A novel vehicle tyre inflation system for Automobiles

R.P. Bachute[1], Suraj Jadhav[2], Dhiraj Gandhile[3], Aditya Gophane[4], Shailesh Raskar[5]

[1]*Head of the Department, Department of Mechanical Engineering, D Y Patil School of Engineering and Technology,Pune, India*

[2,3,4,5]*U G Student, Department of Mechanical Engineering, D Y Patil School of Engineering and Technology,Pune, India*

Abstract:

The paper titled "Automatic Air Inflation in Vehicle Tyre" addresses the challenges associated with driving vehicles that have either low or high tyre pressure. Irregular and uneven tyre pressure can lead to driving difficulties and even accidents. The primary focus of the project is to maintain optimal tyre pressures, thereby reducing driving challenges. This is achieved through mechanical means, allowing air to be inflated into the tyres without the need to stop the vehicle. The air tank supplies the air for tyre inflation, which is directed to the tyres through a one-way valve. A joint prevents any twists in the air hose. The system's design is both simple and cost-effective, making it easily implementable in vehicles with minimal space requirements.

By adopting Automatic Air Inflation systems in Vehicle Tyres, significant benefits can be achieved. The system continuously monitors and adjusts the pressurized air levels in the tyres, ensuring proper inflation even while the truck is in motion. The system utilizes the vehicle's own air-brake compressor to supply air to all tyres. Once the Automatic Air Inflation system is installed in the vehicle, it operates seamlessly without requiring any special attention from the drivers. This eliminates the need for manual tyre pressure checks, saving time and labor while ensuring consistent and proper tyre inflation.

Furthermore, implementing Automatic Air Inflation systems in Vehicle Tyres can lead to considerable savings. It can reduce tyre maintenance costs and improve fuel economy by nearly 1 percent, resulting in saving 100 gallons of fuel and eliminating 1 metric ton of greenhouse gas emissions annually. Additionally, properly inflated tyres experience fewer punctures and have a longer life expectancy. Overall, the system enhances driving safety, efficiency, and reduces the environmental impact of vehicle operations.

The article also provides a literature review on the importance of regular tyre inflation to improve automobile efficiency and ensure optimal tyre performance. Several studies have highlighted the benefits of Automatic Pressure Controlling and Self-Inflating Systems, indicating their potential in the automobile industry.

The working principle of the Automatic Air Inflation system is described, involving components such as pressure sensors, ATMEGA16 controller, LCD display, relay switch, solenoid valve, pneumatic actuator, and air compressor. Each component's function and specifications are explained in detail, emphasizing the role they play in maintaining proper tyre pressure and enhancing the efficiency of the system.

In conclusion, the Automatic Air Inflation in Vehicle Tyre system offers a practical solution to the challenges associated with tyre pressure in vehicles. Its simple design and cost-effectiveness make it a viable option for implementation in vehicles, leading to improved driving safety, reduced maintenance costs, and increased fuel efficiency.

Key Words: Automobiles, Tyre, Inflation, Long Drives, Sensors

1. INTRODUCTION

The paper titled "Automatic Air Inflation in Vehicle Tyre" addresses the challenges associated with driving vehicles that have either low or high tyre pressure. Irregular and uneven tyre pressure can lead to driving difficulties and even accidents. The primary focus of the project is to maintain optimal tyre pressures, thereby reducing driving challenges. This is achieved through mechanical means, allowing air to be inflated into the tyres without the need to stop the vehicle. The air tank supplies the air for tyre inflation, which is directed to the tyres through a one-way valve. A joint prevents any twists in the air hose. The system's design is both simple and cost-effective, making it easily implementable in vehicles with minimal space requirements.

By adopting Automatic Air Inflation systems in Vehicle Tyres, significant benefits can be achieved. The system continuously monitors and adjusts the pressurized air levels in the tyres, ensuring proper inflation even while the truck is in motion. The system utilizes the vehicle's own air-brake compressor to supply air to all tyres. Once the Automatic Air Inflation system is installed in the vehicle, it operates seamlessly without requiring any special attention from the drivers. This eliminates the need for manual tyre pressure checks, saving time and labor while ensuring consistent and proper tyre inflation.

Furthermore, implementing Automatic Air Inflation systems in Vehicle Tyres can lead to considerable savings. It can reduce tyre maintenance costs and improve fuel economy by nearly 1 percent, resulting in saving 100 gallons of fuel and eliminating 1 metric ton of greenhouse gas emissions annually. Additionally, properly inflated tyres experience fewer punctures and have a longer life expectancy. Overall, the system enhances driving safety, efficiency, and reduces the environmental impact of vehicle operations.

2. LITERATURE REVIEW

Currently, the automobile sector plays a crucial role in the economies of all countries worldwide, and extensive research has been conducted to enhance vehicle efficiency. Regular tyre inflation is recognized as one of the effective techniques to improve automobile efficiency. Large motor vehicles used for passenger or cargo transportation, especially over middle or long distances, face a significant challenge in ensuring optimal tyre performance. This entails maintaining the right tyre pressure suitable for the load and road conditions, ensuring not

only the preservation of the tyres' outer covering but also the safe and efficient operation of the vehicle.

According to V. Jeeva Bharathi et al. (2017), an Automatic Pressure Controlling and Self-Inflating System is poised to become a groundbreaking product in the automobile supplier industry, as it is not currently installed in the majority of passenger automobiles. The market conditions are favorable for introducing such a system. This system fulfills user requirements by maintaining ideal tyre pressure, improving fuel efficiency, and enhancing overall automobile safety. It constantly monitors the appropriate tyre pressure, adjusting it as needed to achieve the best mileage, comfortable driving, and safety. Moreover, the installation of this essential system is cost-effective, making it accessible to all passenger vehicle owners at an affordable budget [1].

Tyre deflation refers to the process of releasing air or gas from the tyres, which poses a problem for automobile vehicles, particularly those covering long distances. Over time, the tyres gradually lose air due to osmosis, resulting in a loss of 1 to 3 PSI per month, depending on the specific tyre make and model. The type of compounds used in tyre manufacturing significantly affects osmosis, including the composition and gauge of the tyre's inner liner compound [2].

As concluded by Inderjeet Singh et al. (2016), the tyre implementation system is designed to maintain uniform tyre pressure in automobiles, reducing tyre wear, increasing fuel efficiency, and enhancing overall safety by ensuring the proper air pressure in the tyres [3].

Kamlesh R. Patil highlighted several benefits of Tyre Inflation Systems for the transportation industry and vehicle owners. These benefits include improved vehicle mobility through enhanced traction, improved ride quality, and cargo safety due to reduced vehicle vibrations when using the correct tyre pressure. The systems also contribute to reducing road maintenance, increasing fuel efficiency, and considerably extending the tyre life of vehicles. Thus, Tyre Inflation Systems should be utilized in vehicles to benefit the automobile industry, vehicle owners, passengers, and society as a whole [4].

3. WORKING PRINCIPLE

The system comprises a solenoid valve, control unit, pressure sensor, and Tyre model. The pressure sensor is used to detect the tyre's pressure level, which is already programmed into the control unit. When the pressure level decreases, the sensor sends a signal to the control unit. Subsequently, the control unit activates the solenoid valve to fill the air until the desired pressure is achieved. Once the required pressure is reached, the control unit turns OFF the Solenoid valve. On the other hand, if the pressure level exceeds the desired amount, the control unit activates another solenoid valve to release air into the atmosphere. The operation stops when the control unit ensures that the correct pressure is attained. Components and specification.

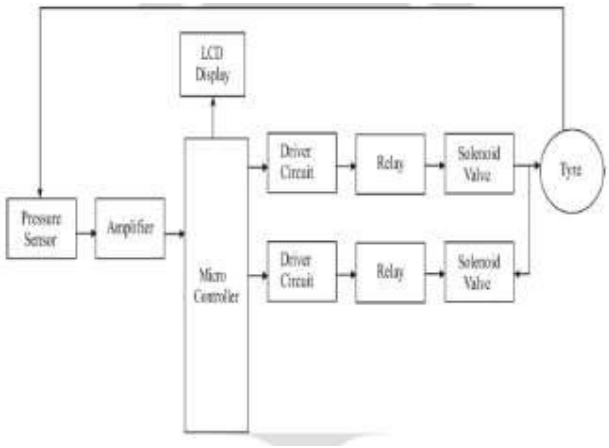


Fig -1: Block Diagram of System

3.1 Pressure Sensor

Typically functioning as a transducer, a pressure sensor produces an electrical signal corresponding to the applied pressure. In the context of this article, the generated signal is electrical. Pressure sensors find applications in numerous everyday scenarios for control and monitoring purposes. Additionally, they have the capability to indirectly measure various other variables, including fluid/gas flow, speed, water level, and altitude.

3.2 ATMEGA16 Controller

ATmega16 belongs to Atmel's Mega AVR family, being an 8-bit high-performance microcontroller with low power consumption. It operates on an enhanced RISC (Reduced Instruction Set Computing) architecture, offering 131 powerful instructions, and many of these instructions can execute in just one machine cycle. The microcontroller can run at a maximum frequency of 16MHz. Additionally, ATmega16 is equipped with 16 KB of programmable flash memory, 1 KB of static RAM, and 512 Bytes of EEPROM.

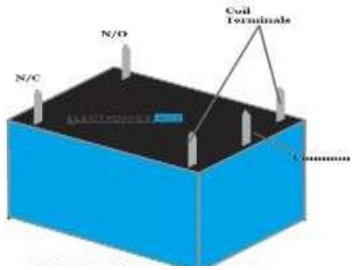
3.3 LCD (Liquid-Crystal Display)

A liquid-crystal display (LCD) is an electronically modulated optical device or flat-panel display that utilizes the light-modulating properties of liquid crystals. Unlike emitting light directly, liquid crystals use a backlight or reflector to create images in either color or monochrome. LCDs are capable of displaying arbitrary images, such as those found in general-purpose computer displays, as well as fixed images with low information content, which can be shown or hidden, like preset words, digits, and 7-segment displays found in digital clocks.

Although arbitrary images are composed of numerous small pixels, other displays feature larger elements while employing the same underlying technology.

3.4 Relay Switch

A relay is a type of switch that is operated electrically. While many relays utilize an electromagnet to mechanically activate a switch, other operating principles, such as solid-state relays, are also employed. Relays are particularly useful in situations where the control of a circuit is required through a separate low-power signal or when multiple circuits need to be controlled using a single signal.



3.5 Solenoid Valve

It is an electromechanical device designed to regulate the flow of air, either allowing or restricting it to pass from the compressor. This device is positioned between the compressor and the flexible air hose. The casing of the coil or solenoid is hollow and possesses a metallic outer finish. Within this hollow part, the coil winding is present, which can be energized or de-energized through the lead wire. At the center of the casing, there is a plunger accompanied by a calibrated spring situated above it.

3.6 Pneumatic Actuator

A Pneumatic Actuator primarily comprises either a piston or a diaphragm that generates the driving force. By retaining air in the upper section of the cylinder, the actuator employs air pressure to induce movement in the diaphragm or piston, which, in turn, controls the valve stem or rotates the valve control element. Valves necessitate minimal pressure to function and typically amplify the input force by two or three times. As the size of the piston increases, so does the output pressure it can produce. Air Compressor

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more andmore air into a storage tank, increasing the pressure.

3.7 Power Supply

In power supply, power means energy (electrical) and supply means transportation. It is a device which supplies the electric power to an electrical load. Its main function is toconvert the electrical current from source to required current, voltage and frequency to the load.

4. 4. DISCUSSIONS .

The paper "Automatic Air Inflation in Vehicle Tyre" presents a comprehensive overview of an innovative system designed to address the challenges associated with tyre pressure in vehicles. The primary objective of the project is to maintain optimal tyre pressures, ensuring safe and efficient driving while reducing the risk of accidents caused by irregular or uneven tyre pressure. The system operates through mechanical means, allowing air to be inflated into the tyres without the need to stop the vehicle, making it convenient for drivers and eliminating the need for manual tyre pressure checks.

By adopting Automatic Air Inflation systems in Vehicle Tyres, significant benefits can be achieved. The continuous monitoring and adjustment of pressurized air levels in the tyres ensure proper inflation even while the vehicle is in motion, enhancing driving safety and efficiency. The system cleverly utilizes the vehicle's own air-brake compressor to supply air to all tyres, optimizing resources and simplifying the installation process. Once installed, the system operates seamlessly without requiring any special attention from drivers, further improving the convenience and effectiveness of the technology.

Moreover, the implementation of Automatic Air Inflation systems in Vehicle Tyres leads to substantial cost savings. By reducing tyre maintenance costs and improving fuel economy, the system can save up to 1 percent of fuel consumption annually, resulting in significant fuel savings and reduced greenhouse gas emissions. Properly inflated tyres experience fewer punctures and have a longer life expectancy, contributing to further cost reductions and enhancing the overall sustainability of vehicle operations.

The literature review reinforces the importance of regular tyre inflation to improve automobile efficiency and ensure optimal tyre performance. Studies by V. Jeeva Bharathi et al., Inderjeet Singh et al., and Kamlesh R. Patil highlight the benefits of Automatic Pressure Controlling and Self-Inflating Systems, indicating the potential of such systems in the automobile industry. This highlights the relevance and significance of the current paper's findings, further validating the importance of the proposed Automatic Air Inflation system.

5. CONCLUSION

The paper presents a novel solution to the challenges associated with tyre pressure in vehicles by introducing the "Automatic Air Inflation in Vehicle Tyre" system. The system's mechanical means of inflating the tyres without stopping the vehicle ensures optimal tyre pressures, enhancing driving safety and reducing accidents caused by irregular tyre pressure.

The Automatic Air Inflation system offers several key advantages, including the continuous monitoring and adjustment of tyre pressure while the vehicle is in motion, eliminating the need for manual pressure checks, and utilizing the vehicle's own air-brake compressor for air supply. These features improve driving convenience, efficiency, and overall safety.

Additionally, the system leads to substantial cost savings by reducing tyre maintenance expenses and improving fuel economy. The reduction in fuel consumption results in significant fuel savings and reduced greenhouse gas emissions, promoting environmental sustainability.

Overall, the Automatic Air Inflation in Vehicle Tyre system proves to be a practical and cost-effective solution for maintaining optimal tyre pressure in vehicles. Its simplicity, ease of implementation, and significant benefits make it a valuable addition to the automobile industry, benefitting vehicle owners, passengers, and society as a whole.

REFERENCES

[1] V. Jeeva Bharathi1 , Design And Fabrication of A. V. Wadmare ,Automatic Tyre Pressure Controlling and Self Inflating System, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X PP. 01-05 www.iosrjournals.org (2017)

[2] Automatic Tyre Inflation And Deflation System,Vol-2 Issue-3 2016 IJARIIE-ISSN(O)-2395-4396 (2016)

[3] Indrajeet Burase: A Survey on Automatic Air Inflating System for Automobile,International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization),Vol. 5, Issue 10, October 2016

[4] Kamlesh R. Patil: Self-Inflating Tyre System, Imperial Journal of Interdisciplinary Research (IJIR) Vol-3, Issue-3, 2017 ISSN: 2454-1362, http://www.onlinejournal.in

[5] P.A Pilavachi.:Power generation with gas turbine systems and combined heat and power,(2004).

[6] Ming Zheng (est.al):A new advanced power-generation system using chemicallooping combustion-MasaruIshida Diesel engine exhaust gas recirculation(2011)

[7] Tata McGraw Hills: Crouse.Anglin,Automotive Mechanics

[8] Ram Bansal: Automatic Tyre Inflation System In Dynamic Condition (IJAuERD), ISSN(P) :2277-4785;ISSN(E):2278-9413 Vol.8,Issue 1,Jun 2018,1-10

[9] Harshal Junankar: A Review: Automatic Tyre Inflation System (IJSRD),Vol. 3,Issue 01,2015,ISSN(online):2321-0613

[10] Shivam Dangi: Automatic Tyre Presssure Inflation System (IRJET),Vol.5 Issue 02,Feb 2018 ISSN(P):2395-0072;ISSN(E):2395-0056