-1)1
Lf =142.26mm
Now, Lf = pn + 2d
142.26 = p (12.6) + (2x7.1)
p=10.16mm

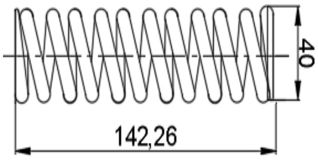

Fig -3: Spring

4.2 Frame

The Height of frame must be greater than the radius of wheel for proper rotation (Figure 4).
Hence Rad. Of wheel=325 mm
Hence frame height selecting giving proper clearance between ground level = 350mm
Frame width at one end =140mm which is near about less than the length of pedal rod.
Frame width at one end =180mm which is near about less than the length of axle rod of the hub.

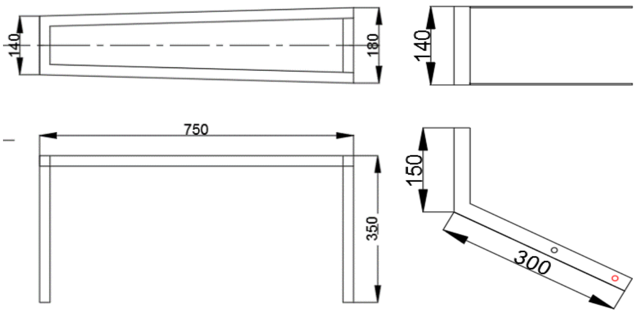

Fig -4: Frame and Flexible Bumper

5. LIST OF MATERIALS

Table -1: List of materials [6]

Sr. No.	Description	Material	Quantity
1	Wheel	STD	01
2	Link	Steel	01
3	Link	STD	01
4	Flexible Bumper	MS	01
5	Spring	Steel	01
6	Frame	MS	01
7	Brake Pedal	STD	01

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5.3 Cost of Equipment

Table -1: Material Cost

Sr. No.	Name of component	Specification	QTY.	Cost
01	Wheel with Drum	325 mm dia.	01	450
02	Tyre	3300 mm dia.	01	120
03	Brake shoe with link		01	350
04	Axle	200mm long	01	80
05	Bearing for wheel hub		02	160
06	L channel (Angle)	1" and 15 feet	01	420
07	Sheet metal	0.5 mm thick perforated	01	40
08	Pivot rod	200mm long	02	80
TOTAL				1700

Table -1: Manufacturing Cost

Sr. No.	Manufacturing	Time	Cost
01	Frame	80 min.	510
02	Bumper	40 min.	230
03	Assembly	10 min.	30
TOTAL			770

6. ADVANTAGES

1. It avoids unnecessary movement of bumper as it activates only when obstacle compresses the flexible bumper of vehicle.
2. It does not require any proximity sensor which is costly.
3. It does not require any intelligent braking system to stop the vehicle when bumper is activated.
4. It does not require any Compressor for activating the bumper.
5. Overall cost & size becomes low due to absence of sensor, intelligence braking system, pneumatic system with compressor.

6.1 Limitations

1. System has very few limitations in densely traffic road.
2. To avoid total accident, system must be situated at both sides of the vehicle.
3. Time interval require for obstacle to compress flexible bumper and chassis must be as high as possible.

6.2 Applications

1. Three wheeler & four wheeler can use this to avoid damage of vehicle body & human due to accident from obstacle coming from the front of vehicle.
2. Heavy vehicles like buses, trucks, trailers etc. can also successfully use this system.

7. CONCLUSIONS

With limited knowledge, an excellent opportunity and experience has provided by this paper. This paper introduces a system which is totally mechanical and apply the clutch and brake when obstacle compress the spring loaded flexible bumper. The Overall cost & size is lowered due to absence of sensor, intelligence braking system, and pneumatic system with compressor.

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