

Automatic Air Inflation in Vehicle Tyre

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Abstract - The main aim of this paper is to develop an Automatic Air Inflation in Vehicle Tyre. This can be placed in all automobiles while long drives and that can be utilized while climbing up hills or down hills. It is very necessary for every automobile to be cautious while driving through long distances. So, we have fabricated this machine to fill the air automatically by using control units. Main aim of this project is that when the air is decreased to the automobile vehicles then the sensor signal alert the person for usage of air tank to fill the air in the tyre. Then the air pressure will get increased in the tyre of the vehicle it is same as the process of indicating the sensor signal through the person using solenoid valve to reduce the excess air in the tyre.

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

1. INTRODUCTION

This paper titled as Automatic Air Inflation in Vehicle Tyre deals with the difficulty in driving the vehicles with low and high tyre pressure. The irregular and uneven tyre pressure causes difficulty in driving and even leads to the accidents. The project mainly concentrates on maintaining the tyre pressures and thereby reducing the driving difficulties. This is done by mechanical means. The air can be inflated into the tyres without stopping the vehicle. The air from the air tank is used for inflating the tyres. The air from the tank is sent to the tyres through a one-way valve. The twist made in the air hose is prevented by a joint. The design of the system is very simple and also very economical. Therefore, it can be implemented easily in the vehicles. The space requirement for the installation is also very less. Automatic Air inflation systems in Vehicle Tyre can save tyre maintenance costs and improve fuel economy by nearly 1 percent, saving 100 gallons of fuel and eliminating 1 metric ton of greenhouse gas emissions per year. Properly inflated tyres also have fewer punctures and a longer life expectancy.

Automatic Air inflation systems monitor and continuously adjust the level of pressurized air in tyre, maintaining proper tyre inflation automatically even while the truck is in motion. Our system uses the vehicles own air-brake compressor to supply air to all the tyre. Once Automatic Air Inflation system is installed in Vehicle; it should not require any special attention from the drivers. This eliminates the need to check

tyre pressure manually, which saves time and labor while ensuring consistent and proper tyre inflation

2. LITERATURE REVIEW

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 tyre regularly. As its well-known, one of the most serious problem that the large motor vehicle has whether they are for the transportation of passenger or cargo and especially those used for middle or longer distance travel, resides the ensuring the correct performance of the tyres. This means making sure that tyre are 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 tyres, but also the correct operation of vehicle without any risks.

V. Jeeva Bharathi and it's all (2017) has concluded that Automatic pressure controlling and self-inflating system would be exploding as new product in the automobile supplier industry as such a product does not currently installed for majority of passenger automobiles, hence the market conditions would be favorable to release such a system. It satisfies the user requirement by maintaining ideal Tyre pressure for under inflated Tyre, also improves fuel efficiency and overall safety of automobile is concerned. It assists in monitoring appropriate Tyre pressure constantly, reduces or increases the Tyre pressure according to requirement of the Tyre and help in gaining best mileage and most importantly assures to provide comfortable and safe driving. The installation of such a system in vehicles is a low cost affair so all the passenger vehicle can take the advantage of this very essential system at affordable installation budget [1]

The deflation is a process of letting air or gas out of the tyres. Deflation is the problem of an automobile vehicle. Because a certain period of time in air reduced to the vehicle for running time. So, a long distance travelled vehicle scar able things for deflation. The air is also decreasing the tyre. Fleet tyre managers typically ask how frequently they should be checking tyre pressure and loss so much of air during the course of the year. Osmosis of air through the tyre casing can lead to a loss 1 to 3 PSI per month, depending on the specific tyre make and model. The type of compounds used in the

manufacture of the tyre can have a big impact on osmosis. The composition and gauge of the tyre inner liner compound also plays significance in osmosis.[2].

Inderjeet Singh & it's all (2016) has concluded that the tyre implementation system is based on the idea to maintain uniform tyre pressure of an automobile reduce tyre wear, increase fuel efficiency & increase overall safety. So, this system maintains the proper air pressure in tyre. [3].

Kamlesh R. Patil has concluded that Tyre Inflation Systems have several benefits for the transportation industry and for the for the vehicle owners. These benefits include, improved vehicle mobility due to improved traction, improved ride quality and cargo safety due to the reduction in vehicle vibrations when the correct tyre pressure is used, reduction in road maintenance, increased fuel efficiency and a considerable increase in the tyre life of vehicles. Thus, Tyre Inflation System should be used in vehicles for the betterment of automobile industry, vehicle owners, passengers and society as a whole [4].

3. WORKING PRINCIPLE

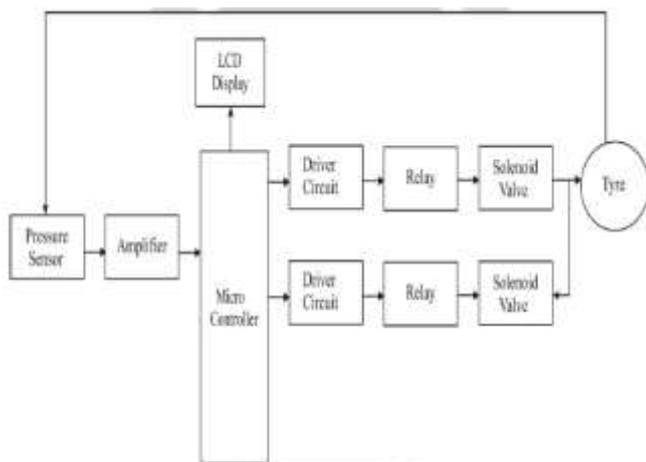


Fig -1: Block Diagram of System

It consists of solenoid valve, control unit, pressure sensor and Tyre model. Here we are using pressure sensor to detect the pressure level in the tyre. The level of pressure is already programmed in the control unit. When the pressure level is decreased, the sensor gives signal to the control unit. After that the controller unit will open the solenoid valve for filling the air when the required pressure is obtained the control unit will turn OFF the solenoid valve. In case the pressure level will be more than the required level means control unit will switch ON another solenoid valve for air to the atmosphere. When the required pressure is reached the operation will be stopped by the control unit.

4. COMPONENTS AND SPECIFICATION

4.1 Pressure Sensor

A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude.



4.2 ATMEGA16 Controller

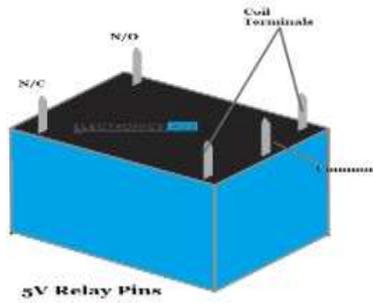
ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz. ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes.

4.3 LCD (Liquid-Crystal Display)

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays, as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

4.4 Relay Switch

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.



4.5 Solenoid Valve

It is an electromechanical controlled device which is used to allow or restricted the flow of air to pass through them from the compressor. It is attached between the compressor and the Flexible air hose. The coil/solenoid casing which is hollow and has a metallic finish in outer, in the hollow part the coil winding is present, which is energized and de-energized by the lead wire. The plunger is present at the centre of the casing with the calibrated spring, which is above the plunger.



4.6 Pneumatic Actuator

A Pneumatic Actuator mainly consists of a piston or a diaphragm which develops the motive power. It keeps the air in the upper portion of the cylinder, allowing air pressure to force the diaphragm or piston to move the valve stem or rotate the valve control element. Valves require little pressure to operate and usually double or triple the input force. The larger the size of the piston, the larger the output pressure can be.



4.7 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 and more air into a storage tank, increasing the pressure.



4.8 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 to convert the electrical current from source to required current, voltage and frequency to the load.

Power Supply Component Design

7805 → 5V

Transformer Design

We require 15V r.m.s.
The drop-out voltage of regulator is 2V (As per data sheet)

$$V_{dc} = 5 + 2 = 7V$$

So at the regulator input minimum 7V should be applied.

7805 → 5V



According to formula,
 $V_{dc} = 2V_{m} / \pi$
Assuming there is no Ripple Capacitor
Pulse
 $V_{in} = V_{dc} \cdot \pi / 2$
 $= 7 \times 3.14 / 2$
 $= 10.99V$

$V_{in} = 10.99V$

During one cycle, two diodes are conducting:
Drop of voltage of one diode = 0.7V
Drop of voltage of two diode = 1.4V
 $V_{in} = V_m + 1.4V$
 $V_{in} = 10.99 + 1.4 = 12.39V$

$V_{in} = 12.39V$

$V_{rms} = V_{in} / \sqrt{2}$ (2)
 $= 12.39 / \sqrt{2}$ (2)
 $= 8.76V$

$V_{rms} = 8.76V$

So we select transformer of 9V
Similarly $I_m = I_{dc} \times \pi / 2$
 $I_m = 400mA \times 3.14 / 2$
 $= 628mA$

$I_{rms} = I_m / \sqrt{2}$ (2)
 $= 628mA / \sqrt{2}$ (2)
 $= 444.00mA$

$I_{rms} = 444.00mA$

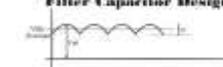
So we select transformer with current rating of 500mA.
Considering voltage and current transformer:
we take 6-9V / 500mAmp

Transformer - 6-9V / 500mA Step down transformer

Rectifier Design

PIV of diode = $V_m = 12.39V$
 $I_m = 628mA$
So we select bridge IC of 1 Ampere rating.

Filter Capacitor Design



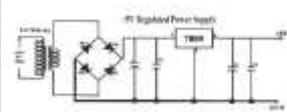
$R = V_{dc} / I_{dc}$
 $= 7 / 400mA$
 $= 17.5 Ohms$

$W = 2(V_{in} - V_{dc})$
 $= 2(12.39 - 7)$
 $= 10.78V$

$C = V_{dc} / (f \times \Delta V)$
 $= 7 / (100 \times 17.5 \times 10.78)$
 $= 371.05 \mu F$

So for safe working we select capacitor of 1000 μF

$C = 1000 \mu F / 25V$



C1 - 1000 μF / 25V - Electrolytic Capacitor
 C2 - 4.7 μF / 25V - Electrolytic Capacitor
 C3 - 220nF / 25V Electrolytic Capacitor

5. ADVANTAGES AND SAVINGS

- Under low pressure friction creates heat and if enough heat is generated the rubber that holds the tyre cords melts and tyre trails. Because of the extra resistance an under inflated tyre has when it rolls, the car's engine has to work harder. As it effects mileage it can cause severe loss in the cost considerations.
- It does not only extend tyre life but truck fleets can also see additional savings from reducing the risk of expensive tyre failure caused by underinflation. Installing this system on a trucks drive axles and trailer costs up to 60000.
- For a typical long-haul combination truck, annual fuel savings could be 28000 in fuel cost and eliminating 1 metric ton of greenhouse gas emissions.
- Annual tyre maintenance costs can also decrease.
- The cost of installing this system in a long-haul truck is generally recouped in just over 2 years through fuel and maintenance cost savings.

6. RESULTS AND CONCLUSION

We applied all these techniques to reduce the process time and human efforts of the conventional manual air filling system. The system helps to reduce cost and friction between surface of tyre and road so that will reduce the wastage of tyre material. As a result, it will increase the life of tyre. This can be used in all automobile vehicles. Existing project is designed for ideal condition tyre. In this system we have developed the next level of running condition of tyre when tyre is running at 30 to 40 rpm. Because of the vehicles in a running condition can sometimes causes puncturing the tyre. So, the alternative sensors are used to their process. Then the air will be filled in the tyre pressure per the seconds. Then calculate the air filling efficiency and find out the punctured tyre. So easily identified the punctured and to solve the problems. This process is an advanced technique of our project.

After fabrication of automatic air inflation in vehicle tyre, the result obtained that if the system utilization will be executed in proper by taking and concerning all the relevant according to the project demand the process time, cost and human efforts can be reduced in a great manner.

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