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Automatic Pneumatic Collapsible Steering Wheel System

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Abstract:-In frontal impacts, the steering wheel is an essential component in fatal injuries to drivers. Due to the kinetic energy of the driver or occupant body during a frontal collision, it pushes forward on the steering wheel and wind shield. In a frontal impact, the driver's feet actually serve as the fulcrum via which forces are first transmitted, causing the body to rotate around them. The steering serves as the fulcrum for the taller driver. Driver's head and chest hitting the steering wheel or windshield could result in serious injury or even death. We are introducing a novel concept called the Pneumatic Collapsible Steering Column (PCS) in light of the risk of harm from steering wheels.

Keywords:- *Sterring Mechanisum; Pneumatic Cylinder; Solenoid Valve; Bumper.*

I. INTRODUCTION

The number of auto accidents is rising daily all around the world. Frontal impacts happen more frequently than other forms of impacts and are more vulnerable. When a frontal collision happens, the car may strike a fixed or moving object or another car. The engine supports are meant to reduce the risk of the engine and firewall extending into the occupant compartment when the crush progresses towards engine components. Due to this kinetic energy, the body of the driver or passenger pushes up against the steering wheel and windscreen. Vehicle is at present slowing to its maximum capacity. Head, neck, coxa, and knees of the driver and front passenger were moving far faster forward than the seat under them was still. The driver's shoulder will move if they are using their seatbelt. The steering serves as the fulcrum for the taller driver. Driver's head and chest hitting the steering wheel or windshield could result in serious injury or even death. The typical location for fatal injuries for drivers in frontal impacts is the steering wheel. Before 1967, the steering column was a rigid pole that ended in a small hub in motor cars. When a head-on collision occurs, the driver's load is concentrated on the small hub and strikes the stiff column. Many steering wheel designs enable extremely high impact loads to be delivered to the driver's chest and head during crash deceleration.

The steering wheel was discovered to have caused skeletal injury to the skull in some additional cases without deforming the wheel rim. Despite the low forces, the axial movement of the steering wheel is more injurious. Therefore, numerous types of collision prevention measures, such as seat belts, air bags, etc., are required to lower the death rate during vehicle collisions. And we are taking a new form called “Automatic Pneumatic Collapsible Steering Wheel System”

II. LINE DIAGRAMS OF PARTS

A. Bumper with Spring

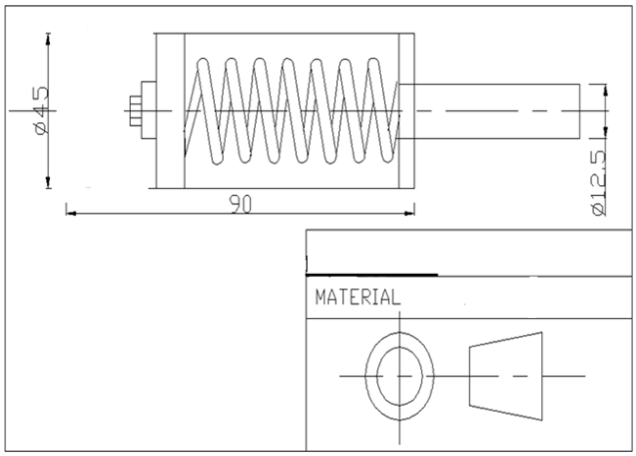

Fig 1 Bumper with Spring All Dimensions are in mm

If in case the sensor is broken or damaged or if it does not sense the vehicle coming then after the vehicle is hit on firstly to the bumper. This bumper will have a switch attached to it where it will trigger the valve then the collapsing of the steering wheel will take place as the usual procedure.

B. Double Acting Pneumatic Cylinder

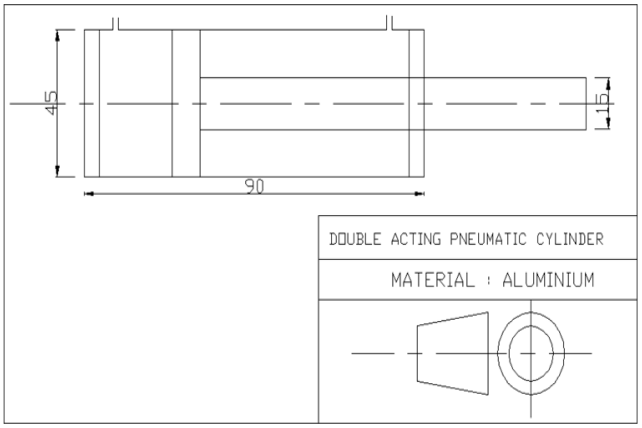

Fig 2 Double Acting Pneumatic Cylinder All Dimensions are in mm

Pneumatic cylinders are mechanical devices that utilize the power of compressed gas to produce a force in a reciprocating linear motion. They are also referred to as air cylinders. Similar to hydraulic cylinders, a piston is propelled in the desired direction by an external force. The piston, which can be a disc or cylinder, transfers the force it generates to the object that has to be pushed through the piston rod. Because pneumatics are cleaner, quieter, and require less space for fluid storage, engineers sometimes prefer to utilize them.

C. Reducer

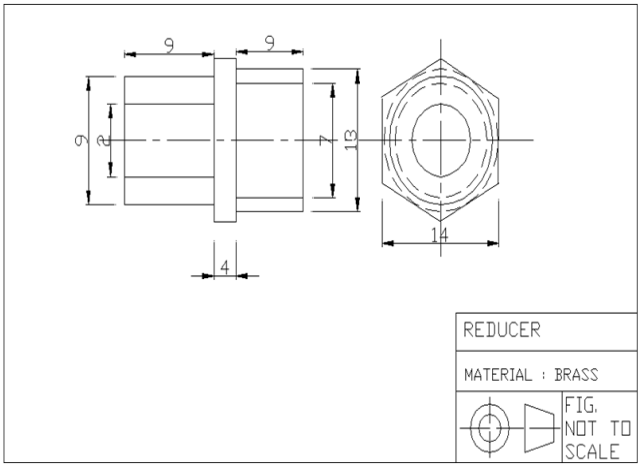

Fig 3 Reducer All Dimensions are in mm

A reducer is a pipeline component that shrinks the inner diameter of the pipe from a bigger to a smaller size. The average of the bigger and smaller pipe diameters is typically used to determine the length of the reduction. Eccentric and concentric reducers are the two primary categories of reducer. Depending on the flow's Mach number, a reducer can be utilized as a nozzle or a diffuser, Hose collar.

D. Hose Collar

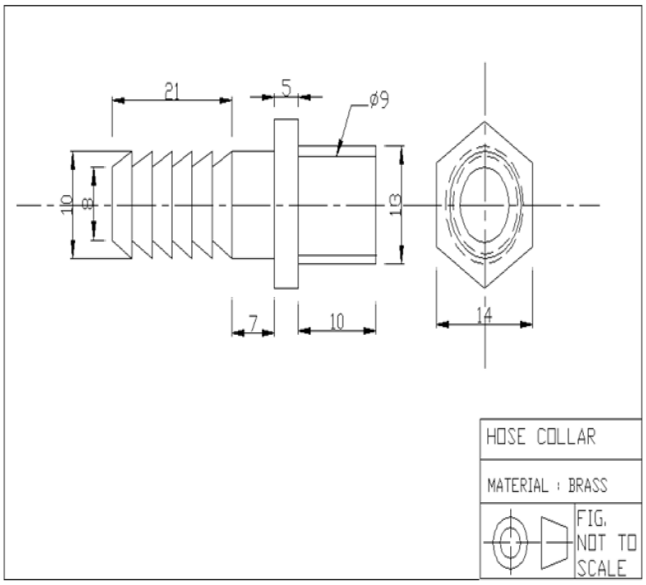

Fig.4 Hose collar All Dimensions are in mm

A hose is a flexible hollow tube designed to carry fluids from one location to another. A hose collar is one which holds the hose (pipe) in a very tight manner so that there is no leakage present in the pipe line.

E. Solenoid Valve

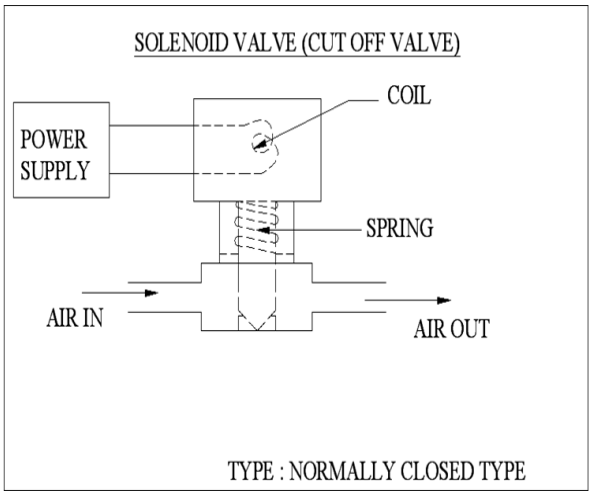

Fig 5 Solenoid Valve All Dimensions are in mm

A solenoid is an electrical device that uses electricity to deliver force and motion in a straight line. In addition, these are employed to operate a mechanical process that controls the valve mechanism. Solenoids come in push or pull variants. The plunger is pushed when the solenoid is electrically energized in a push type solenoid. The plunger is pulled when the solenoid is energized in a pull type solenoid.

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F. Assembly of Collapsible Steering Wheel to Chassis

Fig 6 Assembly of Collapsible Steering Wheel to Chassis

III. WORKING OF PNEUMATIC COLLAPSIBLE STEERING

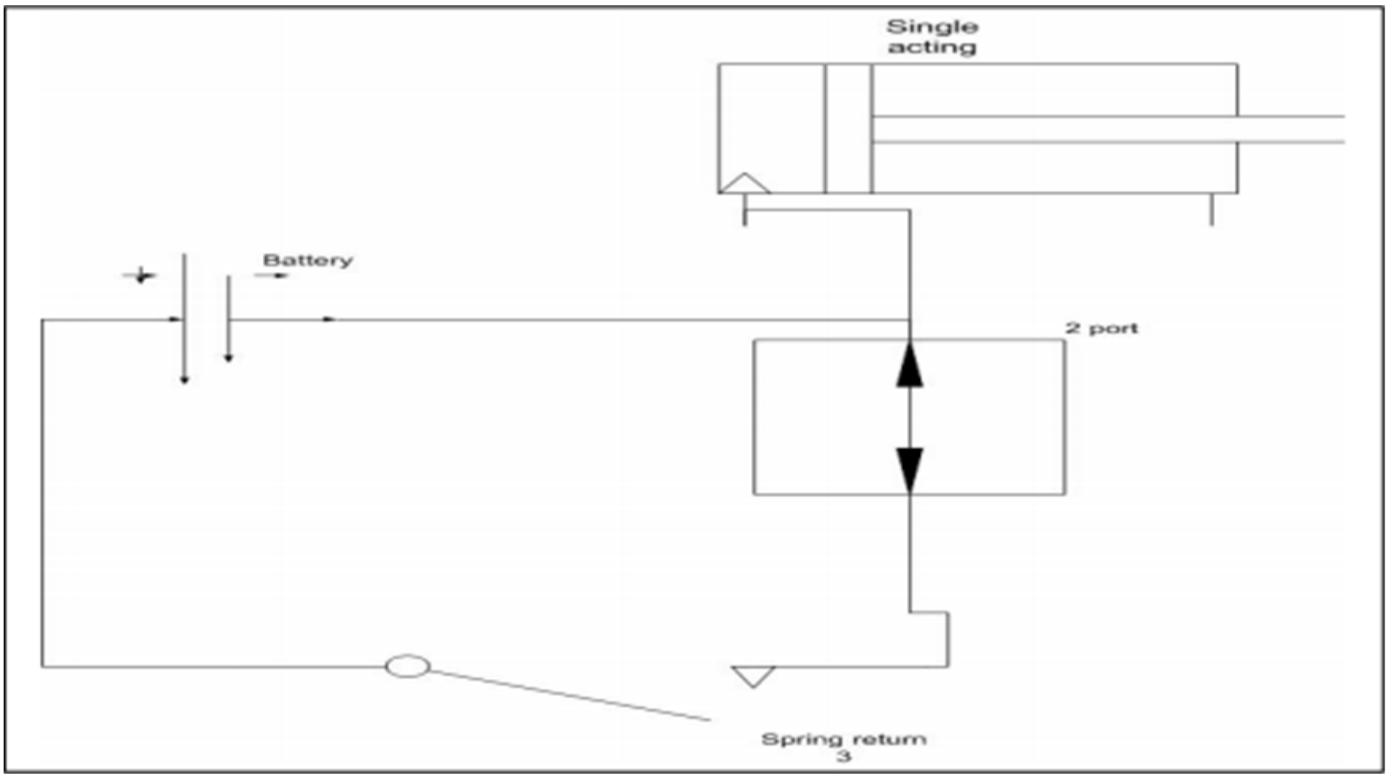

Fig 7 Circuit diagram of Pneumatic Collapsible Steering

A circuit diagram (Fig.7) can be used to show how Pneumatic Collapsible Steering (PCS) operates. Assume a car has a PCS system installed. The vehicle's front side is equipped with a few mechanical switches. Therefore, one or more mechanical switches will be damaged during a frontal collision. As aresult, the circuit will close, and the battery will then supply DC current to the solenoid valve. Thus, the solenoid valve allows the compressed air from the pneumatic cylinder to rapidly escape. As a result, the steering will collapse.

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IV. PRACTICAL TRIALS

A. Trial for Sensor Board.

Table 1 Detection on Sensor Board

Trial	SlNo	Distance FromBoard (Cm)	Detected TheObject	Collapsing Of Steering Wheel
			(Yes Or No)	*(Yes Or No)*
1	1	65	No	No
	2	60	No	No
	3	45	Yes	No
	4	40	Yes	No
	5	35	Yes	Yes
		Distance Detected = 35	Yes	Yes
2	1	55	No	No
	2	50	Yes	No
	3	40	Yes	No
	4	35	Yes	Yes
	5	30	Yes	Yes
		Distance Detected = 35	Yes	Yes
3	1	40	Yes	No
	2	38	Yes	No
	3	35	Yes	Yes
	4	30	Yes	Yes
	5	25	Yes	Yes

B. Trial For Bumper Switch

Table 2 Force Applied On Bumper Switch

Trail	SlNo	Force Applied(Kg)	Did Sensor Detect It (YesOr No)	Collapsing Of Steering (YesOr No)
1	1	2	No	No
	2	3	No	No
	3	4	No	No
	4	4.5	Yes	No
	5	5	Yes	Yes
2	1	3	No	No
	2	4	Yes	No
	3	5	Yes	Yes
	4	7	Yes	Yes
	5	8	Yes	Yes
3	1	4	No	No
	2	5	Yes	Yes
	3	8	Yes	Yes
	4	9	Yes	Yes
	5	10 (Max)	Yes	Yes
	6	12(Max)	Yes	Yes (Switch Button Broken)

C. Over All Result of Practical Error

- *Sensor Board*

Maximum distance detection of the object = 50cm. Maximum distance for collapsing of the steering wheel = 35cm.

- *Bumper Switch*

Minimum force required = 5kg.

Maximum force could be applied = 12kg.

V. CALCULATIONS

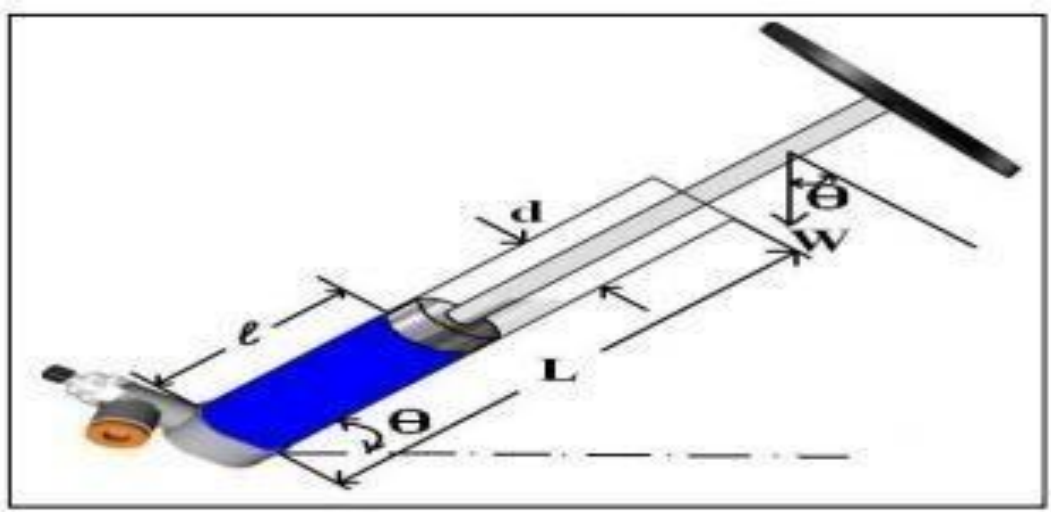

Fig.8 Assembly of Steering Wheel and Pneumatic Cylinder with Notations

- A cylinder that is L in length and has a length air column inside.
- Let W represent the top assembly's weight.
- treating forces as equal; downward force equals upward force
- Downward pressure W = **mg** $sin\Theta$. **V**. **g** sin Θ
- ∴ **m** = **ρV** Where m is the steering rod's mass and kg/m is the alloy's density in kg/m, Volume is 3 V in m 3. Pressure X area = upward force. Pressure = force / area
- i.e.; from this upward pressure = $\boldsymbol{V.g\ sin\Theta\ \pi\ 4\ d2}$

Total volume = base area of rod x length of rod = π/ 4 × 0.022

× 0.4 =1.25 × 10−4 m^3 .v.

∴ Mass = 7850 kg / m 3 = 7850 ×1.25 × 10^{-4} = 0.9865 kgApproximated mass of steering = 2 kg

∴ Total weight =2 + 0.9865 = 2.9865 kg

∴ Pressure, p = (2.9865×9.81×sin 60) π/4×0.0362 = 24,926.84N m^2 = 0.24926 bar.

Mechanical Switch Research shows that, average duration of frontal collision is around 100 milliseconds (ms). In that time average amount of kinetic energy produced = 6733J.

For a Vehicle speed of 30mph. i.e.: Duration of frontal collision = 100millisecond = 0.1 sec. Energy in one second, power = **6733**×**0.1** = 67330J/s

Vehicle speed in m/s = 30 × 1.606 = 48.2Km /S = 48.2×5 18 = 13.389m/s (1 mph = 0.44704 m / s) We have power = Force×velocity

Therefore Force = Energy/Velocity = 67330 13.389 = 5032.13N Equating this with basic spring equation; F = KX

Where k = stiffness in N/m Deflection X in meter Assuming deflection as 10mm=0.01m (Distance between the contact points in mechanical switch)

Therefore stiffness, K= $\boldsymbol{F\ X}$ = **5032**. **.01** = 5.03× **10 5** N/m this is the required stiffness of the spring in Mechanical switch. Thus when frontal collision occurs the solenoid valve will get activated, for a force greater than 5050 N. Thus the steering will collapse.

VI. RESULTS

➢ *Sensor Board*

Maximum distance detection of the object =50cm.

Maximum distance for collapsing of the steering wheel =35cm.

➢ *Bumper Switch*

Minimum force required = 5kg. Maximum force could be applied = 12kg.The maximum steering height is 12 cm.

- ➢ The response time for the collapsing steering action is 0.1to 0.3 seconds.
- ➢ A pneumatic cylinder must have a minimum pressure of0.24926 bar.
- ➢ The maximum pressure will be affected by the cup sealcapacity and comfort steering height level.

Finally, we utilized a Go-Kart to apply our Pneumatic Collapsible Steering (PCS).

A go-kart is a scaled-down version of an actual vehicle. It has practically all of the fundamental maneuverability of a typical car.

It can be used to study the basic operation and working of an automobile.

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VII. CONCLUSION

This idea offers a new and safer design for the steering wheel after taking the injury risk of the wheel into account. We anticipate that this research will contribute to a reduction in the number of fatal frontal collisions. The cost of manufacturing pneumatic collapsible steering is minimal. It can become more comfortable by increasing the gas or air pressure inside of it. It is sensitive because it uses sensors to detect collisions. A good collision prevention tool is the steering column. Since just air or gas needs to be replaced in it, its maintenance costs are inexpensive. The primary benefit ofpneumatic steering is that it offers room for the air bag to operate correctly.

REFERENCES

[1]. Technical Report - Dynamics Of Vehicle Collision And Equipment's Use For Protection Of Driver Ramesh Nepal Mechanical & Manufacturing Engineering St. Cloud State University, St. Cloud, MN 56301, USA.
[2]. White, A.J,1965, "Passenger Car Safety Dynamics," Research Center of Motor Vehicle Research of New Hampshire Lee, New Hampshire. Pp383-438.
[3]. Nordhoff, L.S., 1996, "Motor Vehicle Collision Injuries," Aspen Publishers, Inc., USA. Pp.278- 319.
[4]. "Highway Vehicle Safety", Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York. Vol.13. pp. 414-420.
[5]. Design, Analysis and Optimization of Collapsible SteeringColumn
[6]. Imran J. Sheikh, M. Shakebuddin Department of Mechanical Engineering, RTMNU University, Nagpur, India.