International Journal of Future Generation Communication and Networking
Vol. 13, No. 2s, (2020), pp. 839–844

Autonomous Tire Inflation System

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Abstract

Since the discovery of tires, amelioration is being done in tires of a vehicle on a regular basis for its improved life and its role in increasing vehicular safety. As we all know that vehicle is the most important part of our life, because it helps us in traveling miles in a few minutes. The air pressure of the tires needs to be maintained at ideal level for better running of vehicle and for its safety purposes. So, this system was introduced keeping in mind the fuel consumption, vehicular safety and comfort. It maintains the required tire pressure of vehicle, increases fuel efficiency and reduces tire wear thus increasing their life and reducing the tire replacement time and cost. Significant aim of introducing this system is to maintain ideal pressure in tires and when the pressure of tire goes below ideal vale pressure gauge monitors it and the tire is inflated again. This paper provides a better understanding for researchers and new learners on the working, advantages and limitations of the "Autonomous tire inflation system" used in tires of a vehicle. Project is concerned about and to develop an "automatic tire pressure inflation system". As we are aware that by drop of few pressure units in vehicle its results in the reduction in mileage, tire life, safety and performance. This system can be placed in every in automobile under any operating condition, this will not only maintain the correct tire pressure but also increase tire life, mileage and safety so we have fabricated this system to inflate and deflate the tire automatically by using control units. This system is named automatic because it checks the tire pressure continuously using built control device and accordingly gives alert signals to the driver about the tire condition.

Keywords— Tire inflation, Autonomous Tire Inflation System, Tire pressure.

I. INTRODUCTION

According to a Recent Survey, about 80 percent of the cars on the roads are driving with one or more tires under inflated. Tires lose air through normal driving (especially after hitting pot holes or curbs), permeation and seasonal changes in temperature. They can lose one or two psi (pounds per square inch) each month in winter and even more in the summer. And, you can't tell if they're properly inflated just by looking at them. You have to use tire pressure gauge. Not only is under inflated bad for your tire but it's also bad for your gas mileage, affects the way your car handles and is generally unsafe. When tires are not inflated properly, the tread wears more quickly. According to Goodyear, this equates to 15 percent fewer miles you can drive on them for every 20 percent that they're under inflated. Under inflated tires also overheat more quickly than properly inflated tires, which causes more tire damage. Today automobile sector plays a big role in the economics of all the countries in the world and lots of researches have been carried out to improve the efficiency of the vehicle one the techniques to improve the efficiency of an automobile is inflate the tire regularly. As its well-known, one of the most serious problems that the large motor vehicle have whether they are for the transportation of passengers or cargo and especially those used for middle or longer distance travel, resides the ensuring the correct performance of the tires. This means making sure that tire is inflated and stay inflated for the right amount of pressure for the load being carried and for road condition this way one can ensure not only the preservation of outer covering of the tires, but also the correct operation of vehicle without any risks.

- *Effects of Tire Pressure*

Proper air pressure in a tire helps to distribute the weight of a vehicle evenly across the tire's tread pattern, so the tire (and the vehicle) is at its most stable. When a tire is under-inflated or over-inflated,

ISSN: 2233-7857 IJFGCN

it loses stability, negatively affecting handling, cornering, and stopping. Eventually the tire will also start to wear unevenly. Under-inflated tires tend to show wear on the outside edges of the tread, while overinflated tires show wear down the middle of the tread. With incorrect inflation pressure more tire wear and thus there is a need to change tire quickly. The main motivation for properly inflated tire is to distribute the vehicle load evenly across the tire footprint thereby providing good contact with the road, passenger comfort, responsive handling and uniform tire wear. It should be remembered that it is the air pressure inside the tire that supports the weight of the vehicle. Two situations can arise with improperly inflated tires namely, under-inflated and over-inflated. In the case of under-inflated tires, the tire life could be reduced considerable if the tire pressures is maintained low for long periods of time. Tire manufacturers Michelin and Goodyear have claimed a reduction in tire life of up to 30 % if tires are operated 20 % below recommended pressure. Tire also bends and distorts more, resulting in over-heating and increased RR. In a test conducted, it was even found that the vehicle was a few seconds slower around a track on under-inflated tires, with drivers reporting a detached feeling from the vehicle in the corners. For the over-inflated case, the tire could sustain damage when riding over road surface irregularities such as potholes and bumps. Passenger comfort is also marginally compromised. Increasing the tire pressure results in a decrease in tire-road contact area, resulting in slightly poorer traction and braking capabilities. Figure 11 shows typical tire wear patterns observed for under-inflated, recommended and over-inflated tires. An under-inflated tire tends to wear at the shoulders more than at the center, since the pressure is not sufficient at the tire center to bear the load. For over-inflated tires, the wear is severe along the center due to bulging of the tire. Proper tire pressure becomes particularly important in wet weather conditions from a safety point of view. Tread depth, tire footprint size and tread design play a vital role in determining the hydroplaning characteristics and wet traction performance of a tire. From a series of test conducted by Michelin it was concluded that the tire pressure plays an important role in determining the tire's contact patch surface area, especially at increasing vehicle speeds. Tests revealed that an under-inflated tire would hydroplane at speeds lower than well inflated tires for the same height of standing water.

II. CASE STUDY

The objective of this trial was to assess the economic and environmental performance of automatic central tire inflation in B-double regional line haul applications. This trial involved an in-field assessment of two cement tankers operating regional linehaul routes in New South Wales. The vehicles operated over an average of 12 week between February 2013 and May 2013. Both trial vehicles underwent a monitoring period of 6 weeks with the CTI system turned on. This was followed by a 6-week period with the CTI system turned off. In order to ensure that the operation of each vehicle was directly comparable before and after the intervention, data loggers were fitted to each vehicle to capture key descriptors of vehicle operation. A summary of the results for each of the trial vehicles when using automatic tire inflation is provided in Table 1. Comparison of the fuel consumption data revealed that when using a CTI system changes in fuel efficiency ranged from a 1.22% fuel use reduction in Truck 2, to a 0.84% fuel use increase in Truck 1. Of the two trial vehicles, Truck 2 provided a stronger argument in support of CTI producing fuel savings, despite more idling and more PTO use during the CTI period. Combined, the average fuel efficiency benefit was 0.19%. Analysis of the GHG performance mirrors the fuel trend: GHG emissions generated by the trial vehicles were, on average, 0.19% lower than before the monitoring intervention.

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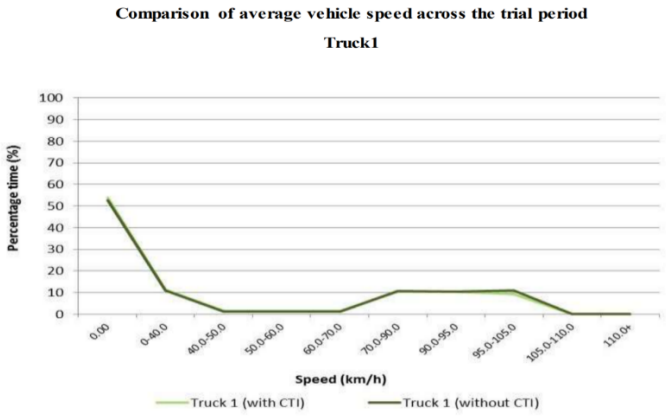
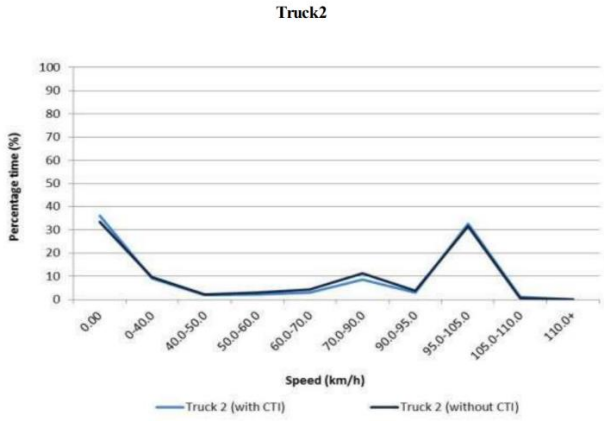


Fig.1 Frame Design



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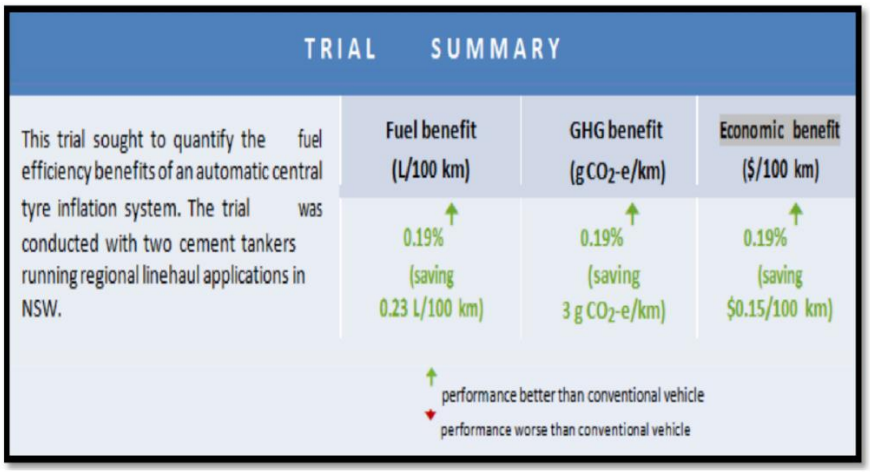

Fig.1 Frame Design

III. FRAME DESIGN

We used SOLIDWORKS software to design a three-dimensional model of the Frame. This software allowed our team to visualize the design in 3-D space and reduce errors in fabrication.

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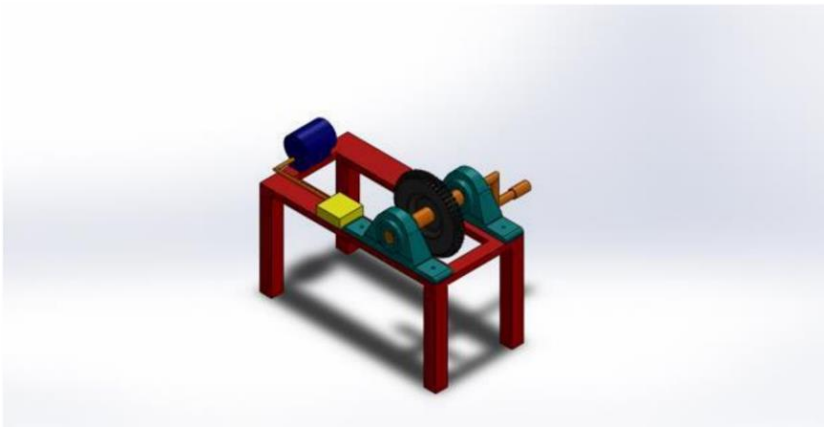

Fig.1 Frame Design

IV. OVERVIEW OF THE WORK

In this project we propose to create a Pneumatic system for indicating the tire pressure condition and inflate the tire to optimal
point so as to mitigate the problems due to over-inflation/underinflation. For this experiment: -

1. Setup a wheel on a frame structure along with a compressor and an air tank.
2. Connect rotary seal to the wheel.
3. We fit a solenoid valve to comp0ressore outlet.
4. We fit two TEE section to the tubing, one for pressure transducer and other for pressure relief valve.
5. Then we connect this system to the rotary seal and the to the valve of the tire.
6. We program an Arduino to control the solenoid valve according to the feedback given by the pressure sensor.
7. Last, we check if the system if working properly.

V. CONCLUSIONS

ATIS is a system which can inflate automobile tires autonomously and maintain tire pressure in the tire. This will help in increasing the life of the tire and also increase performance of the automobile. This ATIS (Autonomous Tire Inflation System) has various applications in many industries such as:
1. Military Vehicles (Armored truck and All-Terrain Vehicles)
2. All Terrain Rovers
3. Robotics
4. Autonomous Vehicles
5. Construction and Mining Vehicles.

Such types of application in the real world will be possible and make the modern vehicles more safe and secure. The system we propose automatically adjusts the pressure in each tire while the vehicle is in operation to compensate for leaks and slow leak punctures. The driver will be able to adjust the pressure depending on the desired driving mode: comfort, sporty, all-terrain or over-obstacle. The goal is to constantly maintain a specific pressure which this system achieves with precision.

ISSN: 2233-7857 IJFGCN

TABLE I
COMPONENTS

Components	Function and Specifications
Tube	To supply compressed air to wheel. 6 mm Tube.
Rotary Seal	Prevent twisting of tube. 1/4-inch size.
Pressure Sensor	To measure pressure in the wheel. Pressure transducer.
Wheel	R14 size wheel.
Solenoid Valve	To control the inlet from air compressor and outlet for pressure relief. 1/4- solenoid valve.
Arduino	Control solenoid valve, pressure sensor and other components as desired.
Air Tank	Reservoir for compressed air. 9 litres.
Compressor	Compress air. 8 bars.
Check Valve	Set the air flow in one direction.
Breadboard	Building the circuit for Arduino.

ACKNOWLEDGMENT

We take this opportunity to thank all those who have contributed in successful completion of this Project work. We would like to express my sincere thanks to my guide Prof.G.B.Firame who have encouraged me to work on this topic and provided valuable guidance wherever required. We also extend my gratitude to Dr. N. P. Sherje (H.O.D Mechanical Department) who has provided facilities to explore the subject with more enthusiasm.

We express my immense pleasure and thankfulness to all the teachers and staff of the Department of Mechanical Engineering of Smt. Kashibai Navale College of Engineering for their co-operation and support.

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