LOW TYRE PRESSURE WARNING SYSTEM IN AUTOMOTIVES BY USING ADVANCED TECHNOLOGY

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Abstract: With miles to go in every journey be it the small vehicle or a commercial truck its always driven with a concern the dreaded tyre puncture**.** Our roads infested with iron debris, potholes and with parts falling of vehicles put up a serious concern for the always dreaded tyre puncture. While a TPMS cannot avert a tyre puncture it can sure, do away with your concern of an impending flat tyre due to a slow air leak and its consequences. Vehicles become difficult to maneuver with an underinflated tyre and may lose course during a harsh brake. Accidents at high speeds due to tyres blowing out because of rise in temperature slow air leak can result in a flat tyre if driven unattended and destroy a tyre permanently. With a fastidious economy necessitating to transport goods and travel at the best possible speeds only a TPMS can give you the assurance with real time information about your tyre health so that you can drive with confidence without any concern. TPMS gives automatically warnings to the driver in the event of a slow air leak or rise in tyre temperature before an unhealthy tyre can become dangerous.

***Index Terms* – Tyre, LED's, Pressure.**

I INTRODUCTION:

The majority of automobile drivers do not adequately maintain their tyre pressure, even though they lose approximately one to two pounds per square inch (PSI) of air pressure a month. Under inflated tyres cause a greater contact surface area with the road, resulting in higher friction between the road and tyre. This significantly decreases tyre life and fuel economy. According to Doran Manufacturing, when tyres are 20% underinflated, tyre life and fuel economy can be reducing by 30% and 3% respectively. Vehicle handling characteristics are also adversely affected due to low tyre pressures. Stopping distances increase and driver experiences cornering stability. With all these undesirable effects, proper tyre pressure should be of greater concern. The National Highway Traffic Safety Administration (NHTSA) statistics show that 660 fatalities and 33,000 injuries occur every year as a result of low-tyre pressure-related crashes. The main reasons for incorrectly inflated tyres include vehicle owners not knowing proper tyre pressures for certain conditions, difficulty finding an air pump, lack of a pressure measuring device, and a general lack of concern. The Rubber Manufacturers Association has estimated that only about 19 percent of drivers properly check their tyre pressure. These facts show that a system is needed to maintain proper tyre pressure for optimal performance in a variety of driving conditions.

Due to the significant influence tyre pressure has on vehicle safety and efficiency, TPMS was first adopted widely by the European market as an optional feature for luxury passenger vehicles in the 1980s. The first passenger vehicle to adopt tyre-pressure monitoring (TPM) was the Porsche 959 in 1986, using a hollow spoke wheel system developed by PSK. In 1996 Renault used the Michelin PAX system for the Scenic and in 1999 the PSA Peugeot Citroën decided to adopt TPM as a standard feature on the Peugeot 607. The following year (2000), Renault launched the Laguna II, the first high volume mid-size passenger vehicle in the world to be equipped with TPM as a standard feature.

OVERVIEW OF TYRE PRESSURE MONITERING SYSTEM(TPMS):

A Tyre pressure monitoring system(TPMS) is an electronic system designed to monitor the air pressure inside the pneumatic tyres on various types of vehicles. TPMS report real-time tyre-pressure information to the driver of the vehicle, either via a gauge and a simple low-pressure warning light.

There are two types of tyre pressure monitoring systems

DIRECT MONITORING SYSTEMS:

Direct tyre pressure monitoring systems measure, identify and warn the driver of low pressure. Because direct systems have a sensor in each wheel, they generate accurate warnings and can alert the driver instantly if the pressure in any one tyre falls below a predetermined level due to rapid air loss caused by a puncture. In addition, direct tyre pressure monitoring systems can detect gradual air loss over time. Some direct systems use dashboard displays that provide the ability to check current tyre pressures from the driver's seat.

Direct systems attach a pressure sensor/transmitter to the vehicle's wheel inside the tyre's air chamber. Most Original Equipment and some aftermarket systems attach their air pressure sensor/transmitter to special tyre valves. While the presence of a metal clamp-in valve typically identifies the presence of a direct tyre pressure monitoring system, special snap-in rubber valves have also been used to support direct system sensors. The transmitter's signal is broadcast to the in-car receiver and the information is displayed to the driver.

INDIRECT MONITORING SYSTEMS:

Indirect systems use the vehicle's antilock braking system's wheel speed sensors to compare the rotational speed of one tyre to that in another position on the vehicle. If one tyre is low on pressure, its circumference changes enough to roll at a slightly different number of revolutions per mile than the other three tyres. Reading the same signal used to support ABS systems, the vehicle manufacturers have programmed another function into the vehicle's onboard computer to warn the driver when a single tyre is running at a reduced inflation pressure compared to the others.

Unfortunately, indirect tyre pressure monitoring systems have several shortcomings. Indirect systems won't tell the drivers which tyre is low on pressure, and won't warn the driver if all four tyres are losing pressure at the same rate (as occurs during the fall and winter months when ambient temperatures get colder). Additionally, our current experience with indirect systems indicates that they can generate frequent false warnings. We have found that false warnings may occur when the tyres spin on wet, icy and snow-covered roads. In these cases, the false alarms would train the driver to disregard the tyre pressure monitoring system's warnings, negating its purpose completely.

INTRODUCTION TO PRESSURE:

Pressure is the effect of a force applied to a surface. Pressure is the amount of force acting per unit area. The symbol of pressure is p

Mathematically:

$$p = \frac{F}{A} \text{ or } p = \frac{dF_n}{dA}$$

where:

p is the pressure,

F is the normal force,

A is the area of the surface area on contact

Pressure is a scalar quantity. It relates the vector surface element (a vector normal to the surface) with the normal force acting on it. The pressure is the scalar proportionality constant that relates the two normal vectors:

$$d\mathbf{F}_n = -p\, d\mathbf{A} = -p\, \mathbf{n}\, dA$$

The minus sign comes from the fact that the force is considered towards the surface element, while the normal vector points outward.

It is incorrect (although rather usual) to say "the pressure is directed in such or such direction". The pressure, as a scalar, has no direction. It is the force given by the previous relationship to the quantity that has a direction, not the pressure. If we change the orientation of the surface element, the direction of the normal force changes accordingly, but the pressure remains the same.

Pressure is transmitted to solid boundaries or across arbitrary sections of fluid normal to these boundaries or sections at every point. It is a fundamental parameter in thermodynamics, and it is conjugate to volume.

per second.

II PROBLEM DEFINITION:

Winter sees the highest number of road accidents. Fog, cold, roadside revelry and of course drinking and driving are the major causes. May be its time to add a new cause incorrect TYRE pressure! While it is difficult to put a precise figure to exactly how many accidents on Indian roads are directly due to incorrect TYRE pressure; with under or over-inflated TYREs on passenger vehicles being a norm in India, the correlation is probably very high. Over-inflated TYREs decrease braking efficiency and are prone to bursts at high speeds resulting in collisions. Under-inflated or deflated TYREs have poor vehicle handling leading to accidents due to lack of control, Says Salish Sharma, Chief, India Operations, Apollo TYREs Ltd: “Our most recent all-India survey has some very scary figures on something as simple as tyre pressure. The level of apathy and ignorance amongst Indian drivers could easily be the leading cause of accidents on our roads.

A six-month survey of 36,000 tyres, on 9,000 passenger vehicles across India's 50 largest cities conducted by Apollo tyres reveal:
• Only 22% of the cars surveyed had tyres with the OE recommended inflation
• Almost 44% of the car tyres were over-inflated
• rolling resistance, requiring more fuel to maintain the same speed -– adversely affecting fuel efficiency! This data was collected from a cross-section of the personal vehicle driving population in housing societies, petrol pumps, corporate houses and highways during morning or evening hours, when the tyres were cold and therefore showed the correct inflation. The Transportation Research & Injury Prevention Programmed in IIT-Delhi, estimates that deaths due to road accidents in India is rising by 8% every year and costs the nation 3% of India's GDP.

The need of the hour is the system which constantly monitors the pressure of the system and is economically feasible to a common man and we focused on developing a low cost system which has been prepared by keeping our Indian middle class in mind.
The remaining 34% were under-inflated
Apart from running a higher risk of accidents due to loss of control, improper air pressure also leads to tyre damage, requiring faster replacement. Additionally, under-inflated tyres have increased

BOURDON PRESSURE GAUGE:

The Bourdon pressure gauge uses the principle that a flattened tube tends to change to be straightened or larger circular cross-section when pressurized. Although this change in cross-section may be hardly noticeable, and thus involving moderate stresses within the elastic range of easily workable materials, the strain of the material of the tube is magnified by forming the tube into a C shape or even a helix, such that the entire tube tends to straighten out or uncoil, elastically, as it is pressurized.
Bourdon tubes measure gauge pressure, relative to ambient atmospheric pressure, as opposed to absolute pressure. vacuum is sensed as a reverse motion. Some aneroid barometers use Bourdon tubes closed at both ends (but most use diaphragms or capsules, see below). When the measured pressure is rapidly pulsing, such as when the gauge is near a reciprocating pump, an orifice restriction in the connecting pipe is frequently used to avoid unnecessary wear on the gears and provide an average reading; when the whole gauge is subject to mechanical vibration, the entire case including the pointer and indicator card can be filled with an oil or glycerin. Tapping on the face of the gauge is not recommended as it will tend to falsify actual readings initially presented by the gauge. The Bourdon tube is separate from the face of the gauge and thus has no effect on the actual reading of pressure. Typical high-quality modern gauges provide an accuracy of ±2% of span, and a special high-precision gauge can be as accurate as 0.1% of full scale.

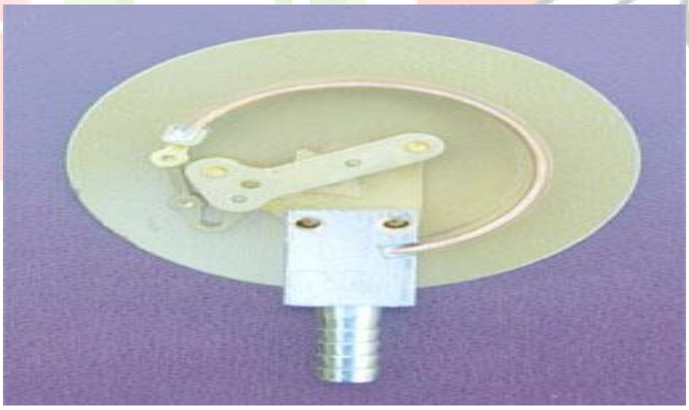


FIG 1: BOURDON TUBE

MECHANICAL DETAILS OF A BOURDON PRESSURE GUAGE:

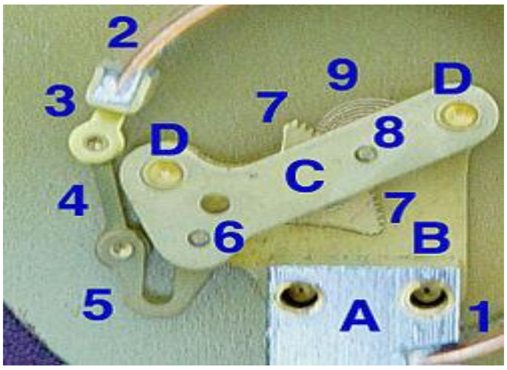


Fig 2: Stationary parts:

- A: Receiver block. This joins the inlet pipe to the fixed end of the Bourdon tube (1) and secures the chassis plate (B). The two holes receive screws that secure the case.
- B: Chassis plate. The face card is attached to this. It contains bearing holes for the axles.
- C: Secondary chassis plate. It supports the outer ends of the axles.
- D: Posts to join and space the two chassis plates.

Moving Parts:

1. Stationary end of Bourdon tube. This communicates with the inlet pipe through the receiver block.
2. Moving end of Bourdon tube. This end is sealed.
3. Pivot and pivot pin.
4. Link joining pivot pin to lever with pins to allow joint rotation.
5. Lever. This is an extension of the sector gear.
6. Sector gear axle pin.
7. Sector gear.
8. Indicator needle axle. This has a spur gear that engages the sector gear and extends through the face to drive the indicator needle. A small motion of the tube results in a large motion of the indicator needle.
9. Hair spring to preload the gear train to eliminate gear lash.

ZINC CARBON (6F22)-NINE VOLT BATTERY:

Zinc–carbon batteries are the least expensive primary batteries. They are commonly labeled as general purpose batteries.

CHEMICAL REACTIONS:

In a zinc–carbon dry cell, the outer zinc container is the negative terminal. The zinc is oxidized according to the following half equation.

$$Zn(s) \rightarrow Zn^{2+}(aq) + 2\ e^- \ [e° = -1.04 \text{ volts}]$$

A graphite rod surrounded by a powder containing manganese(IV) oxide is the positive terminal. The manganese dioxide is mixed with carbon powder to increase the electrical conductivity. The reaction is as follows:

$$2MnO_2(s) + 2\ e^- + 2NH_4Cl(aq) \rightarrow Mn_2O_3(s) + 2NH_3(aq) + H_2O(aq) + 2\ Cl^- \ [e° \approx +.5 \text{ v}]$$ and the Cl^- combines with the Zn^{2+}.

There are other possible side-reactions, but the overall reaction in a zinc–carbon cell can be represented as:

$$Zn(s) + 2MnO_2(s) + 2NH_4Cl(aq) \rightarrow Mn_2O_3(s) + Zn(NH_3)_2Cl_2\ (aq) + H_2O(l)$$

CONSTRUCTION:

The container of the zinc–carbon dry cell is a zinc can. The inside surface of the zinc can be originally treated with mercury. This decreased 'local action' where impurities in the zinc set up small areas of galvanic action which would cause the zinc to react with the electrolyte more quickly than it otherwise would. The mercury was subsequently banned by legislation in many jurisdictions on environmental grounds. The can contains a layer of NH_4Cl or $ZnCl_2$ aqueous paste impregnating a paper layer that separates the zinc can from a mixture of powdered carbon (usually graphite powder) & manganese (IV) oxide (MnO_2) which is packed around a carbon rod. Carbon is the only practical conductor material because every common metal will quickly corrode away in the positive electrode in salt based electrolyte.

FIG 3: SOME OTHER 9V BATTERIES THAT CAN BE USED ARE GIVEN BELOW:

Type		IEC name	ANSI name	Typical capacity (mAh)	Nominal voltage	
Primary (disposable)	Alkaline	6LR61	1604A	565	9	
	Zinc-Carbon	6F22	1604D	400		
	Lithium		1604LC	1200		9.6
Rechargeable	NiCd	6KR61	11604	120	7.2	8.4 (some)
	NiMH	6HR61	7.2H5	175-300	7.2	some:[3] 8.4 9.6
	Lithium-ion Polymer			520	7.3	

III. EXPERIMENTAL SETUP:

TYRE

The tyre used is Dunlop Jap tyre. It is a nylon tyre and its dimensions are: Radius-32cm Wheel base-9cm Rim diameter-56cm

FIG 4: THE TYRE USED IN THE SYSTEM WITH IT'S MOUNTING.

TYRE MOUNTING:

Mounting of the tyre is necessary to demonstrate the operation of the TPMS system on real time basis. The mounting consists of a rectangular base and two side bars are welded to it.
The shaft passes through the tyre and is supported by the side bar which takes the wheel weight.

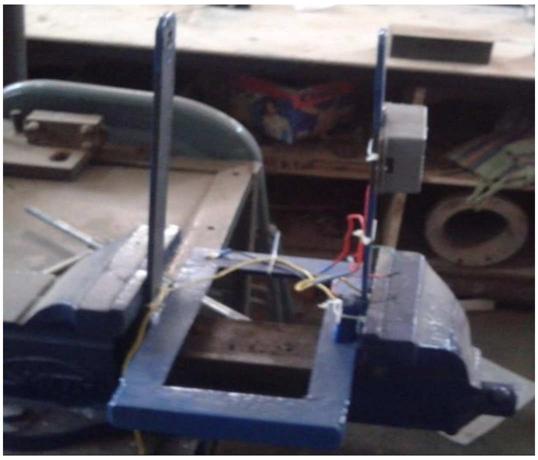


FIG 5: STAND WITH IT'S MOUNTINGS.

VALVE STEM:

The valve stem used is of Schrader type. Two valve stems are inserted in the tube for the convenience of the rider. If only one valve stem is used. The pressure gauge attachment needs to be removed at the time of refilling the air.
Thus two valve stem are used where one valve stem is attached to pressure gauge arrangement and other valve stem can be used for air filling.

	
EXTRA VALVE STEM IN FIXED POSITION	VIEW OF THE TUBE

FIG 6: Valve stem

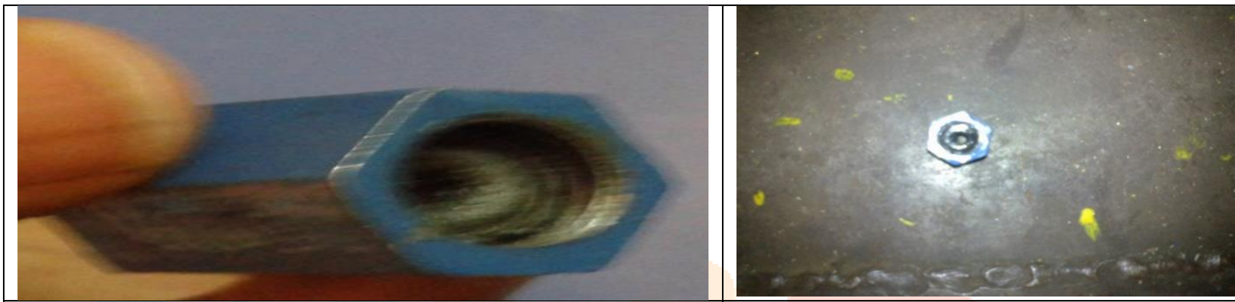
PRESSURE GAUGE:

The pressure gauge used here is a Bourdon pressure gauge. The pressure limit of pressure gauge is 0-140 psi . The pressure gauge is redesigned by placing two contact points, one for minimum pressure indication and another for maximum pressure indication. The minimum pressure set is 20psi and maximum pressure set is 40psi.
When needle of the Bourdon pressure gauge cones in contact with a contact point, the circuit is closed the indication is given through a red LED and a buzzer. Similarly, when the needle comes in contact with the high pressure set point, the high pressure set point, the high pressure indication is given through yellow LED and buzzer.
The pressure line from hexagonal connector is brought to pressure gauge by a copper be capillary tube. For real-time applications the pressure gauge can be directly fixed on the hexagonal connector which is in turn connected to valve system.

FIG 7: PRESSURE GAUGE USED WITH SET POINTS.

HEXAGONAL CONNECTOR:

The thread of valve stem is in metric and the thread of pressure gauge line is in BSP. Thus a hexagonal rod is tapped on both sides with respect to its type of threading which creates a continuous pressure line from tube to pressure gauge.



HEXAGONAL CONNECTOR: SIDE VIEW	TOP VIEW

Fig 8: Hexagonal Connector

INDICATOR ARRANGEMENT:

The indicator is in both virtual and audible. The visual indication is through LED's. Yellow LED for high pressure indication and red LED for low pressure indication. The audible indication is through two piezoelectric buzzers, one for low pressure indication and other for high pressure indication. It is as shown below;

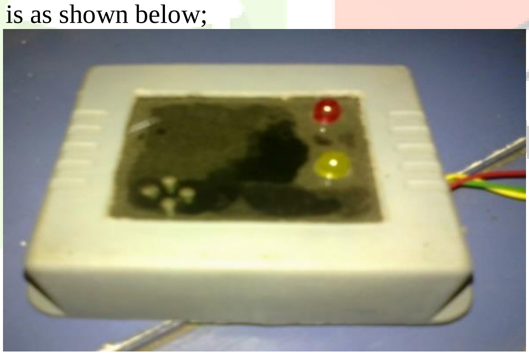


Fig 9: NYLON BUSH

The Nylon bushes are used in the system. Each bush is in between the mounting the sidebar and the wheel on both sides of the wheel. Slot is made in the center of the bush through which axial is passed.

The function of the nylon bushes is to transmit the signals from pressure gauge to the conducting rings. The bushes have aluminum lining at the Centre which is in contact with the conducting rings.

The bush rotates with the wheel and continuously transmit the signals from the rotating pressure gauge to the static conducting rings. The low pressure signal line from the pressure gauge on the wheel is connected to the left nylon bush by green wire.

The high pressure signal line from the pressure gauge on the wheel is connected to aluminum lining on the right nylon bush by red wire.

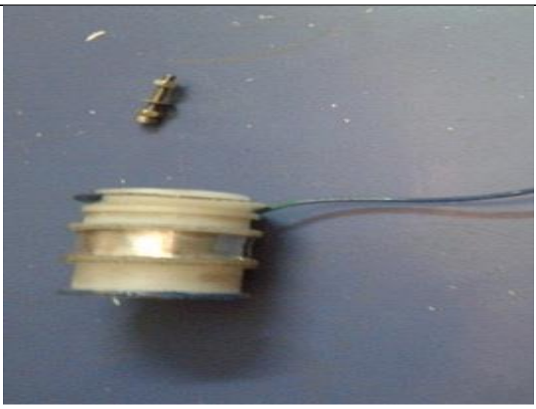
	
Nylon bush with aluminum foil	Side view

Fig 10: Nylon bush

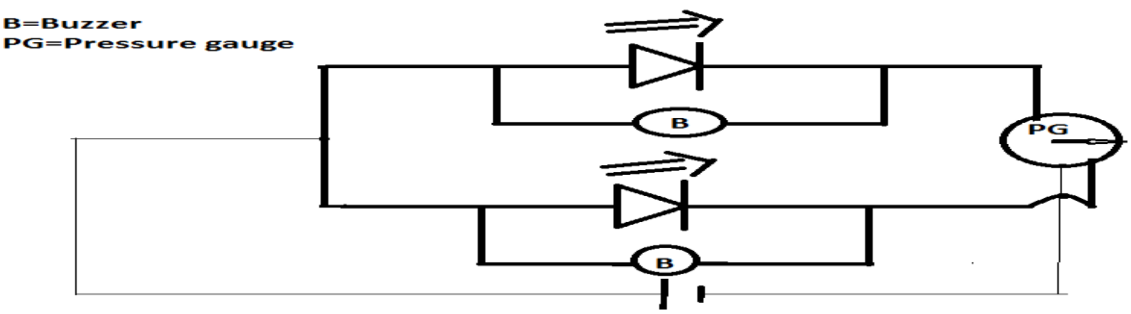
CONDUCTING RINGS:

The rotation of tyre poses problem for transfer of signals from pressure gauge to the indication unit on the side bar.
Thus conducting rings are used. Conducting rings connect the nylon bushes aluminum lining to the indicator unit. Thus the signals from the pressure gauge are transmitted to the indicator.
The left conducting ring connects the low pressure indication line (red wire) to the indicator arrangement containing buzzer and red LED.
The right conducting ring connects the high pressure indication line (yellow) to indicator arrangement containing buzzer and yellow LED.

FIG 11: CONDUCTION RINGS

CIRCUIT DIAGRAM SHOWING BUZZER, LED AND PRESSURE GAUGE:

Piezoelectric buzzer is a device made of electrical connections containing capacitor and transistor with a light emitting diode of two colors.
As the connection in the circuit closes, the vibration occurs inside the buzzer as a result of this vibration we get the sound and thus the aim of the buzzer is realized. The circuit diagram of the buzzer and its connection with the system is as shown,



The circuit installed in our system is as shown above. As the pressure rises in the tube, the same is indicated on the pressure gauge and once if it crosses 40psi, the set points which is a metal is directly connected to the ciruit and the circuit completes giving to the generation of vibrations of a piezoelectric matreial and hence the sound throgh the buzzer is propagated.
On the same lines, when the level of the tyre pressure decreases below the normal it is indicated on the dial gauge of the instrument and the set point is set at 10psi and once it reaches the level of 10psi or below the circuit is completed through the dial gauge pointers and hence the magnet in the buzzer get once again produces the sound with the help of vibrating piezoelectric material and thus the buzzer produces a beep sending the warning signals to the rider.

IV RESULTS AND DISCUSSIONS:

Often an unbalance of force is produced in rotary or reciprocating machinery due to the inertia forces associated with the moving masses. Balancing is the process of designing or modifying machinery so that the unbalance is reduced to an acceptable level and if possible is eliminated entirely.
A particle or mass moving in a circular path experiences a centripetal acceleration and a force is required to produce it. An equal and opposite force acting radially outwards acts on the axis of rotation and is known as centrifugal force. This is a disturbing force on the axis of rotation, the magnitude of which is constant but the direction changes with the rotation of mass.
In a revolving rotor, the centrifugal force remains balanced as long as the center of mass of the rotor lies on the axis of the shaft. When the center of mass does not lie on the axis or there is an eccentricity, an unbalanced force is produce. This type of unbalance is very common. For example, in steam turbine rotors, engine crankshafts, rotary compressors and centrifugal pumps.
Most of the serious problems encountered in high-speed machinery are the direct result of unbalanced forces. These forces exerted on the frame by the moving machine members are time varying, impart vibratory motion to the frame and produce noise. Also, there are human discomfort and detrimental effects on the machine performance and the structural integrity of the machine foundation.
The most approach to balancing is redistributing the mass which may be accomplished by addition or removal of mass from various machine members.
There are basic two types of unbalancing-rotating unbalance and reciprocating unbalance-which may occur separately or in combination

STATIC BALANCING CALCULATIONS:

A system of rotating masses is said to be in static balance if the combined mass center of the system lies on the axis of rotation.

Mass of the pressure gauge=m_1=25g

Mass of the hexagonal rod=m_2=40g

Radius of the pressure gauge=r_1=13cm=0.13m

Radius of the hexagonal rod=r_2=25cm=0.25m

Angle of inclination of pressure gauge=$\Theta_1=150^o=(5\pi/6)$rad

Angle of inclination of hexagonal rod =$\Theta_2=100^o=(5\pi/9)$ rad

Let 'F' be the vector sum of these forces,

$F= m_1r_1w^2+m_2r_2w^2$

If 'F' is zero then the system is said to be statically balanced.

If 'F' is not zero, then it is an unbalanced system, a counterbalance weights have to be introduced which is of mass m at radius r to be balance the rotor so that,

$$m_1r_1w^2+m_2r_2w^2+m_cr_cw^2=o$$

$$=m_1r_1+m_2r_2+m_cr_c=0$$

Mathematically solution can be arrived by the equation

$$m_cr_c=\sqrt{[(\sum mr\cos\Theta)^2+(\sum mr\sin\Theta)^2]}$$

$$\text{and } \tan\Theta_c=-\sum mr\sin\Theta/\sum mr\cos\Theta$$

$$m_1r_1\cos\Theta+m_2r_2\cos\Theta=(25*10^{-3}*0.13*\cos 5\pi/6) + (40*10^{-3}*.25*\cos(5\pi/9)$$

$$=0.01324$$

$$m_1r_1\sin\Theta_1+m_2r_2\sin\Theta_2= (25*10^{-3}*0.13*\sin 5\pi/6) + (40*10^{-3}*.25*\sin5\pi/9)=4.544*10^{-4}$$

$$m_cr_c=\sqrt{[(\sum mr\cos\Theta)^2+(\sum mr\sin\Theta)^2]}$$

$$=\sqrt{[(4.544*10^{-4)2}+(0.01324)^2]}$$

$$=0.01324$$

Let the radial distance be 20cm =0.2m

$$m_c=0.0132/0.2=0.066\text{kg}=66.23\text{g}$$

$$\tan\Theta_c=-\sum mr\sin\Theta/-\sum mr\cos\Theta$$

$$=(4.544*10^{-4)}/(0.01324)$$

$$\Theta_c =1.968 \text{ rad}=112.8$$

TABULATIONS:

Consider the wheel to be rotating at 30 kmph, the following readings were taken with the help of a compressor and the following results were obtained:
The LED color indicators were used to indicate the high and low level indications. Yellow for high pressure and red for low pressure.

PRESSURE(psi)	BUZZER INDICATION	LED COLOUR
45	ON (High level indication)	Yellow
40	ON (High level indication)	Yellow
35	Nil	-
30	Nil	-
25	Nil	-
20	Nil	-
10	ON(Low level indication)	Red

TRAIL 1: At 45psi,
As the tyre we have used is of the rear wheel of motorbike the optimum pressure required would be 36psi but due to more than the optimum the buzzer will give us the indication by the beep sound and LED.
The tyre may burst due to high pressure and the probability of accidents increase.
TRAIL 2: At 40psi,
The pressure is still above the normal level and it is shown by the sound of the buzzer.
Prone to accidents but less when compared at 45psi.
TRAIL 3: At 35psi,
This is the optimum level at which tyre runs smoothly and no indication is obtained.
TRAIL 4, 5, 6: At 30, 25 AND 20 psi,
At the above mentioned pressures the buzzer will not make the beeps nor the LED glows.
This pressure will increase the fuel consumption and economy decreases and the risk of accidents are more.
TRAIL 7: At 10psi,
This is the critical pressure at which the tyre retains its ability to provide the cushioning and good traction for the vehicle below which may prone the vehicle to get lost of the control and skidding may occur.
This is indicated by the beep of buzzer and the glow of LED.

V CONCLUSION:

Under inflated tyres are the cause of tyre failure and contribute to tyre disintegration, heat buildup, ply separation and sidewall/casing breakdowns. Further, a difference of 10 lbs. in pressure on a set of duals literally drags the lower pressured tyre 13 feet per mile. Moreover, running a tyre even briefly on inadequate pressure breaks down the casing and prevents the ability to retread. It is important to note that not all sudden tyre failures are caused by under-inflation. Structural damages caused, for example, by hitting sharp curbs or potholes, can also lead to sudden tyre failures, even a certain time after the damaging incident. These cannot be proactively detected by any TPMS.

There is actually only one real advantage to TPMS hardware, but it's a big one – it can save your life and/or your tyres. TPMS is designed to warn you by means of a dashboard light when any one of your tyres has fallen below 25% of the vehicle maker's rated pressure. This will let you know you have a problem before the sidewalls of your tyre begin to fold over and rub together, which is usually the first tactile warning of a problem. By this time your tyres are already damaged beyond repair and unsafe. Running on them for much longer can cause the rest of the air in the tyre to exit in a much more uncontrolled manner. Nothing good ever comes of that. By warning you of a problem well before the liner of the tyre is worn off, TPMS can not only save your life, it can save you a considerable amount of money. Fuel savings: According to the GITI, for every 10% of under-inflation on each tyre on a vehicle, a 1% reduction in fuel economy will occur. In the United States alone, the Department of Transportation estimates that under inflated tyres waste 2 billion US gallons of fuel each year.

This project is purely concentrated on low and middle class people because of low cost and good life. Majority of vehicles on Indian roads run on tube tyres and hence the TPMS system will be an effective product for monitoring tube tyre pressure and will be a feasible product for production.

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