AUTOMATIC TYRE PRESSURE INFLATION SYSTEM FOR AUTOMOBILE

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Abstract

Roads are the most important modes of transport now a days & cars are integral part of it. Tyres lose air through normal driving-especially when run through pot holes & permeation. Moreover temperature changes are also one of the reason due to which tyres lose air. Thus vehicles run with an under-inflated tyre which may cause accidents. Studies show that a drop in tire pressure by just a few PSI can result in the reduction of gas mileage, tire life, safety, and vehicle performance. This project aims to develop an automatic, self-inflating tire system. Such a system ensures that tires are properly inflated at all times. Our project design is successfully tested and implemented with help of centralized compressor. The compressor will supply air to all four tires via hoses and a rotary joint fixed between the wheel spindle and wheel hub at each wheel. The Rotary joint is an integral component of the system-which has half of its part rotating with the wheel & rest half part is stationary. Considering today's ever increasing environmental threats; oil price hikes & energy consumption our system is most compatible and potential improvement in gas mileage & tyre wear reduction which leads to an increase in performance of Tyre in Diverse Conditions.

Key words: Roads, Tyres, Centralized Compressor, Hoses, Rotary Joint, Mileage

Introduction

The use of automobiles has been increasing day-by-day. Humans are completely reliable on automobiles for transport purpose. In today's competitive automobile sector; various automobile industries are competing with each other in order to win hearts of human. In order to do so the companies are making the system more effective by improving the safety systems in cars. The more reliable the system is, more successful the car becomes.

After the discovery of wheels by man, it has been used extensively for variety of purposes. Wheels have become the vital part of human lives since ages. The effective use of wheels with more innovative ideas further developed with developing technologies. One such upcoming technology is automatic air inflation system used in automobiles. This system is used to maintain the pressure of tires in running condition.

The best application of such automatic air inflation system is in military vehicles. Military vehicles are supposed to run on various environmental conditions; where land conditions are continuously changing. Such vehicles are supposed to be operated in worst conditions such as heavy rainfall, snowfall & deserts. At such remote places tyre maintenance stations are not available. In such crucial conditions such systems serves as a boon for the users.

Thus such a system will maintain correct inflation pressure in tyre automatically, whenever the pressure in tyres (psi) is low.

The advantage of this system is that it does not require any special attention from driver side after the system being installed. It eliminates the need of checking tyre pressure manually, thus saving time and labour.

A. Objectives:

1) Maintains the required tyre pressure: The function of the system is to maintain and adjust the pressure in all the tyres of the system according to varying loading and driving conditions.

2) An Automatic System: An automatic system further saves human energy & time in filling the air in tyres when they are in under inflated conditions.

3) Builds a Low cost system: The installation of such a system in vehicles is a low cost affair.

4) Improves fuel efficiency & tyre life: This system helps in less consumption of fuel and also improves tyre life by reducing chances of wear in tyre.

B. Problem Statement:

To develop an automatic air filling system, this recognizes and fills air in respective tyre when its pressure goes below the desired/required pressure (under inflated condition). Underinflated tyres overheat more quickly than properly inflated tyres, which cause damage to tyres. To reduce this problem we are designing this system. As soon as a tyre Pressure goes under inflated, then a pressure sensor senses it and send it to the Controller which activates the solenoid valve and air is filled up to proper inflation.

Literature review

A. Design of Automatic Tyre Inflation System:

The aim of this study is to design and fabricate a system which works on automatic filling of air into a tyre that is in running condition with a low cost device. It automatically checks the pressure inside the tyre with the help of pressure gauge and ON the compressor which takes air from atmosphere, compresses it and then delivers the compressed air to tyre and ensures that tyres are always properly inflated to improve tyre life, human safety, reduction of gas mileage and vehicle performance. As the wheel is in rotating condition while filling of air into it, rotary joint is fixed between wheel spindle and wheel hub at each wheel so that there is no tangling of hoses.

B. P.Omprakash, T.Senthil Kumar, "M.A.R.S - Mechanized Air Refilling System":

The aim of this study is 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.

This system can be used in any type of tyre either tube or tubeless tyres and the permanent

connection between valve and hoses which is only meant for tight connection during rotation of tyre; can be removed while changing a tyre by driver. The valve used with tyre is one way valve so that inside air should not escape from it.

C. Case Study on Automatic Tyre Inflation Management:

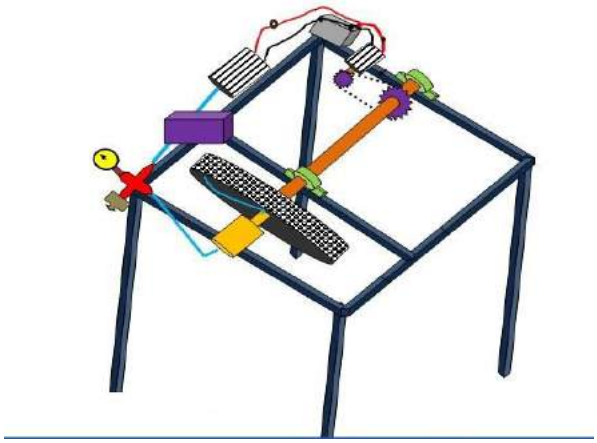
The aim of this study is to design and fabricate a system in which there is proper inflation in the tyre at all times which produce fuel savings of 1-4% and increase tyre life by up to 10%. A trial was done in this case paper involving two cement tankers in NSW Australia operated over a period of 12 weeks in 2013. For first 6 weeks central inflation system was turned ON in both tankers and for another 6 weeks central inflation system was turned OFF in the both and graphs are prepared showing trucks with central inflated system is good in conditions like average vehicle idle time, average vehicle time spent using power take off, average vehicle GHG emissions, average vehicle fuel consumption across the trial period.

Methodology

After referring several papers we got many ideas. This system consists of centralized compressor, rotary joint, pressure sensor, electronic control circuit, battery, wheel and a motor to run that wheel. After getting ideas of different components needed, we will start making rough design and after that we will draw a 3-D model in Auto CAD.

By referring this 3D model we will buy the standard component required for the projects. After this we will start manufacturing work in workshop. Along with this electronics part will also be done. In electronics we will have to build controller circuit to get signal from pressure. Later testing will be started for getting various results.

A. System design and cad model



Basic components

1. Rotary joint

Rotary joint or a Rotary Union is a device that provides a seal between a stationary passage and a rotating part. Stationary passage may be a pipe or tubing; whereas rotating part can be a drum, spindle or a cylinder. Thus it permits the flow of the fluid into and/or out of the rotating part. Generally the fluids that are used with the rotary joints and rotating unions are steam, water, thermal oil, hydraulic fluids etc.

A rotary union will lock onto an input valve while rotating to meet an outlet. During this time the liquid and/or gas will flow into the rotary union

from its source and will be held within the device during its movement.

This liquid and/or gas will leave the union when the valve openings meet during rotation and more liquid and/or gas will flow into the union again for the next rotation.

2. Pressure gauge

A pressure sensor measures pressure of gases or liquids. It generates a signal as a function of the pressure imposed; in our system such signal is electrical. Pressure sensors can also be uses to measure other variables such as fluid/gas flow, speed and water level. Pressure sensors can alternatively be called pressure transducer, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers among other names

3. Bearing

Journal or plain bearings consist of a shaft or journal which rotates freely in a supporting metal sleeve or shell. There are no rolling elements in these bearings. Their design and construction may be relatively simple, but the theory and operation of these bearings can be complex. This article concentrates on oil- and grease-lubricated full fluid film journal bearings; but first a brief discussion of pins and bushings, dry and semilubricated journal bearings, and tilting-pad bearings.

Low-speed pins and bushings are a form of journal bearing in which the shaft or shell generally does not make a full rotation. The partial rotation at low speed, before typically reversing direction, does not allow for the formation of a full fluid film and thus metal-to-metal contact does occur within the bearing. Pins and bushings continually operate in the boundary lubrication regime.

These types of bearings are typically lubricated with an extreme pressure (EP) grease to aid in supporting the load. Solid molybdenum disulfide (moly) is included in the grease to enhance the load-carrying capability of the lubricant. Many outdoor construction and mining equipment applications incorporate pins and bushings. Consequently, shock loading and water and dirt contamination are often major factors in their lubrication.

4. Compressor

The system uses compressor to get the air from atmosphere & to compress it to a required pressure. A 12V DC compressor has being used in our system. It is perfect for cars, bikes and inflators. It operates from the cigarette lighter socket of a DC-12V.

Proper design has been set up for installing hose and cord. It is ideal for inflating all vehicle tires and other high-pressure inflatables. The following table shows the specification of our portable compressor.

Operating Pressure Range (psi)	0-80 psi
Voltage Supply	12 V DC
Weight	336 gram
Dimensions	10.8*4.7*9.5 cm

Table 1 Specifications of our portable compressor

4. Calculation:

1) Compressor Selection:

For tyre pressure of 30 psi

Where, 1 psi = 0.06895 bar

Therefore,

30 psi = 30*0.06895 bar

= 2.0685 bar

= 2.1 bar (approx.)

Therefore, we are selecting 12V D.C., 5.5 bar compressor for tyre pressure of 30psi

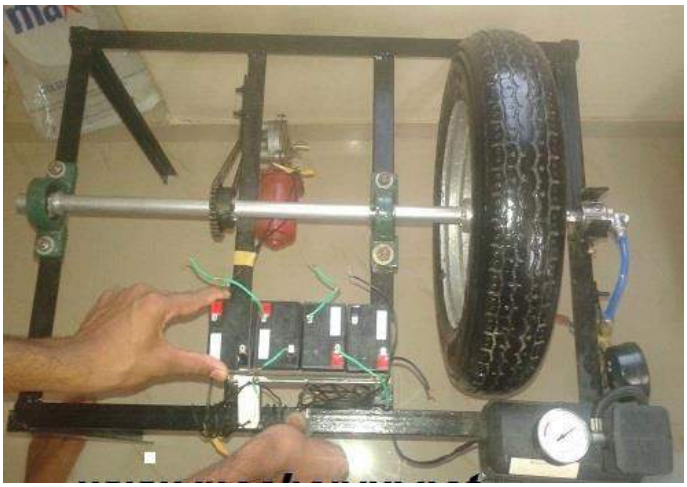
5. Specifications:

The specifications and material used for manufacturing of different components are as follows

SI. No	Description	Specifications
1	Compressor	80 psi (5.516 bar) 12V D.C.
2	Rotary Joint	Size= ½, Pressure= 10kg/cm2
3	Pressure Sensor	Pressure range= 0-100 psi
4	Bearing	Roller bearing ,Carbon Steel
5	Chain Sprocket	No. of teeth =18, Carbon steel
6	Shaft	Carbon Steel
7	Frame	75*60*50, Mild Steel
8	Wheel	Auto-richsaw Wheel
9	Hoses	Polyvinyl chloride (PVC)
10	DC motor	12V DC ,100rpm

Table 2: Material used for different components

SYSTEM WORKING



In this system, compressor is connected to wheel with the help of hoses through a rotary joint. Pressure sensor and control circuit are connected between wheel and compressor.

Two limits (upper limit and lower limit i.e. 20psi and 30 psi respectively) are set in the control circuit for automatic start and stop of compressor. Compressor works on 12V DC supply that is either a car battery or bike or an adapter.

A non-return valve is connected between pressure sensor and compressor, so that the air flow must be unidirectional from compressor to tyre. When the pressure reduces below the lower limit (20psi) in the tyre during its rotation, pressure sensor senses this drop and starts the compressor automatically for the filling air into tyre with the help of control circuit.

As soon as the pressure crosses the set upper limit (30psi), compressor stops working with the help of pressure sensor and control circuit. In this way, a proper required tyre pressure is maintained.

Advantages

There are vast and many important positive points of this system as explained below:

1- The first main advantage is you don't have to check tire pressure regularly and so never want to go for the air filling.
2- The next major advantage is you don't have to stop in any unsafe area if tire get punctured, where safety is the matter of concern.
3- The most important is you don't have to change your tire with another tire which saves a lot of time and you can utilize that time in reaching to your destination.
4- The cost of system is optimum, but increases safety, comfort and efficiency.
5- The weight of this system is also very less so one can use it in cars, buses, etc.

Conclusions

We can conclude that this automatic centralized compressor self-inflating tyre system ensures that all tyres are always properly inflated and thus improves the tyre life, safety, reduction of gas mileage and vehicle performance by supplying air to all tyres via hoses and a rotary joint fixed between wheel spindle and wheel hub at each wheel whenever there is a pressure drop inside the tyre.

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