“MONITORING OF PRESSURE IN A TWO WHEELER TUBING TYRE UNDER MOTION”

PROJECT REFERENCE NO. : 37S1297

COLLEGE : K S SCHOOL OF ENGINEERING & MANAGEMENT, BANGALORE
BRANCH : MECHANICAL ENGINEERING
GUIDE : YUVARAJA NAIK
STUDENTS : MOHAMAD UMAR
            MANEESH R

Keywords: TPMS: Tyre pressure monitoring system, OEM – Original Equipment Manufacturer, ABS: Anti Lock Breaking System

Introduction: The tubing tyre pressure in automobiles needs to be monitored for better road grip and mileage. When the tubing tyre is punctured, it must be immediately attended to reduce the complete wearing & tearing, so that vehicle can be brought to halt and the damaged tubing tyre wheel can be fixed.

There are two types of Tyre pressure monitoring systems, namely

- Direct Tyre Pressure Monitoring Systems (Direct-TPMS) and
- Indirect Tyre pressure Monitoring System (Indirect-TPMS)

In the Direct TPMS the pressure sensors physically measure the tire pressure in each tire and report it to the vehicle's instrument cluster or a corresponding monitor. These systems can identify under-inflation in any combination, be it one tire or all, simultaneously. Although the systems vary in transmitting options, many TPMS products (both OEM and aftermarket solutions) can display real time tire pressures at each location monitored whether the vehicle is moving or parked. There are many different solutions but all of them have to face the problems of exposure to tough environments and the majority are powered by batteries which limit their useful life.

In the Indirect TPMS tyre is measured by monitoring the individual wheel rotational speeds and other signals available outside of the tire itself. These type of systems utilize the effect that an under-inflated tire has a slightly smaller diameter (and hence higher angular velocity)
than a correctly inflated one. These differences are measurable through the wheel speed sensors of ABS/ESC systems.

**Objectives of the project:**

In the present project a system is being developed to sense the pressure of tubing type (even during motion) and display the same for the review by the rider. It is intended to adopt this technology for a two wheeler due to ease of adoption.

As the tyre used here is of tubing type the type of sensor to be selected plays an important role such as if the sensor is too thick then it can damage the tube, hence care must be taken in selecting a sensor which is not too thick and at the same time it should measure the tyre pressure accurately.

When the wheel is under motion, drawing the electrical connections from the wheel to the display meter will be very difficult, hence a methodology has to be devised so that the electrical connections can be successfully given from the wheel to the display meter and the power source.

**Methodology:**

As it was discussed in the above topics that the thickness of the pressure sensor plays an important role in the selection of the sensor which is suitable for the operation, a variety of sensors were explored. After a thorough examination it was decided to select the strain gauge for the purpose of monitoring the tyre pressure because the thickness of a strain gauge is very minimal and it is able to measure the variation in micro-strain induced in the component as it works on the principle of wheat stone bridge.

In order to draw electrical connections from the wheel which is under motion using only wires is not possible because the wires will also rotate along with the tyre and therefore it is not possible to connect those wires to a stationary display unit which is mounted on the vehicle, in order to overcome this problem a slip ring will be fitted on to the wheel. The slip rings will be fixed to the centre of the wheel and it is used to draw the electrical connections from the rotating wheel and to connect it to the stationary display unit. After fixing of the strain gauges on the inner surface of rim and giving all the electrical connections through a slip ring as shown in the fig 1 below.
Figure 1: Schematic Representation of Monitoring of Tyre Pressure

The experimentations were conducted and the variation of strain induced on the surface of rim due to variation in the air pressure inside the tubing tyre is tabulated.

Two strain gauges have been pasted on the inner surface of rim in perpendicular direction to each other. Each of which will measure lateral strain and longitudinal strain respectively.

The strain gauges should be calibrated initially before starting the experiment each time the experiment is conducted.

Results & Conclusions:

The Experimentations were conducted and the values of variation of the Micro strain due to variation in tyre pressure were tabulated and the values are shown in the Table 1 below.

<table>
<thead>
<tr>
<th>SL No</th>
<th>Pressure in Psi</th>
<th>Lateral Strain in με</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>26</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>24</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 1: Variation of Lateral
It can be said from the table above that as the pressure in the tyre decreases the strain also decreases. For the variation in Lateral strain due to variation in pressure it can be concluded that strain induced in the rim is directly proportional to the tyre pressure.

**Scope for Future Work:**

The sensors used here are the strain gauges which means that the readings that are shown here are in terms of micro strain, it will not give the direct pressure value. Hence a Microprocessor can be programmed which would convert the strain into the value of the Pressure of the Tyre.

A motor can be added to the test rig so that the wheel can be rotated at different speeds and the Experimentations can be carried out, so that the variation in tyre pressure at different speeds can be studied. Further more the experimentation can conducted in different road conditions of road and the variation of tyre pressure can be studied.

This technology can also be implemented to four wheeler vehicles and also other heavy Traffic vehicles and the variation of Tyre pressure can be monitored.