Self-Inflating Tyre Pressure Safety System Suitable for the Automotive Industry

Alexander.F 1*, Ashik Manoj.J 2, Amal C Gokul 2, Gokul Jayanth M 2

1Asst Professor, Dept of Mech Engg, Jansons Institute of Technology, Coimbatore, Tamilnadu, India.
2UG Scholars, Dept of Mech Engg, Jansons Institute of Technology, Coimbatore, Tamilnadu, India.

*Corresponding author E-Mail ID: alexmech18@gmail.com, Mobile: 9788091612

ABSTRACT

Four wheelers are often used by most of the people in today’s life for their comfort and sophistication. Some of the vehicle accidents are taken place, due to the burst of tyre, it mainly occur because of under inflation which creates overheating during which causes loss of human life and also severe damage to the vehicle because of uncontrollable vehicle motion. To overcome the problem, this paper focuses on achieving accurate pressure in the vehicle tyre which can be attained by introducing a self-inflating system for tyre while in running condition with a low cost. This system checks the tyre pressure periodically and inflates automatically to the precise pressure. Self-inflation pressure has added advantages like increase fuel economy, reduction of distance while applying braking, improves tyre life. Approximately 3/4 of all automobiles operate with at least has one underinflated tyre. The main causes of under inflation in tyres are because of natural leakage, temperature changes, and road hazards. Maximum drivers normally didn’t check tyre pressure unless they notice unusual vehicle performance. Visual checks are often insufficient to determine under inflation. This paper will focuses to overcome the problems and suggested a proposed working model with expected results of precise pressure maintenance in the tyre.

Keywords: Self-Inflating, Tyre Pressure, Vehicle Accidents, Working Model

1. INTRODUCTION

The use of automobiles has been increasing day-by-day and humans are entirely reliable on automobiles for the transportation purpose. Wheels have been used extensively for wide range of purposes and the effective use of wheels with more innovative ideas further developed with developing technologies like automatic or self-inflation system applied in automobiles to maintain the vehicle tyre pressure during running. Fig: 1 indication the concept of inflating in tyre based on pressure. It’s one of the techniques to improve the vehicle efficiency by inflate tyre regularly. The preeminent application of this automatic inflation system is in military vehicle which has to run on various environmental and land conditions which are continuously changing. A circular cover which placed over the wheel rim is known as tyre which is used to save the wheel and provide the better performance for vehicle moving by means of providing the traction from the road. The tyre is a flexible cushion which is used for shock absorption. The wheel materials used initially with wood which is used in carts and replaced with wheel rim of metals and tyres which fits around the wheel. By means of filling air in the tube which is placed in between the wheel and tyre, the vehicle moves without any difficulty. With suitable pressure maintained in the tube results in better tyre performance like tyre wear, vehicle fuel can be saved, avoidance of tyre blast. The vehicle manufacturers indicate the necessary pressure that has to maintain in the front and rear wheel for every model and maximum of them place these details in the vehicle by means of stickers which is easily viewable to the driver. The same information is also indicated in the
vehicle manual which carries all the details about the vehicle. In the manual they also indicated the safety rules including the tyre minimum pressure details.

![Diagram of correctly, over, and under inflated tires](image)

**Fig: 1 Concept of Inflating in Tyre**

[1] Significant aim of introducing a system to maintain the ideal pressure in tyres and when the pressure of tyre goes below ideal value pressure gauge monitors it and the tyre is inflated again. Their study provides a better understanding for researchers and new learners on the working, advantages and limitations of the “Automatic tyre inflation system” used in tyres of a vehicle. [2] The design presented in the report herein functions to restore the tyre pressure on vehicles so that they are kept at optimum pressure levels, thus extending their life time at the same time saving the owner from fuel costs and maintenance cost incurred with underinflated tyres. It constitutes of a wind driven turbine-compressor unit which uses drag wind as source of drive to a turbine and quickly converts it to rotational energy which powers a small compressor that feeds the tyre with pressurized air whenever the need arises. [3] The objective of their project is to develop an “Automatic tyre inflation and deflation system”. This can be placed in all automobiles while long drives and that can be utilized while climbing uphill or down hills. In that project main function is suddenly the air is decreased to the automobile vehicles the sensor signal alerted to the person when the use of air tank to fill the air in the tyre. Then the air pressure is increased to the tyre in the vehicle it is same as the process of indicating the sensor signal through the person when the use of solenoid valve to reduce the excess air in the tyre.

[4] The only part of a vehicle which is not getting automated is tyres. From their studies, a small pressure drop will affect the tyre wear, safety, mileage and whole performance of the vehicle. To reduce the unwanted stress and waste of time for inflating the tyres, Automatic Air Inflation system was designed by them. This system states that the tyres are optimally inflated at all running conditions. Whenever the pressure is reduced below the mentioned or set level the sensor senses and displays it on the LCD screen. The paper focuses of design aspects the system. [5] The paper has the objectives of developing an automatic pressure inflating tyre system which properly inflated the tyres at all the times. A centralized compressor was used for system testing and implemented. They used a rotary joint, one half of the joint is attached to the wheel which rotates and another half is stationary. The benefits of their system are compatible, better mileage less tyre wear reduction so the entire system will perform better. From the study, The model is focuses on to design and fabricate a system which reduces human labour and time by eliminating the condition of driver to go to a gas station or he has to attach a pump manually as physical connection of tyre and pump consumes more time. Secondly, tyre must not be under inflated nor
over inflated i.e. pressure should be in optimized level as under inflation causes wearing of tyre, consumption of more fuel and over inflation causes explosion of tyre. It also gives better mileage and saves both money and life. It also predicts about the puncture when there is continuous reduction of its set threshold value.

2. COMPONENTS AND DESCRIPTION

The components used in the concept of automatic tyre inflating system is indicated in the Fig: 2 in the two dimensional form. The concept was explained with the help of a CAD model in the Fig: 3. The description of these components are briefly explained below and the list components with different material used is indicated in the Table:1.

2.1 Pressure Switch: A pressure switch is the important component in the system which is used to allow air up to the set pressure given as an input and electrical contact is cut-off once it’s reached the set value. The pressure switch can be used for both pressure rise and fall with the designed based on the contact.

2.2 Pressure Gauge: It is a monomeric device which is used for measuring the pressure which is nearer to the atmosphere.

2.3 Bearing with Cap: The bearings are pressed smoothly to fit into the shafts because if hammered the bearing may develop cracks. Bearing is made up of steel material and bearing cap is mild steel.

2.4 Wheel Arrangement: The simple wheel and braking arrangement is fixed to the frame stand. Near the brake drum, the pneumatic cylinder piston is fixed.

2.5 Frame: Frame stand is made up of mild steel material. The whole above mentioned parts are fixed in to this frame stand with a suitable arrangement. The other components which make the project a great success are mounted on the stand. The effective working of this project is shown once all the components are mounted and installed.

2.6 Quick Joint Coupling: A small length of pipe having a socket, is known as coupling which is used to connect two pipes on the both the sides. It’s widely used in plumbing or piping industry

2.7 Solenoid Valve: Directional control valves control the way the air passes and used for controlling the commencement, termination and direction of air flow. Depending on the number of paths the air is allowed to take, directional valves are termed as two way, three way, and four way or multi way valves. The different number of ways by means the number of controlled connections of the valve, inlet connections to the compressed air supply. The Outlet connection is given to the air consumer and exhaust connection is given to the atmosphere.

2.8 AC Motor: It is found to drive the roller shaft which fixed on the end of the frame structure. The free end of the shaft in the motor a large pulley is found around which the belt runs.

2.9 Pulley: A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power.

2.10 Belt Drive: Belt drive is designed to link two or more rotary shafts which are mostly connected in parallel to each other. Belt is a flexible material which is mainly for power transmission with relative motion between the shafts.
3. MODEL DESIGN

The principle behind the modelled system working are as follows, a fixed solenoid valve inlet is connected with the compressed air. To sense the pressure inside the tyre of the wheel a pressure switch is installed at the air flow passage with the necessary tyre pressure is set which has to be maintained. The existing pressure is measured with the pressure switch and it sends the output signal to the solenoid valve. The solenoid valve energizes the pressure switch if the pressure moves down to set value. From the pressure switch signal, compressed air is supplied to the rotating wheel tyre for that a quick release coupling is used. Until the necessary pressure is obtained the process is continued once it’s reached the pressure switch deactivates the solenoid valve.
Table: 1 List of Components used in the model

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>PARTS</th>
<th>Qty.</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Motor</td>
<td>1</td>
<td>AC</td>
</tr>
<tr>
<td>2</td>
<td>Pulley</td>
<td>2</td>
<td>CI</td>
</tr>
<tr>
<td>3</td>
<td>Belt</td>
<td>1</td>
<td>Rubber</td>
</tr>
<tr>
<td>4</td>
<td>Wheel</td>
<td>1</td>
<td>Rubber</td>
</tr>
<tr>
<td>5</td>
<td>Frame</td>
<td>1</td>
<td>MS</td>
</tr>
<tr>
<td>6</td>
<td>Bearing with bearing cap</td>
<td>2</td>
<td>MS</td>
</tr>
<tr>
<td>7</td>
<td>Pressure gauge</td>
<td>1</td>
<td>Plastic</td>
</tr>
<tr>
<td>8</td>
<td>Solenoid valve</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Pressure switch</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Hose</td>
<td>Adequate</td>
<td>-</td>
</tr>
</tbody>
</table>

The function of manual work in the system is very minimal for maintaining the constant pressure in the tube. Some of the advantages of the system are, low handling characteristics with low vehicle control, Longer stopping distances, less maintenance cost and efficient timely response, less human efforts, better efficiency and performance of the vehicle, Increase the life span of tyre and Avoids accidents and fatality. The system has limitations of regular maintenance and also a separate gas tank must be installed for operation of the entire system. These types of automatic tyre pressure inflation systems have a wide range of applications in the fields like, Automobile and Manufacturing Industry. The assembled view of the model is indicated in the Fig: 4.

Fig: 4 Assembly view of the self-inflating tyre system
4. CONCLUSION

This designed concept on self-inflating pressure in the tyre guarantees that every tyre in the vehicle are properly inflated and shows that the system improves the safety in driving and also ensures the life of the tyre. The system provides a smooth ride while the vehicle is in the running condition and eliminating a situation of the driver to go to a gas bunk particularly for air filling which is done by manually. The model also improves the fuel efficiency and reduction of over inflation causes explosion of tyre which gives better mileage and saves both money and life. This modelled concept also provides the indication to the driver about the puncture occur in the tyre when there is continuous reduction of its set threshold value. This model can be modified and developed accordingly to the real time applications.

REFERENCES

7. Image source: sleaford-tyres.co.uk.