EasyChair Preprint

№ 5789

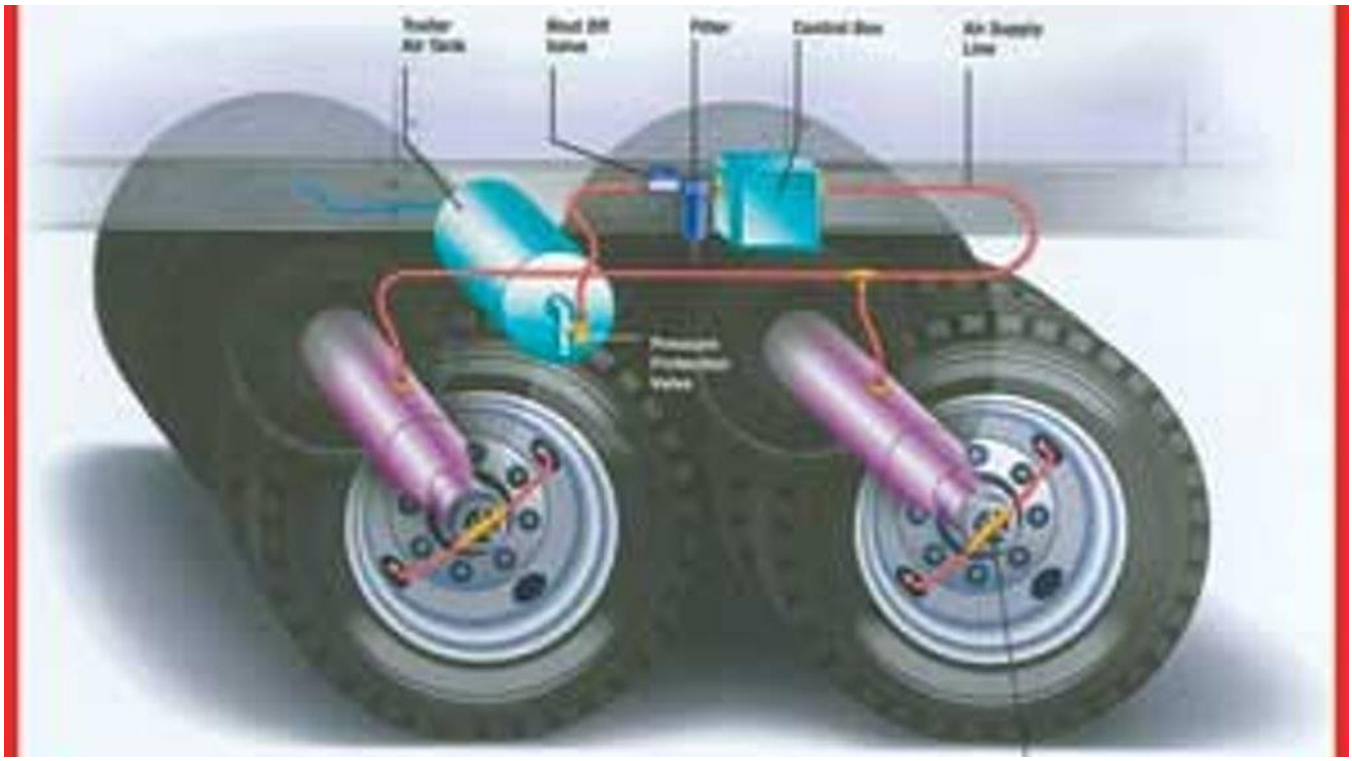
Solar Tyre Inflating System with Pressure Switch K35

Sudarshan Bhalshankar

June 15, 2021

Solar Tyre Inflating System With Pressure Switch K35

Sudarshan Bhalshankar
M.E [CAD/CAM]
PradnyaSurya Engineering Works.Pvt.Ltd.
Sudarshanbhalshankar111@gmail.com



PradnyaSurya Engineering Works.Pvt.Ltd.

Add. :- vidi Gharkul, Solapur, Maharashtra, India.

Pin code :- 413005

pradnyasuryaengineerinworks@gmail.com

Abstract

D*riven by studies that show that a drop in tyre* ***pressure*** *by just a few PSI can result in the reduction of gas mileage, tyre life, safety, and* ***vehicle performance****, we have developed an automatic, self-inflating tyre system that ensures that tyres are properly inflated at all times. Our design proposes and successfully implements the use of a portable compressor that will supply air to all four tyres via hoses and a rotary joint fixed between the wheel spindle and wheel hub at each wheel. The rotary joints effectively allow air to be channeled to the tyres without the tangling of hoses. With the recent oil price hikes and growing concern of* ***environmental*** *issues, this system addresses a potential improvement in gas mileage; tyre wear reduction; and an increase in handling and tyre performance in diverse conditions, In* ***automobile sector*** *we always try to make everything perfect around us and there are major problem is that puncture in tyre while running. We have developed tubeless tyres butt that’s not a perfect solution, so there is a major need of improvement in this sector. In this paper* ***self-inflating*** *tyre system that ensures that tyres are properly filled at all times. Our* ***design*** *successfully implements the use of a portable compressor that will supply air to all tyres via hoses and a rotary joint fixed between the wheel spindle and wheel hub at each wheel. The rotary joints effectively pass air to be channeled to the tyres without the tangling of hoses. If pressure is below the desired, the compressor will refill in the tyre. If it is above desired, excess pressure will release through a valve. With the recent oil price growing concern of environmental issues, this system addresses a potential improvement in tyre wear reduction and an increase in handling & tyre performance in diverse conditions.*

Keywords:- Vehicle performance, Self-inflating, Tyer- Conditions, Refill , Mileage, Rotary- Joint.

❖ *Introduction.*

A*ccording to American Automobile Association (AAA), about 80 percent of the cars on the road are driving with one or more tires under inflated. Tyres lose air through normal driving (especially after hitting pot holes) seasonal changes in temperature. They can lose one or two psi each month in the 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 a tire pressure gauge. Not only is under inflation bad for your tyres but it’s also bad for your gas mileage, affects the way your car handles and is generally unsafe. When tires are under-inflated, the tread wears more quickly. As tyres are flexible, they flatten at the bottom when they roll. This contact patch rebounds to its original shape once it is no longer in contact with the ground, This rebound creates a wave of motion along with some friction When there is less air in the tire, that wave is larger and the friction created is greater. And friction creates heat. If enough heat is generated, the rubber that holds the tyre’s cords together begin to melt and the tyre fails. See how tyre works to learn more. Because of the extra resistance an under inflated tyre has when it rolls, your car’s engine has to work harder.*

AAA statistics show that tyres that are under inflated by as little as 2 psi reduce fuel efficiency by 10 percent. Over a year of driving, that can amount to several hundred dollars in extra fuel purchases.

The tyre must be inflate properly in appropriate pressure in order to obtain a good vehicle performance , handling, mileage, as well as to maintain a good life span of tyre. Due to improper inflation of tyre it causes the rapid wear & tear of tyre which reduces its life span. Hence to obtain the good performance, handling & good mileage it is required to inflate tyre in desired pressure, in different operating conditions as well as temperature. To eliminate such troubles we designed the tyre inflation system to deliver the air pressure in the tyre when pressure drops. The tyre is inflated even in running of a vehicle.

The main beneficiaries of this advancement in technology that will allow for tyre pressure to be adjusted for driving conditions will be the vehicle owners. Despite an initial investment in the technology, they will experience a reduction in tire wear and an increase in fuel economy; both of which will result in saving money in the long run.

It is acceptable to say that society as a whole will benefit from the resulting design. The reduction in tyre disposal in landfills and decrease the rate of consumption of natural resources will truly benefit society. Also, the improvement in vehicle safety will benefit all people who drive a vehicle on the roadways.

❖ *Problem Statement.*

As we are aware that maintenance of correct tyre pressure is extremely important for the enhancement of tyre life. Due to drop in the pressure the tyre goes underinflated and reduces fuel economy, quickest tyre wear, not proper rolling, discomfort ride etc. So to solve out all these problems we make an automatic tyre inflation system, which will properly inflate the tyre all the times.

❖ *Literature Review.*

Over a period of 12 weeks in 2013 a trial was conducted involving two cement tankers in NSW, Australia. For the first 6 weeks this system was turned on in both tankers and for another 6 weeks this system was turned off and graphs are prepared which shows that trucks with this system was in good condition like average vehicle idle time, average vehicle time spent using power take off, Avg. Emission and fuel combustion. We also carried out a survey of different people and asked them when they inspect their tyre pressure, the report is as follows:

- 5.40 % -- 6 Monthly
- 8.10% -- Bi- monthly
- 24.32% -- Monthly
- 13.52% -- 5 -6 Days

- 43.24% -- weekly
- 5.40% -- 3 -5 Days

The problems they were facing were tyre wear, time and efforts to check as well as fill the correct air pressure. Also, some unprofessional guys do not fill the correct pressure in the tyre which leads to over inflation or under inflation on the tyre. To overcomes all these our system is the best suitable system also, in summer days, when we drive, the temperature of the tyre increases rapidly, consequently, the heated air inside the tyres expands and its pressure rises quickly, which can lead to a tyre blowout with disastrous consequences. So, therefore, to maintain the correct tyre pressure in any weather condition, we must enable this system.

❖ *Objective.*

1) To Increase Fuel Economy.
2) To Reduce Wearing of Tyre
3) To Increase Overall Vehicle Safety.
4) To Reduce Human Efforts.
5) To Increase the Life Span of tyre.
6) To avoid accidents and fatality.

❖ *Methodology.*

- Review of existing case.
- Secure 3D CAD form of in Steel material are used to manufacture frame work.
- Use Pre-processor for microcontroller
- Solve problem by using suitable FEA Solver for Structural analysis.
- Solve problem by using appropriate FEA for structural.

❖ *Material.*

1) Shaft :
2) Part name - Top shaft support bracket
3) Raw size - 120*190*40
4) Part No. - BARM-04-03-00.
5) Quantity - 02
6) Material - MS
7) Total Weight (Kg) - 1.8 kg

Sr. No	Operation	Machine	Tool Used	Time (min.)
1	Profile cutting as per drawing with the help of template.	Profile Cutting		60
2	Facing milling to get size 110 × 35 × 10 55 × 35 × 170 55 × 35 As per drawing.	Lathe Machine	Single point & Centred drill tool	200
3	Drilling for dia. 3 no. As per drawing.	Milling Machine	Drill Dia. 10 , 18, 22, 25	60
4	Removal of Sharpe edges	Drilling Machine		20

Table. :- 1 Material Specifications.

Sr. No	Operation	Tool Used	Time
1	Cutting Of Bars	Cutter	1 hr.
2	Welding		1.20 hr.
3	Drilling	Drill	20 min.
4	Grinding	Grinding wheel	15 min.

Table. :- 2 Assembly Of Product.

❖ *Components.*

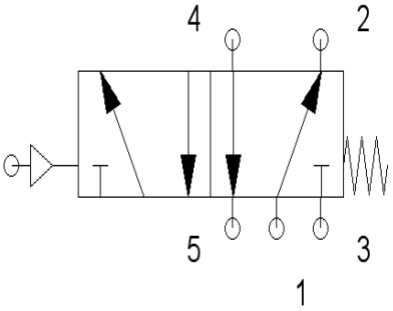
1. Hoses
2. DCV
3. Danfoss KP-35 Pressure Switch
4. Swivel Joints
5. Wheel
6. Electric Motor
7. Spur Gear
8. Nitrogen Cylinder or By compressor

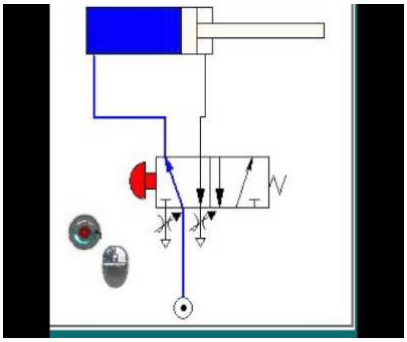
1) Hoses

A hose is a flexible hollow tube designed to carry fluids from one location to another.

2) DCV

A 5/2 directional control valve would have five ports and two spool positions. Ports are the one which helps the liquid to flow through them. Mainly there are 4 ports P-pump, t-tank or oil sump, A&B- flow of liquid to inlet and outlet of tank. Mechanically operated valves apply forces by using cams, wheels, rollers, etc., hence these valves are subjected to wear.





A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be used to isolate and simultaneously bypass a passage way for the fluid which for example should retract or extend a double-acting cylinder. There are variety of ways to have this valve actuated. A solenoid valve is commonly used, a lever can be manually twist or pinch to actuate the valve, an internal or external hydraulic or pneumatic pilot to move the shaft inside, sometimes with a spring return on the other end so it will go back to its original position when pressure is gone, or a combination of any of the mention above.

3) Dan Foss KP-35 Pressure Switch

The KP and KPI pressure switches and thermostats are used for control, monitoring and alarm systems in a wide variety of industry applications. KP pressure switches are mainly used for gaseous fluid whereas KPI pressure switches are more for liquid and gaseous fluid. The KP pressure range include special designed pressure switches and limiters for steam boilers and other heating applications.

PRESSURE SWITCH

Features

- Wide setting range
- Shock and impact resistant
- Snap action electrical contacts minimize chatter, bounce, and wear, and ensure long term electrical and mechanical reliability
- Small dimensions. Space saving – easy to install in panels
- Electrical connection from front of the unit makes rack mounting easier and also saves space
- Suitable for alternating current and direct current
- Single pressure switches and thermostats are fitted with a single pole double throw contact system (SPDT)
- Can be used for both liquids and gases (KPI)
- Manual trip function enables electrical connections verification without any tools or pressure changes in the application
- Versions with automatic and manual reset available

4) Swivel Joints

A swivel is a connection that allows the connected object, such as a gun or chair, to rotate horizontally or vertically. A common design for a swivel is a cylindrical rod that can turn freely within a support structure.

5) Electric Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy.

6) **Spur Gear -** Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially.

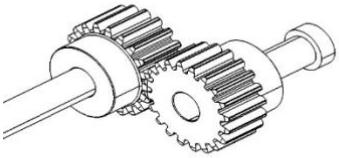


fig. Spur Gear

7) Compressor

A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor

❖ *COSTRUCTIONAL DIAGRAM & WORKING PRINCIPLES.*

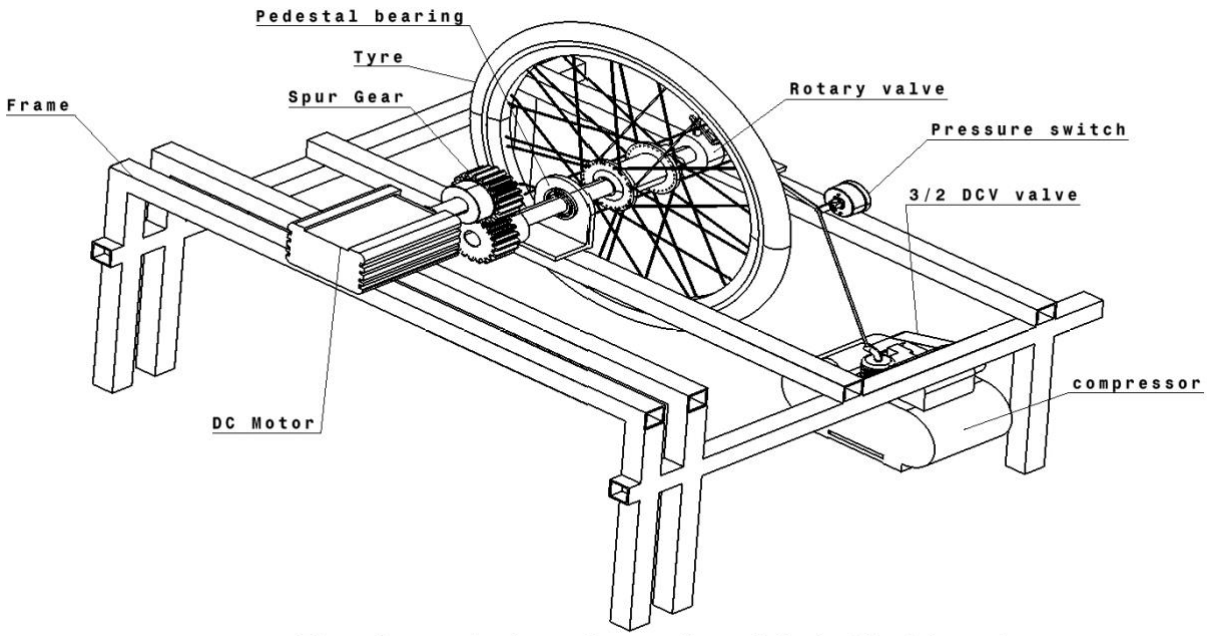


Fig.Isometric view of self inflating tyre

In this one end of the Solenoid valve is attached to the compressor and another to the air hose. This hose is connected to the wheel and the switch, solenoid valve and switch also connected with each other to transmit the signals. The wheel and the components are assembled to the frame.

Whenever there is a pressure drop in the tyre this pressure is a sense of the pressure sensor which is pre-calibrated, this switch gives the signal to the valve and the solenoid will energize and valve open. The compressed air will start flowing and inflating the tyre and when the calibrated pressure is obtained the sensor will give the signal and the solenoid will de-energized and valve close. With this we obtained the calibrated pressure and vehicle will run smoothly.

❖ *FUTURE SCOPE.*

1. As previously mentioned, the main beneficiaries of this advancement in technology that will allow for tyre pressure to be adjusted for driving conditions will be the vehicle owners.
2. Despite an initial investment in the technology, they will experience a reduction in tire wear and an increase in fuel economy; both of which will result in saving money in the long run.
3. The reduction in tyre disposal in landfills and decrease the rate of consumption of natural resources will truly benefit society. Also, the improvement in vehicle safety will benefit all people who drive a vehicle on the roadways
4. Both tire manufacturers and the petroleum industry will be negatively affected by this resulting design.

5. Tire manufacturers will be negatively affected since this product is being designed with the reduction of tire wear in mind.
6. The demand for their products will decrease as tires last longer and fewer replacements are needed
7. This is similarly true for the petroleum industry since this product results in an increase in fuel economy for passenger vehicles, and the demand for oil will go down.

❖ *RESULT AND DISCUSSION.*

1) **Tyre Life:** If a CTI system is installed onto a unit (unit = Truck and trailer combination) the expected minimum increase in tread life is 33 %.
2) **Fuel Consumption:** The expected increase in fuel economy due to the use of a CTI system is 5 %. This is the percentage by which the correct tyre pressure will positively affect fuel consumption. On paved roads, as tyre pressure increases tyre rolling resistance will decrease. This decreased drag requires less power to maintain a given speed. The decrease in required power decreases fuel consumption
3) **Maintenance:** A 10 % reduction in maintenance cost can be expected due to the implementation of CTI.

❖ *ADVANTAGES.*

The dynamically-self-inflating tyre system would be capable of succeeding as a new product in the automotive supplier industry. It specifically addresses the needs of the consumers by maintaining appropriate tire pressure conditions for:

- Reduced tyre wear
- Increased fuel economy
- Increased overall vehicle safety
- Providing sufficient airflow to the tire with minimal leakage.

Because such a product does not currently exist for the majority of passenger vehicles, the market conditions would be favorable for the introduction of a self-inflating tire system. Through extensive engineering analysis, it has also been determined that the self-inflating tire system would actually function as desired. In particular, the product would be capable.

Withstanding the static and dynamic loading exerted on the rotary joints Note that likewise, this system would not produce any negative dynamic effects on surrounding systems. Most significantly, the self-inflating tire system would be a successful product because of its economic benefits to investors. For further development of this product, we recommend increasing the capability of the system by adding the following features.

1. Pressure adjustment based on increasing vehicle speed.
2. Pressure adjustment based on increasing vehicle load.

❖ *CONCLUSION.*

We can conclude that this system ensures us that each and every tyre is properly inflated to the proper tyre pressure throughout the journey and it also improves tyre life, reduces tyre wear, increases fuel efficiency and also increases the overall safety of the vehicle, it also monitors the tyre pressure constantly, provide us the proper inflation and deflation of the tyre, and helps in providing a comfortable ride with better mileage.

1) Using this system, driver can increase or decrease required air pressure in vehicle’s tyres, without stopping the vehicle to do so.
2) Also, using this system in military purposes, it can help driver to increase or decrease pressure without getting out of the vehicle.
3) Using this system, overall performance of vehicle will increase like
   - Increased fuel efficiency.
   - Increased life span of tyres.
   - Compatibility to driver in long journeys.

❖ *REFERENCES.*

1. Inderjeet Singh, Bhupendra Pratap Singh,” To Study on Implementation of Tyre Inflation System for Automotive Vehicles” International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization)Vol. 5, Issue 4, April 2016
2. Hemant Soni, Pratik Golar, AshwinKherde,P. R. Gajhbhiye, Er. S. D. Thakre “DESIGN OF AUTOMATIC TYRE INFLATION SYSTEM” Department Of Mechanical Engineering KDK College of Engineering, RTM Nagpur University, Nagpur, India Vol.1,Issue.4/April. 2014 ISSN : 2347-5420
3. Ajas.M.A, Aiswarya.T.G, Adersh Vinayak “Tire Pressure Monitoring and Automatic Air Filling System” Department of Electronics and Communication Engineering, Matha College of Technology, M.G University,Ernakulam, Kerala, India IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 2, Apr-May, 2014,ISSN: 2320 – 8791.
4. Harshal Junankar ,Vishnusagar Bihare “A Review: Automatic Tyre Inflanation System” IJSRD – International Journal for Scientific Research & Development| Vol. 3, Issue 01, 2015 | ISSN (online): 2321-0613.
5. Sagar Adakmol, Tushar Shende, Dikshit Poriya, Sanjot Fotedar, Prof. S. P. Shinde “Centre Tyre Air Inflation System” International Journal for Scientific Research & Development| Vol. 4, Issue 03, 2016 | ISSN (online): 2321-0613.
6. Prof. Miss. Shingavi Archana Ashoklal, Mr. Bachkar Arvind Nanasaheb, Mr. Domade Ananda Chindhu, Mr. Pote Suyog Kantaram, Mr. Somwanshi Sachin Vitthal “Air Filling in Moving Tyre” International Journal for Scientific Research & Development| Vol. 4, Issue 01, 2016 | ISSN (online): 2321-0613.
7. Ms. S. K. Tope, Prof. J. V. Chopade “Self Inflating Tyre” International Journal for Scientific Research & Development| Vol. 5, Issue 02, 2016 | ISSN (online): 2321-0613.

Er. Sudarshan Bhalshankar
M.E [CAD/CAM]
PradnyaSurya Engineering Works. Pvt.Ltd.
Add :- Solapur, Maharashtra, India.
Pin code :- 413005
pradnyasuryaengineerinworks@gmail.com