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SELF INFLATION TYRE SYSTEM

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Abstract
The Self-Inflating Tyre System (SITS) addresses the critical issue of maintaining optimal tyre pressure in vehicles. Conventional tyres experience gradual air loss due to various factors, including regular driving, road hazards, small leaks, and seasonal temperature fluctuations. This can lead to under inflation, negatively impacting fuel efficiency, handling, safety, and tyre lifespan.
SITS offers a solution by automatically monitoring and adjusting tyre pressure. When pressure falls below a predetermined level, the system activates, drawing air from the vehicle's existing air braking system or pneumatic system. This air is then used to inflate the tyres back to their optimal pressure.
SITS offers several key benefits. Maintaining proper tyre pressure improves fuel efficiency by reducing rolling resistance. It also shortens braking distances and enhances vehicle handling, contributing to overall safety. Additionally, optimal pressure extends tyre life by preventing overheating and excessive wear.
In conclusion, SITS presents a novel approach to managing tyre pressure, promoting fuel savings, enhanced safety, and improved tyre longevity.

Introduction
Due to small leaks, puncture & Environmental condition loss of air pressure in tyres. So, maintaining the proper pressure level in tyre design the Self Inflating Tyres system. SIT is properly works in any how condition & maintaining required pressure level in each tyre in any condition like seasonal change, change in roads. In SIT system works on Mechanically as well as Electronically. The compressor is used for compressing the atmospheric air at the required pressure. The reciprocating compressor is used; Because It is easy to obtain the required pressure level. This air sends to the air tank, it stores the compressed air. Pressure gauge is used to the measure the pressure present in the tyre. Compressors are works on the 12V battery. Compressor supplies the compressed air to tyre through Hose pipe. Further, the hose pipe is connected to Pressure switch and Solenoid Valve. Solenoid valve and Pressure switch are electrically connected to each other. The axle is rotate on which wheel or rim is mounted on one end. One end of coupler is connected to axle & other end is connected to rotary joint.

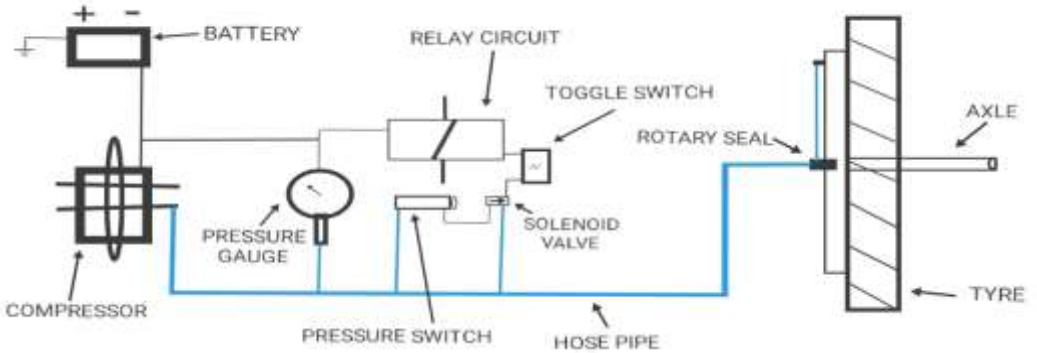

Fig. Layout of Self Inflating Tyre system

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Topics

1. **What happens when the tyre pressure is low**

- Low Tyre Pressure Can Cause a Blowout

Anyone who has ever had the misfortune of suffering a tyre blowout knows how traumatic it can be. When air pressure gets too low, the tyre's sidewalls flex more, and heat builds up within the tyre. If the overheating gets severe, a section of the tyre's rubber can separate from its carcass—the mix of fabric and steel that the tyre is built on. If this happens suddenly, a blowout can result. A blowout is sudden and unexpected and can cause a loss of control that leads to an accident.

2. **What happens when the tyre pressure is high**

It has been thought that increasing tyre pressure to more than the maximum PSI decreases fuel consumption and allows for higher speeds. The real effects of high tyre pressure are a decrease in tyre life and altered performance.

- Different handling

With the tyres inflated to their maximum capacity, your car's handling will be different. Your braking threshold will also change, and this can take some getting used to at first.

- Decreased tyre life

When under-inflated, the life of your tyre decreases as the tyre will wear unevenly on the road. Contact between the tyre and the road will be confined to the middle of the tyre, as opposed to the entyre width, and this area will wear faster than the rest of the tyre.

3. **Self-inflation tyre systems benefits**

- Get Better Mileage with Properly Inflated Tyres

An informal study by students at Carnegie Mellon University found that the majority of cars on roads are operating on tyres inflated to only 80 percent of capacity. According to the website, proper tyre inflation can improve mileage by about 3.3 percent, whereas leaving them under-inflated can lower mileage by 0.4 percent for every one PSI drop in pressure of all four tyres.

- Fully Inflated Tyres are Safer

Besides saving fuel and money and minimizing emissions, proper tyre inflation is safer and less likely to fail at high speeds. Under-inflated tyres make for longer stopping distances and will skid longer on wet surfaces. Properly inflated tyres will last longer as they wear more evenly.

- Less Wear on Tyres

It's also true that good tyre pressure means tyres won't wear out as quickly. Along with other tyre tips like tyre rotation, alignment and balancing, keeping tyre pressure accurate will decrease the issue of "bad wear patterns," where some parts of the tyre can get worn down quickly. Good tyre pressure also provides better handling in a vehicle. When tyre pressure is low, on the other hand, the risk of some kinds of accidents can increase. When the vehicle is not as able to maintain traction on the road, driving gets generally more dangerous.

- Better Experience in Off-Roading

When the vehicles goes on the off-road then, to get proper griping between tyre and the surface the pressure inside the tyre should be low. So, the solenoid valve present in the system releases the pressure of the according to the driver.

4. **Components of self-inflation tyre system**

There are some components of self inflating tyres system are follows: Battery

1. Compressor
   a. Reciprocating Type
2. Pressure gauge
3. Relay circuit
   a. Relay
4. Pressure switch
5. Solenoid Valve
6. Rotary Seal or Valve
7. Hoses

Battery

An Automotive Battery is a rechargeable battery that supplies electrical current to a motor vehicle. Its main purpose is to feed the starter, which starts the engine. Once the engine is running, power for the car's electrical systems is still supplied by the battery with the alternator charging as demands increase or decrease . An automobile battery is an example of a wet cell battery, with six cells. Each cell of a lead storage battery consists of alternate plates made of a lead alloy grid filled with sponge lead (cathode plates) or coated with lead dioxide (anode). Each cell is filled with a sulfuric acid solution, which is the electrolyte. Initially, cells each had a filler cap, through which the electrolyte level could be viewed and which allowed water to be added to the cell. The filler cap had a small vent hole which allowed hydrogen gas generated during charging to escape from the cell.

VRLA batteries, also known as absorbed glass mat (AGM) batteries are more tolerant of deep discharge, but are more expensive. VRLA batteries do not permit addition of water to the cell. The cells each have an automatic pressure release valve, to protect the case from rupture on severe overcharge or internal failure. A VRLA battery cannot spill its electrolyte which makes it particularly useful in vehicles such as motorcycles.

Batteries are typically made of six galvanic cells in a series circuit. Each cell provides 2.1 volts for a total of 12.6 volts at full charge. During discharge, a chemical reaction releases electrons, allowing them to flow through conductors to produce electricity. As the battery discharges, the acid of the electrolyte reacts with the materials of the plates, changing their surface to lead sulfate. When the battery is recharged, the chemical reaction is reversed: the lead sulfate reforms into lead dioxide. With the plates restored to their original condition, the process may be repeated.

Heavy vehicles may have two batteries in series for a 24 V system or may have series-parallel groups of batteries supplying 24 V.

Note:-We have used 12v battery in our project.

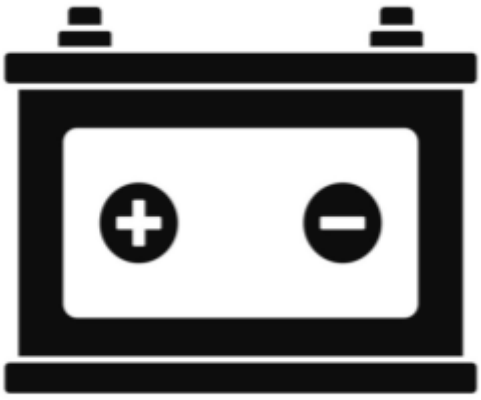

Fig. Battery Compressor

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.

Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, the main action of a pump is to pressurize and transport liquids.

Many compressors can be staged, that is, the fluid is compressed several times in steps or stages, to increase discharge pressure. Often, the second stage is physically smaller than the primary stage, to accommodate the already compressed gas. Each stage further compresses the gas and increases pressure. Those that are powered by an electric motor can also be controlled using a VFD or power inverter, however many (hermetic and semi-hermetic) compressors can only work at certain speeds, since they may include built-in oil pumps. The oil pumps are connected to the same shaft that drives the compressor and forces oil into the compressor and motor bearings. At low speeds, insufficient quantities or no oil is forced into the bearings, eventually leading to bearing failure, while at high speeds, excessive amounts of oil may be lost from the bearings and compressor and potentially into the discharge line due to splashing. Eventually the oil runs out and the bearings are left unlubricated, again leading to failure, and the oil may contaminate the refrigerant, air or other working gas.

Note: Centrifugal compressor is sufficient or good for this work but by cost reason reciprocating is used.

Reciprocating compressor

Reciprocating compressors use pistons driven by a crankshaft. They can be either stationary or portable, can be single or multi-staged, and can be driven by electric motors or internal combustion engines. Small reciprocating compressors from 5 to 30 horsepower (hp) are commonly seen in automotive applications and are typically for intermittent duty. Discharge pressures can range from low pressure to very high pressure (>18000 psi or 180 MPa). In certain applications, such as air compression, multi-stage double-acting compressors are said to be the most efficient compressors available, and are typically larger, and more costly than comparable rotary units. Another type of reciprocating compressor, usually employed in automotive cabin air conditioning systems, citation needed is the swash plate or wobble plate compressor, which uses pistons moved by a swash plate mounted on a shaft (see axial piston pump).

Fig. Reciprocating Compressor (12V DC)

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Pressure gauge

Pressure measurement is the analysis of an applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area. Instruments used to measure and display pressure in an integral unit are called pressure meters or pressure gauges or vacuum gauges. A manometer is a good example, as it uses the surface area and weight of a column of liquid to both measure and indicate pressure. Likewise the widely used Bourdon gauge is a mechanical device, which both measures and indicates and is probably the best known type of gauge.

Most gauges measure pressure relative to atmospheric pressure as the zero point, so this form of reading is simply referred to as "gauge pressure".

Fig. Pressure Gauge

Relay circuit

A relay circuit is an open or close circuit with the help of relay and transistor arrangement.

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations. Relays are used where it is necessary to control a circuit by an independent low-power signal, or where several circuits must be controlled by one signal. Relays were first used in long-distance telegraph circuits as signal repeaters: they refresh the signal coming in from one circuit by transmitting it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

Fig. Relay

The traditional form of a relay uses an electromagnet to close or open the contacts, but other operating principles have been invented, such as in solid-state relays which use semiconductor properties for control without relying on moving parts. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits

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from overload or faults; in modern electric power systems these functions are performed by digital instruments still called protective relays.

Pressure switch

A pressure switch is a form of switch that closes an electrical contact when a certain set fluid pressure has been reached on its input. The switch may be designed to make contact either on pressure rise or on pressure fall. Pressure switches are widely used in industry to automatically supervise and control systems that use pressurized fluids.

Another type of pressure switch detects mechanical force; for example, a pressure-sensitive mat is used to automatically open doors on commercial buildings. Such sensors are also used in security alarm applications such as pressure sensitive floors.

A pressure switch for sensing fluid pressure contains a capsule, bellows, Bourdon tube, diaphragm or piston element that deforms or displaces proportionally to the applied pressure. The resulting motion is applied, either directly or through amplifying levers, to a set of switch contacts. Since pressure may be changing slowly and contacts should operate quickly, some kind of over-center mechanism such as a miniature snap-action switch is used to ensure quick operation of the contacts. One sensitive type of pressure switch uses mercury switches mounted on a Bourdon tube; the shifting weight of the mercury provides a useful over-center characteristic.

The contacts of the pressure switch may be rated a few tenths of an ampere to around 15 amperes, with smaller ratings found on more sensitive switches. Often a pressure switch will operate a relay or other control device, but some types can directly control small electric motors or other loads.

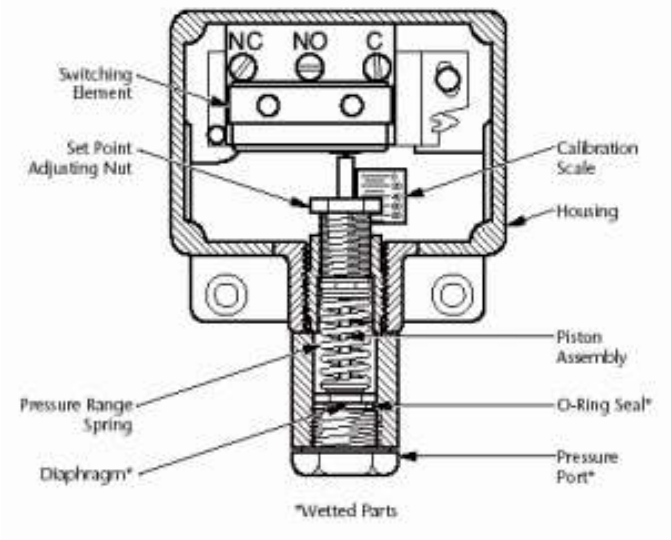

Fig. Pressure switch

Solenoid valve

A solenoid valve is an electromechanically operated valve.

Solenoid valves differ in the characteristics of the electric current they use, the strength of the magnetic field they generate, the mechanism they use to regulate the fluid, and the type and characteristics of fluid they control. The mechanism varies from linear action, plunger-type actuators to pivoted-armature actuators and rocker actuators. The valve can use a two-port design to regulate a flow or use a three or more-port design to switch flows between ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

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Fig. Solenoid Valve

Operation:

There are many valve design variations. Ordinary valves can have many ports and fluid paths. A 2-way valve, for example, has 2 ports; if the valve is open, then the two ports are connected and fluid may flow between the ports; if the valve is closed, then ports are isolated. If the valve is open when the solenoid is not energized, then the valve is termed normally open (N.O.). Similarly, if the valve is closed when the solenoid is not energized, then the valve is termed normally closed.

Solenoid valves may use metal seals or rubber seals, and may also have electrical interfaces to allow for easy control. A spring may be used to hold the valve opened (normally open) or closed (normally closed) while the valve is not activated.

Rotary seals

Steam Joints are sealing components between a steam pipe and a rotation assembly such as a shaft, cylinder or roller. The joint seals water, steam and oils. Further, it neutralises swing, pendular and tumbling motion. This functionality is normally achieved with a concave or convex seal ring surface which is pressed against the sealing surface with a spring. Certain configurations also have a cylindrical wearing surface. Steam Joints are exposed to all known lubrication conditions including wet, mixed and dry running.

Fig. Rotary seal

Hoses

A hose is a flexible hollow tube designed to carry fluids from one location to another. Hoses are also sometimes called pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circular cross section).

Fig. Hose Pipe

5. **References**

1. Automotive Mechanics" by N.K. Giri - This textbook covers various aspects of automotive engineering, including tyre technology, which might include discussions relevant to self-inflating tyre systems.
2. "Automobile Engineering" by K.M. Gupta and N. K. Giri - Another comprehensive textbook on automobile engineering that may cover topics related to tyre technology and advancements in automotive systems.
3. "Automotive Engineering: Lightweight, Functional, and Novel Materials" edited by Brian Cantor, P. Grant, and C. Johnston - While not authored by Indians, this book covers a wide range of automotive technologies, including tyre systems, and may provide valuable insights into the field.
4. "Introduction to Automobile Engineering" by Kirpal Singh - This textbook offers an introduction to various aspects of automobile engineering, which may include discussions on tyre technology and advancements in automotive systems.