

WHEELS & TYRES

WHEELS

- The wheel, along with the tyre has to take the vehicle load, provide a cushioning effect and cope with the steering control.

Requirements

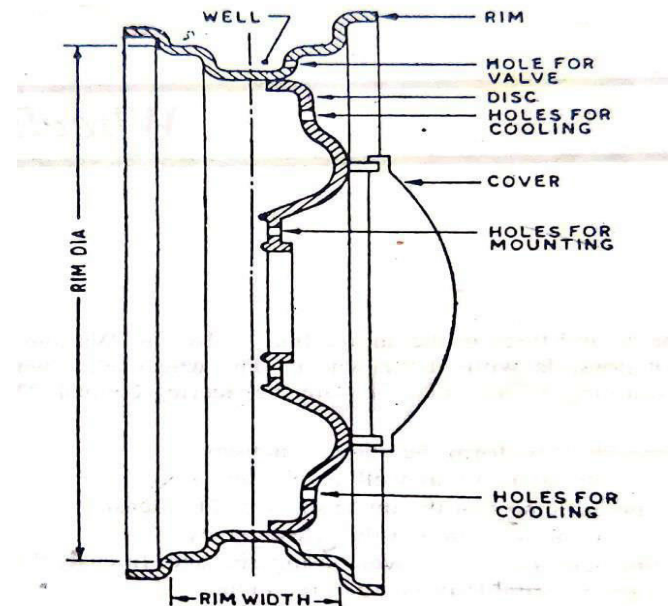
1. It must be strong enough to perform the above functions.
2. It should be balanced both statically as well as dynamically.
3. It should be lightest possible so that the unsprung weight is least.
4. It should be possible to remove or mount the wheel easily.

TYPES OF WHEELS

1. Pressed steel disc wheel
2. Wire wheel and the
3. Light alloy wheel.

1. Disc Wheel

- Disc wheel consists of two parts, a steel rim which is generally well-based to receive the tyre and a pressed steel disc.
- The rim and the disc may be integral, permanently attached or attachable
- Pressed steel disc is welded to the rim.
- The steel disc performs the functions of the spokes. The wheel is fitted on the axle by bolting to a flange attached to the axle.
- Some slots are provided in the wheel disc to allow the air to the inner side for better cooling of the brake drum inside.
- A hole in the rim serves to accommodate tube valve.

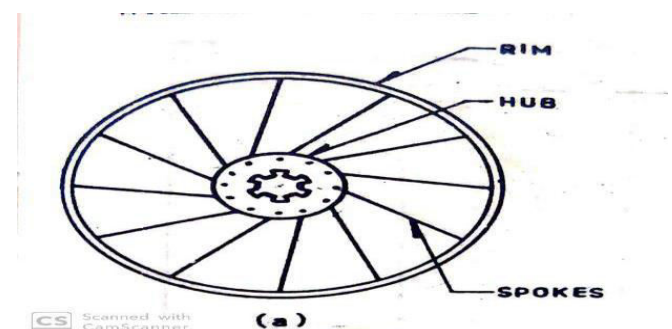


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Fig. 9.1. Disc wheel.

2. Wire Wheel

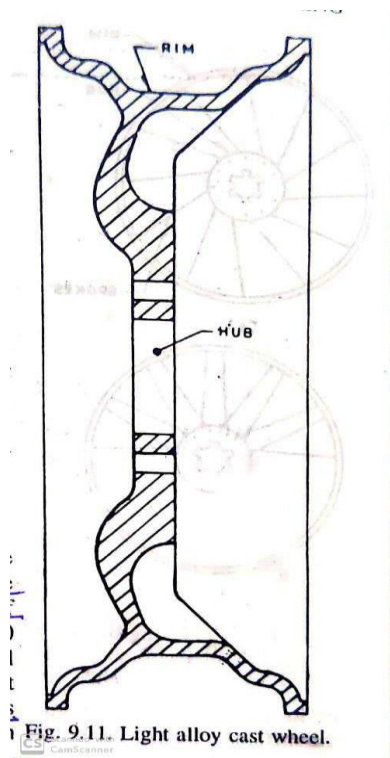
- The wire wheel has a separate hub, which is attached to the rim through a number of wire spokes.
- The spokes carry the weight, transmit the driving and braking torques and withstand the side forces while cornering, in tension.
- The advantages of this type of wheel are light weight and high strength, and above all it provides much better cooling of the brake drum.
- It is also very easy to change the wheel when required, because only one nut has to be opened.
- Wire wheels are expensive due to their intricate construction.
- The rim of a wired wheel has holes, it is not possible to fit tubeless tyres on wire wheels.



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3. Light alloy cast or forged wheel

- Modern automobile wheels are made from aluminium or magnesium alloys.
- Cast wheels are generally used for cars while forged wheels are preferred for wheels of heavier vehicles.
- The main advantages of light-alloy wheel are light weight as compared to other types for similar strength.
- Light alloys are better conductors of heat which helps the wheels dissipate any heat generated by the tyres or brakes and thereby run cooler.
- Magnesium alloys have high impact and fatigue strength and so that they can stand vibrations and shock loading better.
- Aluminium alloys are used for wheels of cars and whereas sports and racing cars usually have magnesium alloy wheels.



TYRE

- A tyre is a cushion provided with an automobile wheel.
- It performs the following functions

1. To support the vehicle load.
2. To provide cushion against shocks.
3. To transmit driving and braking forces to the road.
4. To provide cornering power for smooth steering.

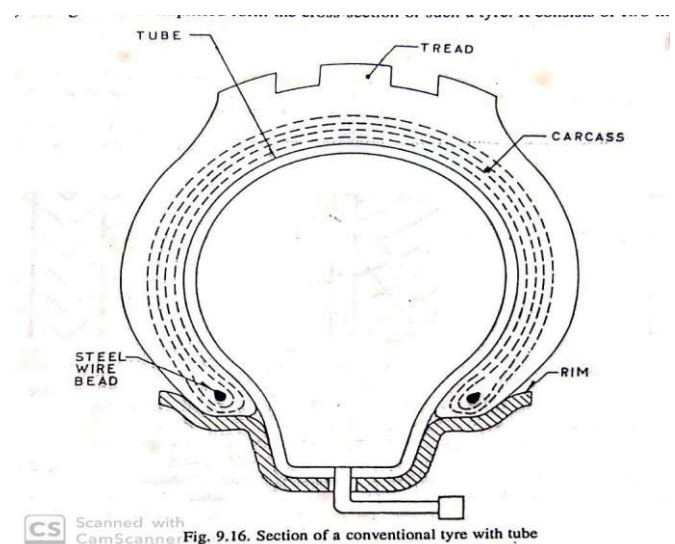
TYPES OF TYRES

These pneumatic tyres may be classified according to

1. Basic construction
2. Use
3. Ability to run flat

Basic Construction.

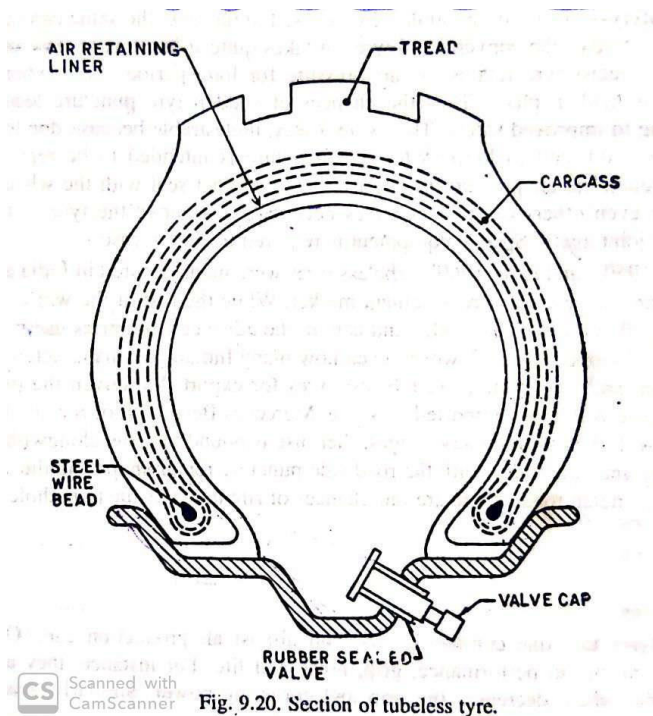
1. Conventional Tubed Tyre



- It consists of two main parts the carcass and the tread.
- The carcass is the basic structure taking mainly the various loads and Consists of number of plies wound in a particular fashion from the cords of rayon or any other suitable material.
- Each cord in each ply is covered with resilient rubber compounds and all the plies are insulated against each other.
- The tread is the part of the tyre which contacts the road surface when the wheel rolls.

- It serves to transmit the forces between the rest of the tyre and the ground.

2. Tubeless Tyre



- This type of tyre does not need a separate tube; instead the air under pressure is filled in the tyre itself for which purpose a non-return valve is fitted to the rim.
- The inner construction of the tyre is almost same as that of tubed tyre, except that it is lined on inside with a special air-retaining liner made up of a halogenated butyl rubber.

Advantages

1. Lesser unsprung weight
2. Better cooling
3. Lesser rolling resistance
4. Comfortable ride
5. Slower leakage of air.
6. Simpler assembly
7. Improved safety

CARCASS TYPES

1. Cross ply or Bias ply
2. Radial ply
3. Belted-bias type.

1. Cross ply type

- In this type, the ply cords are woven at an angle ($30^\circ - 40^\circ$) to the tyre axis. There are two layers which run in opposite directions.
- However, the cords are not woven like warp and weft of ordinary cloth, because that would lead to rubbing of the two layers and thus produce heat which would damage the tyre material.

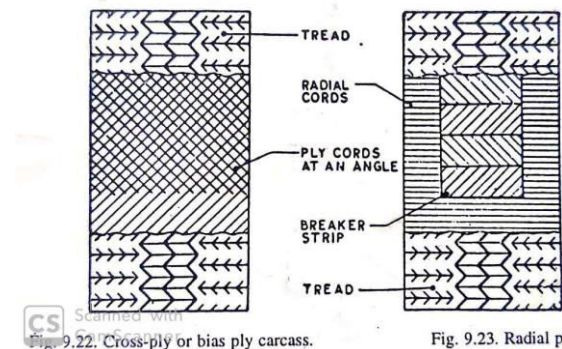


Fig. 9.23. Radial ply carcass.

2. Radial ply type

- In this the ply cords run in the radial direction i.e. in the direction of the tyre axis.
- Over this basic structure, run a number of breaker strips in the circumferential direction.
- The material for the breaker strips must be flexible but inextensible, so that no change of circumference takes place with change in the amount of inflation.

3. Belted bias type

- This is a combination of the above two types. The basic construction is the bias-ply over which run a number of breaker belts.

- The belts improve the characteristics of the bias-ply tyre to a large extent like
 - (i) The stresses in the carcass are restricted and the tread area is stabilized due to belts.
 - (ii) The breaker belts hold the tread flatter against the road surface, thus causing increase of traction and safety, and
 - (iii) The belts increase the resistance of the tyre to cuts and punctures.

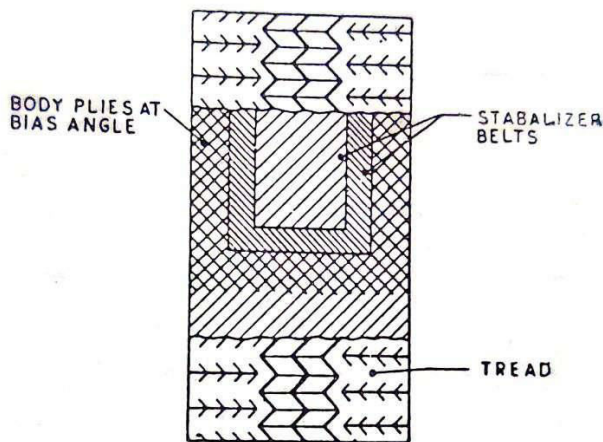


Fig. 9.24. Belted-bias tyre carcass

BRAKES

- Brake is a device used to stop any vehicle by applying frictional force.
- This is done by kinetic energy of a vehicle is converted into heat energy which is dissipated into atmosphere.

Functions of Brake system

1. To stop the moving vehicle in the shortest possible time.
2. To help in controlling the speed of the vehicle.
3. To reduce the speed at turnings and other crowded places.
4. To hold the vehicle in its stationary position, without the presence of the operator, after it has been brought to a

stop.

Requirements of Brake system

1. The brakes should stop the vehicle within a reasonable distance. The retardation shall be smooth and free from jerk or shudder.
2. The braking system should be very reliable to promote high degree of safety on the road.
3. The braking system should not be affected by water, heat, road grit or dust etc.
4. Pedal effort applied by the driver should not be more so as not to strain the driver.
5. Brake should work equally good in all weathers.
6. The wear and tear of the material of the brake lining should be minimum for its longer life.
7. The brake design system should be capable of dissipating this heat very quickly.

CLASSIFICATION OF BRAKES

Based on,

1) Location

- a) Wheel mounted
- b) Transmission mounted

2) Construction

- a) Drum brake
- b) Disc brake

3) Actuating method

- a) Mechanical b) Hydraulic
- c) Air d) Vacuum brake e) Electric
- d) Servo brake (Power assisted)

4) Purpose served

- a) Main brake (Primary or service brake)
- b) Parking brake (Secondary brake/ emergency brake)

MECHANICALBRAKES

- The brakes which are operated mechanically by means of levers, linkages, pedals, cams etc. are known as mechanical brakes.
- Mechanical brakes were employed in olden days but now hydraulic and other types of braking system have taken its place.

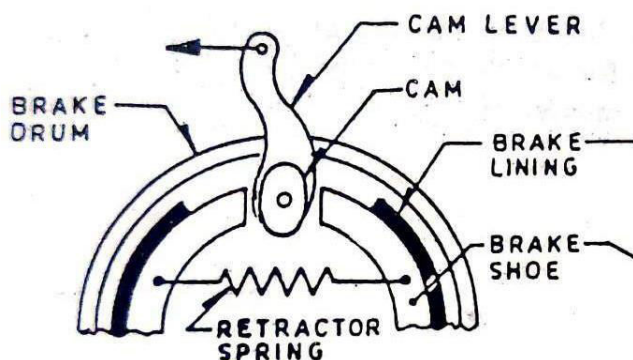


Fig. 10.18. Mechanical expander brakes. (a) hand-operated; (b) lever-operated.

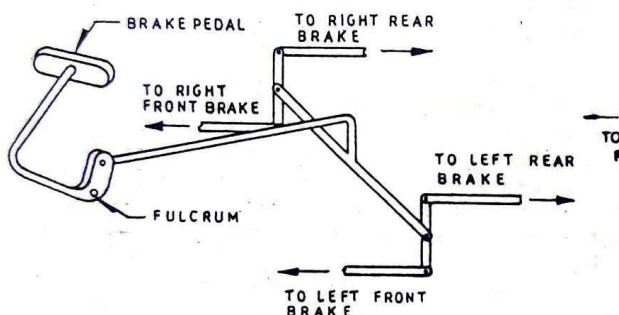


Fig. 10.21. Mechanical brake linkage.



Drum Brakes

- A brake drum is attached concentric to the axle hub whereas on the axle casing is mounted a back plate.
- The back plate is made of pressed steel sheet and is

ribbed to increase rigidity and to provide support for the expander, anchor and brake shoes.

- It also protects the drum and shoe brake assembly from mud and dust. Moreover, it absorbs the complete torque reaction of the shoes due to which reason it is sometimes also called “**torque plate**”.
- Two brake shoes are anchored back plate.
- Friction linings are mounted on the brake shoes.
- One or two retractor springs are used which serve to keep the brake shoes away from the drum when the brakes are not applied.
- The brake shoes are anchored at one end, whereas on the other end Force F is applied by means of some brake actuating mechanism.
- An adjuster is also provided to compensate for wear of friction lining with use.

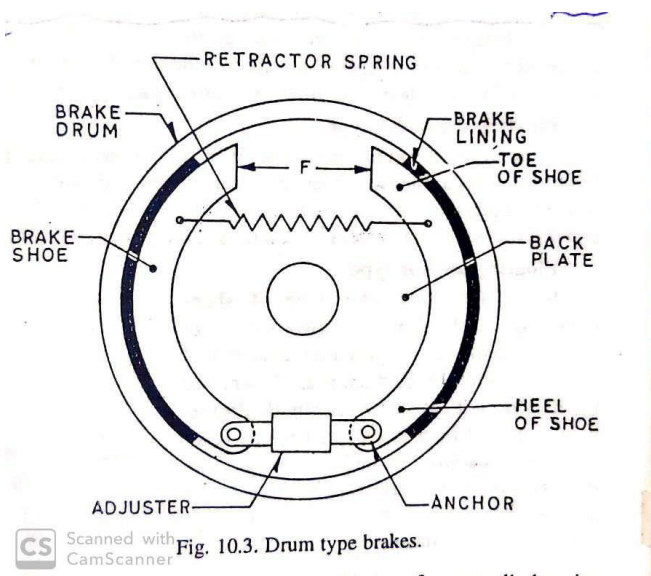
Advantages

- Simple in construction and maintenance.
- Less expensive compared to hydraulic brake
- They are good for emergency and parking brakes

Disadvantages

- Wear and tear happens at brake surfaces
- They are not as effective than hydraulic brake

- Heat dissipation is not uniform they are less effective compared to hydraulic brake.



LEADING SHOE & TRAILING SHOE

- Leading shoe** is a term referring to a shoe that is moving in the direction of rotation when it's being pressed against the drum (Adhere to drum).
- Trailing shoe** is a term referring to a shoe that is moving in the direction opposite to the direction of rotation when it's being pressed against the drum.

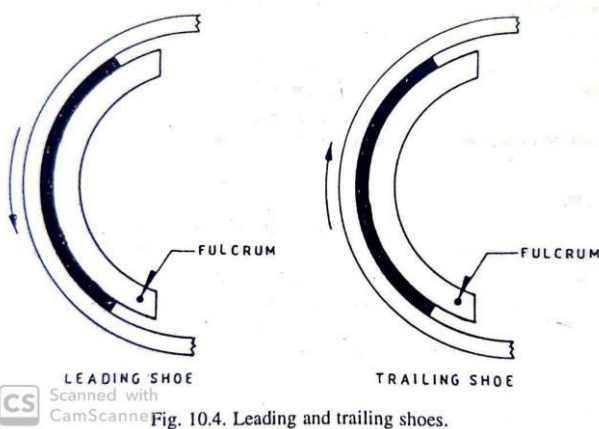


Fig. 10.4. Leading and trailing shoes.

HYDRAULIC BRAKE SYSTEM

- Brakes which are operated by means of hydraulic pressure are known as hydraulic brakes.
- The hydraulic brakes work on the principle of **Pascal's law** which reads as follows
"Pressure applied to a liquid is transmitted equally in all directions."
- The hydraulic braking system consists of four wheel cylinders, one at each of the four wheels of the vehicle.
- The system also consists of one master cylinder, which is connected to the Wheel cylinders by steel tubing.
- Each wheel cylinder contains two pistons, which will move out when the pressure will be applied through brake fluid.

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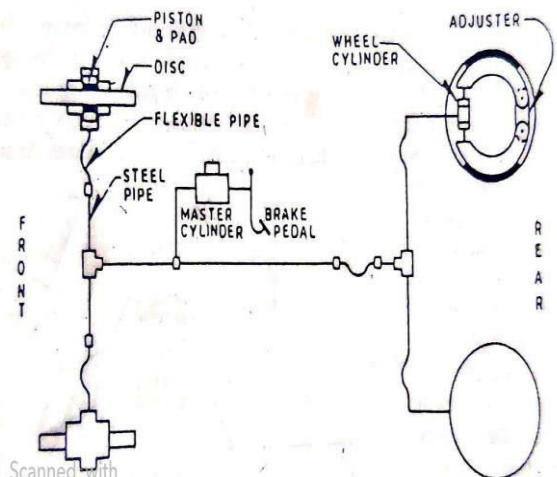


Fig. 10.26. Hydraulic brake system.

HYDRAULIC BRAKE SYSTEM COMPONENTS

MASTER CYLINDER

- Heart of the hydraulic braking system.
- The fluid in the reservoir compensates for any change in the fluid volume in the pipelines

due to temperature variations and to some extent due to leakage.

- To prevent leakage there are rubber seals on both ends of the piston in the compression chamber.
- A rubber boot covers the push rod end of the master cylinder to prevent the dust from entering inside.
- It consists of a small hole called **“bypass or compensation port”** (about 0.7 mm dia.) and an **“intake or the recuperation port”**.
- As the pedal is pressed, push rod moves the piston to left, it building up pressure in the compression chamber, forcing the fluid under pressure in the lines.
- This fluid enters the wheel cylinder or the caliper and moves the pistons thereby applying the brakes.
- This same force of the spring keeps the fluid check valve pressed on its seat for sometime and thereby delays the return of fluid from the lines into the compression chamber again. Some delay is also caused by the inertia of the fluid in the lines.
- This produces a vacuum in the compression chamber and unless this is destroyed immediately, there are all chances of air leaking into the system (Even a very small amount of air will render the brakes useless, the air being compressible) This problem is solved by having intake port.
- As soon as some vacuum is formed, the atmospheric pressure in the fluid reservoir forces the fluid through intake port and holes in the piston which deflects the rubber cup and enters the compression chamber, destroying

the vacuum.

- But by the time this vacuum is destroyed, the fluid from the lines comes back into reservoir by lifting the fluid check valve off its seat.
- This extra fluid now has to be accommodated somehow, because compression chamber is already full.
- If this is not done, the pressure in the lines will not be relieved and there are chances of brake shoes rubbing with the drum.
- Once this happens, there will be more heat generated at the drum, which when transmitted to the wheel cylinders would cause the fluid to expand and exert still more pressure, causing the shoes to move still further towards the drum. It causing the brakes to jam ultimately.
- This is avoided by means of bypass port . The extra fluid coming from the lines passes to the fluid reservoir where pressure is maintained atmospheric by providing an air vent.

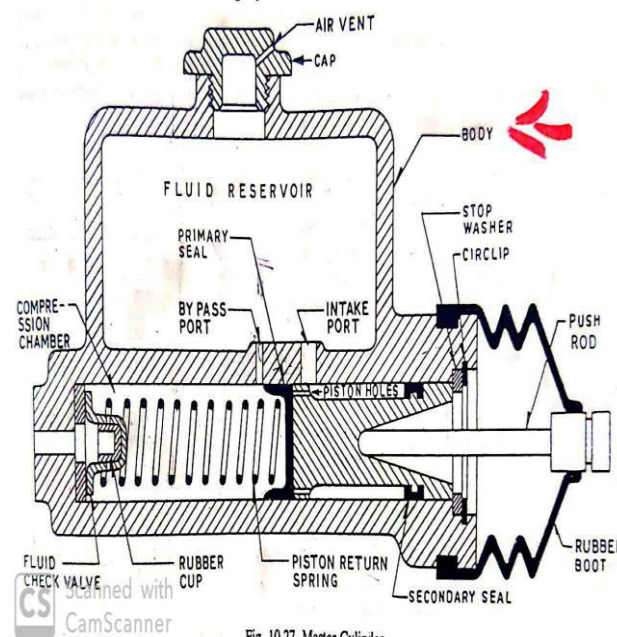
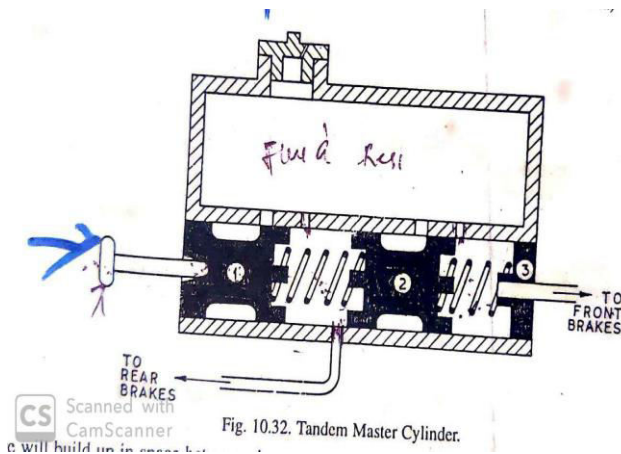


Fig. 10.27. Master Cylinder.

TANDEM MASTER CYLINDER



- In this separate lines go to the rear and the front brakes and it is so arranged that if the front brake line damaged, the rear brakes will be still effective.
- Similarly if rear brake lines is defective, at least front brake Will be applied.
- Under ordinary conditions the brake fluid will transmit pressure both to front as well as to the rear as the brake pedal is applied.
- However, when, say, the front brake lines are damaged, piston (2) will move till it comes up against stop (3).
- After this, the pressure will start building up in the space between (1) and (2) and rear brakes will be applied.
- Similarly when the rear brake lines are damaged, no pressure will build up in space between pistons (1) and (2). So piston (1) will move freely till it comes up against (2). Further push at the brake pedal will move both piston (1) and (2) together thereby applying the front brakes.

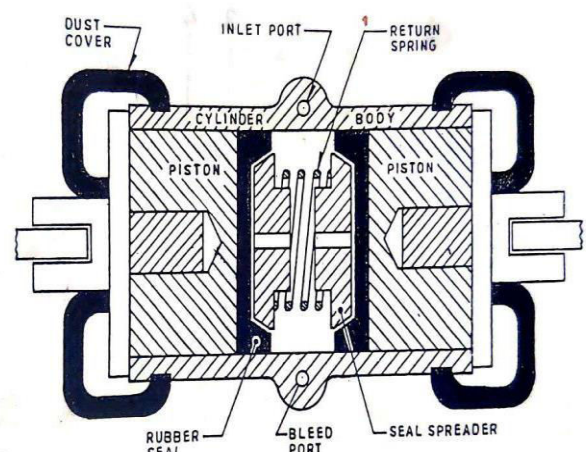
- The functions of bypass and intake ports are same as described earlier.

Wheel cylinder

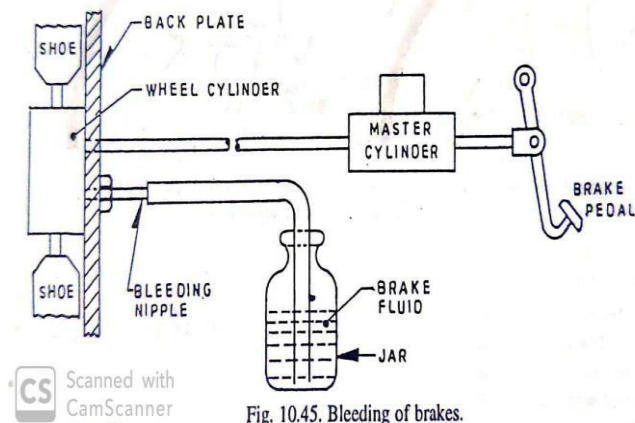
- Wheel cylinders in the brake system are meant to force the brake shoes against the drum.
- Each wheel cylinder is provided with pistons, rubber seals (cups), cup spreaders, spring and dust covers (boots).

The brake line from the cylinder is attached to the inlet port and a bleeder screw with a cover is provided to bleed air from system whenever required.

- Wheel cylinders are mounted on the back plate.
- When brakes are applied the fluid under pressure from the master cylinder enters the inlet Port and forces the pistons to move outward to push the shoes against the drum.
- Similarly, when the brakes are released the brake shoe retractor springs force the brake fluid out of the wheel cylinder by pulling the piston inward.



BRAKE BLEEDING PROCEDURE



- The procedure of driving air out of the braking system is called bleeding.
- A special bleeding valve is provided for this purpose on the shoe expander or the disc caliper.
- For bleeding, the master cylinder is topped up completely with the brake fluid and pipe is connected to the bleeding valve nipple.
- The other end of this pipe is dipped in the brake fluid contained in some jar.
- One person sits on the driver's seat and presses the brake pedal.
- After which the bleeder valve is opened by the second person with a spanner, when some air bubbles will come out of the pipe and escape through the brake fluid into the atmosphere.
- The bleeder valve is now closed and the brake pedal released and pressed once more after which the bleeder valve is opened again when some more air bubbles will come out.
- This procedure is repeated till on pressing the brake pedal, no more air bubbles are noted.
- Now with the Pedal in the pressed

position the bleeder valve is closed.

- The reservoir is then topped up with the fresh fluid. This procedure is then repeated for all wheels.

Advantages

- The fluid exerts equal pressure everywhere in its circuit. For this reason equal braking effort is obtained at all the four wheels.
- The system is simple in construction, due to the absence of brake rods, joints etc. inherent in the mechanical system. Moreover, pipelines can be bent and shaped according to the underside of the body structure.
- Due to absence of joints compared to mechanical brakes, rate of wear is also less.
- The system is mostly self-lubricating.

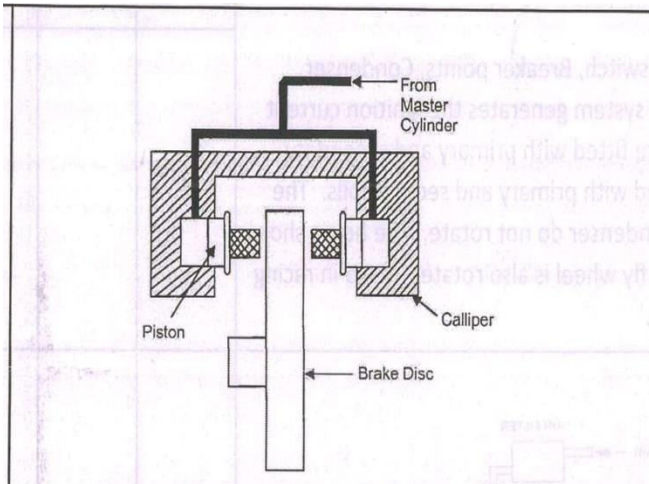
Disadvantages

- Even slight leakage of air into the braking system makes it useless.
- For parking purpose separate mechanical linkage has to be used.

DISC BRAKES

- A disc brake consists of a disc bolted to the wheel hub and a stationary/sliding/ swinging housing called caliper.
- The caliper is connected to some stationary part of the vehicle, like the axle casing or the stub axle and is cast in two parts, each part containing a piston.

- When the brakes are applied, the high pressure brake fluid from master cylinder reaches the wheel cylinder and forces the piston to move towards the disc and the friction pad at the end of piston touches the rotating disc and brake is applied.



COMPARISON OF DISC BRAKE WITH DRUM BRAKES

Advantages

- (i) Lighter than drum brakes.
- (ii) Better cooling (since the braking surface is exposed directly to air).
- (iii) Offer better resistance to fade.
- (iv) Uniform pressure distribution
- (v) Brake pads can be easily replaced.
- (vi) These brakes are self-adjusting by design.

Disadvantages

- (i) Costlier than drum brakes.
- (ii) There is no servo action in the brakes
- (iii) It is difficult to install an adequate parking attachment.

ELECTRONIC IGNITION SYSTEM

- Working of electronic ignition system is similar to the conventional electrical ignition system, except that in the electronic ignition system a timer is employed in the distributor instead of contact breaker.
- This timer may be a pulse generator or a Hall-effect switch or an optical switch which triggers the ignition module, also called the electronic ignition control unit (E.C.U.)
- This control unit primarily contains transistor circuit whose base current is triggered off and on by the timer which results in the stopping and starting of the primary current.
- Breaking of primary circuit generates high voltage in secondary winding and this high voltage is supplied to the spark plug through distributor.

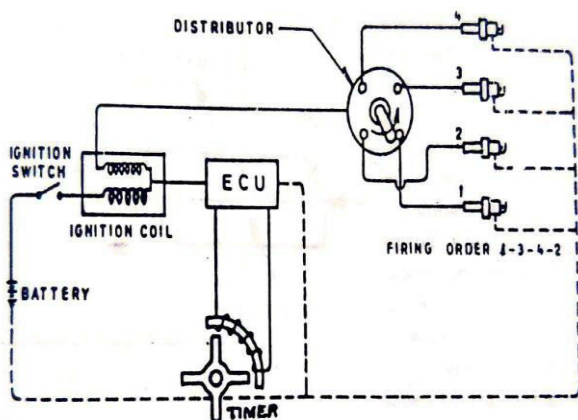


Fig. 14.10. Simplified diagram for an electronic ignition system.

MULTI POINT FUEL INJECTION (MPFI)

- In this system there is a separate injectors for each cylinder mounted in the inlet port.

Components

1. A mechanical solenoid injector
2. The electronic control unit (ECU) -It controls ignition timing and quality of the fuel.
3. Electronic sensors to monitors different

output such as exhaust gas temperature, coolant temperature, speed, and throttle position.

4. Air filters to remove solid particles from the atmospheric air.

Working

- A single injector is placed on the intake port of the different cylinders.
- Using the electrical fuel pump, fuel from the fuel tank supplies to each fuel injector equally.
- The injection of fuel is controlled by ECU by various signals from the different sensors according to engine operating condition.

Advantages

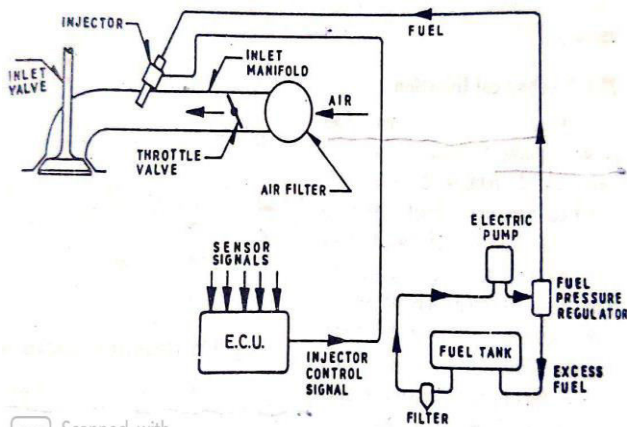
- More uniform air-fuel mixture will be supplied to each cylinder.
- The vibrations produced in MPFI engines is very less, due to this life of the engine component is increased.
- No need to crank the engine twice or thrice in case of cold starting as happen in the carburettor system.
- Immediate response, in case of sudden acceleration and deceleration.
- The mileage of the vehicle is improved.

Disadvantages

- Regular inspection of fuel injectors is required
- It is costly

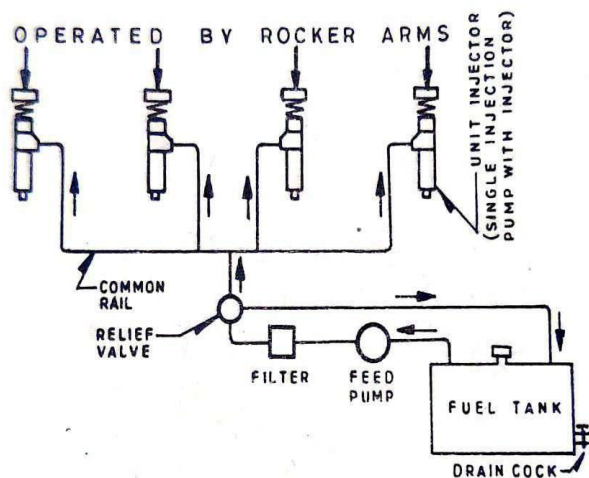
Different types of sensors used in MPFI

1. Crankshaft speed sensor
2. Camshaft speed sensor
3. Knock sensor
4. Mass air flow sensor
5. Manifold absolute pressure sensor
6. Throttle position sensor
7. Coolant air temperature sensor
8. Vehicle speed sensor etc.



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Fig. 9.58. Schematic diagram of electronic petrol injection system.

COMMON RAIL DIRECT INJECTION (CRDI)



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Fig. 10.1. Layout of common rail fuel injection system.

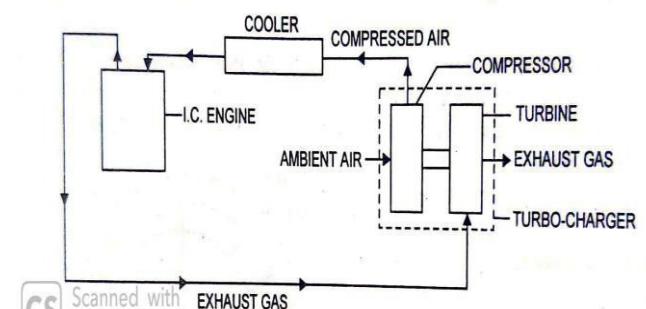
- In this a single injection pump with injector, called as unit injector is employed on each cylinder.
- The unit injectors are operated by rocker arms and spring similar to the engine valves.
- A linkage connects the control racks of all the unit injectors, so that fuel injection in all the cylinders may be equal and simultaneously controlled.
- The fuel is taken from the fuel tank by the feed pump and is supplied at low pressure through a filter, to the low pressure common rail and therefore, to all the unit injectors.
- This avoids the high pressure fuel lines necessary in the individual pump system.

- Any excess fuel from the relief valve is returned to the fuel tank.

TURBO CHARGER AND INTER COOLER

- Turbo charger is a device which is used to improve the volumetric efficiency and overall efficiency of the engine.
- A turbocharger, which employ a centrifugal compressor and a turbine wheel placed at the exhaust side of an engine.
- The energy extracted from the exhaust gases is utilized to drive the compressor.
- The turbocharger includes a turbine and a centrifugal compressor coupled together
- The exhaust gases from the engine enter the turbocharger and run the turbine, which further drives the compressor.
- The atmospheric air enters the compressor which raises its pressure by about 0.5 bar, which means about 50 percent more air by weight (for the same volume, i.e., engine size), which should increase the power by 50% from the same engine.
- The air compressed by the turbocharger gets very hot very fast so that, a intercooler is used to cool it and it also increase the density of the air supplied to the engine

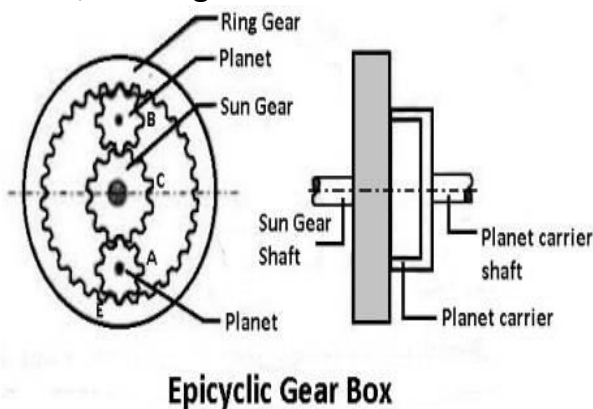
It shows how the engine drives the turbocharger and run the turbine, which drives the



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Fig. 9.74. Working of a turbocharger.

EPICYCLIC GEAR BOX

- An Epicyclic gear box consists of two, three or even four Epicyclic or planetary gear sets.
- It consists of a sun gear, about which planets turn round. These planet gears are carried by a carrier and a shaft and are also in mesh internally with a ring gear, which is also called annulus or internal gear.
- Different torque ratios i.e. speed ratios are obtained by making any one of the parts, viz, the sun gear, the planets and the annulus stationary.
- Similarly by locking two parts with each other, direct gear is obtained.



AUTOMATIC TRANSMISSION

- An automatic transmission is an automobile gear box that can change gear ratios automatically as the automobile moves under varying conditions, thus freeing the driver from having to shift gears manually.
- The main components of an automatic transmission are the converter housing case, oil pan and the extension housing.
- The converter housing encloses the torque converter and may be integral with the case or separately bolted to the case.
- The case contains the Epicyclic gear train while the extension housing encloses the output shaft.
- The oil pan is bolted to the case.

- The turbine of the torque converter drives the ring gear of the first gear train through a free wheel.
- The drive to the ring gear of the second gear train is then taken from the planet carrier of the first train so that low gear the two act in series.
- This arrangement gives three forward and one reverse speeds.
- For direct gear, clutch A is engaged.
- The second gear is obtained by engaging clutch B and applying brake BS.
- The application of both brakes BS and BF gives the first i.e., the lower most gear.
- For reverse gear only brake BR is applied.
- The selection of the particular gear and application of corresponding clutch and brake is done hydraulically.

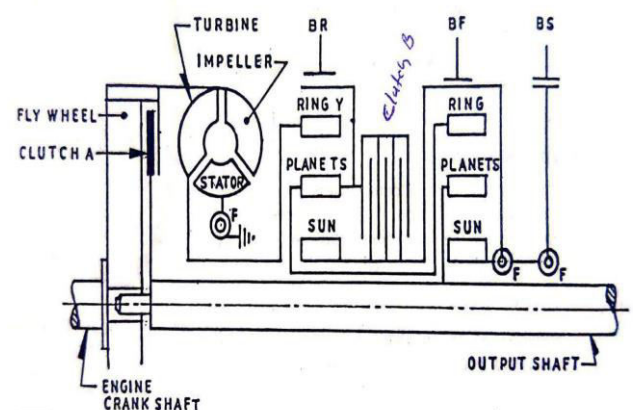


Fig. 5.16 Layout of the Borg Warner automatic transmission. F-free wheel; BR, BF and BS are brakes.

OVERDRIVES

- Overdrive is a device to step up the gear ratio in the car. It is fitted in between transmission and the propeller shaft.
- It enables a high cruising speed to be attained with a comparatively low engine speed.
- This results in less wear of the engine parts and decreases vibration and noise.

- As the friction losses at lower speeds are less, there is a saving of fuel also with the overdrive.
- Overdrive is generally fitted on top gear only
- It consists of an Epicyclic gear train in which the sun gear is free to rotate on the input shaft, while the carrier can move on splines on the input shaft.
- A freewheel clutch is also fitted on the input shaft splines. The output shaft is connected to the ring.
- When the sun gear is locked with the casing, i.e., it becomes stationary, the speed of the output shaft is increased i.e., overdrive is engaged.
- When, however, the sun gear is locked to the carrier or to the ring, direct drive through the gear train is obtained.
- Thus depending on the locking of the sun gear with casing or with carrier, the overdrive or the normal direct drive is obtained.

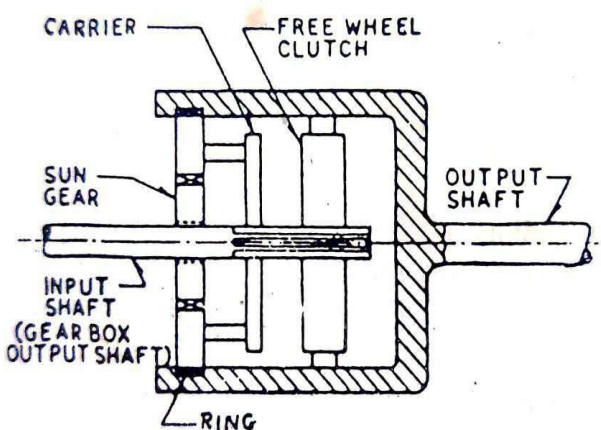


Fig. 5.18. Overdrive.

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AIR SUSPENSION

- In this system air springs are used in wheels instead of coil springs.
- This system consists of air compressor, air accumulator, pressure relief valve, levelling valve, lift control valve and air spring
- The air from the atmosphere

compresses into the required pressure and stored in air accumulator by using a air compressor.

- The required amount of air is then supplied to air springs through pressure relief valve and levelling valve.
- Pressure relief valve is used to maintain the air pressure at pre-determined value.
- Levelling valve is used to compensate maintain the air in the air spring.

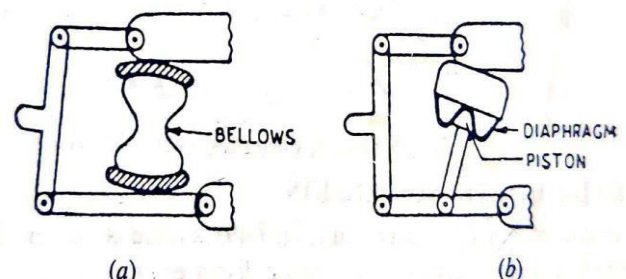
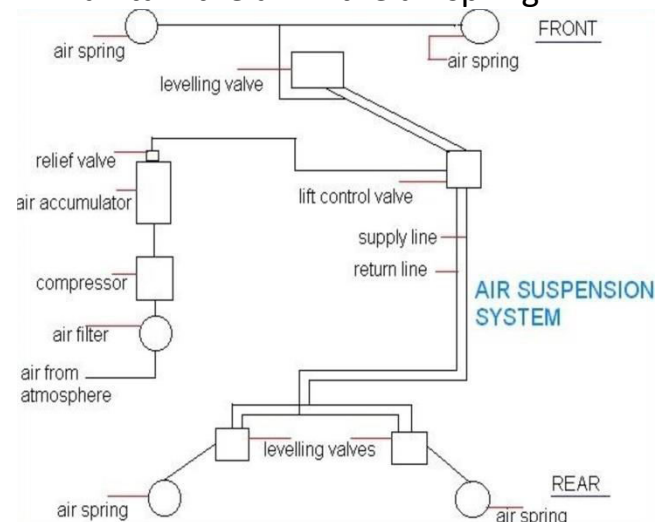


Fig. 7.47: Air spring (a) Bellow type, (b) Piston type.

CS Scanned with CamScanner

POWER STEERING

- Power steering is a type of steering system uses additional power with manual effort to steer the vehicle.

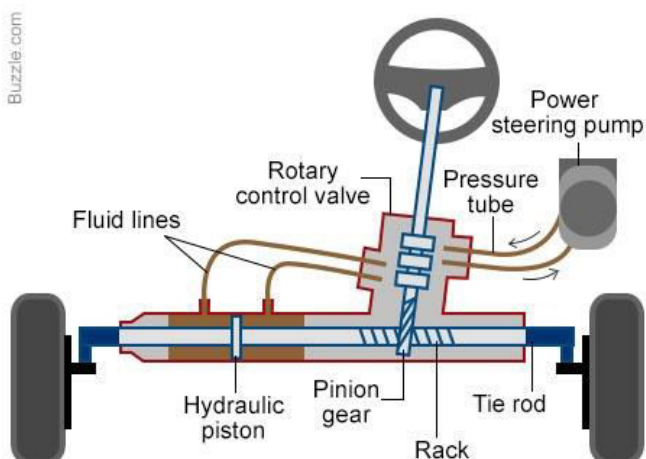
Types of Power Steering System

On the basis of the method used to multiply the steering force there are 3 types of power steering system that are-

1. Hydraulic power steering system
2. Electro – hydraulic power steering system
3. Electronic power steering system

Working

- In this type of power steering system the hydraulic force is used to multiply the steering input force.
- Hydraulic force is generated by a series of components that includes hydraulic cylinder, rotator hydraulic pump, hydraulic lines, highly compressed hydraulic fluid.
- When the driver rotates the steering wheel, the hydraulic pump driven by the engine starts pumping the highly compressed hydraulic fluid through lines.
- The hydraulic pressure produced by the pump enters the hydraulic cylinder which in turn applies pressure over the cylinder's piston.
- The piston which is under high pressure starts moving from one end to the another which in turn pushes the rack gear and the steering action in the front wheels takes place.

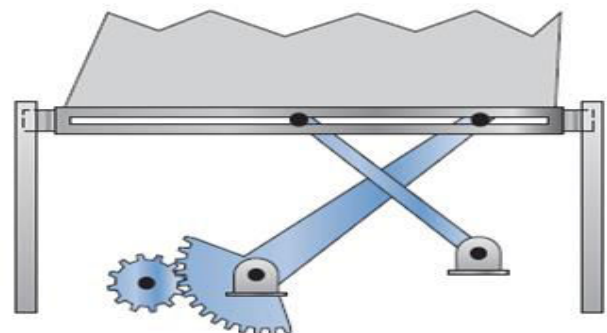


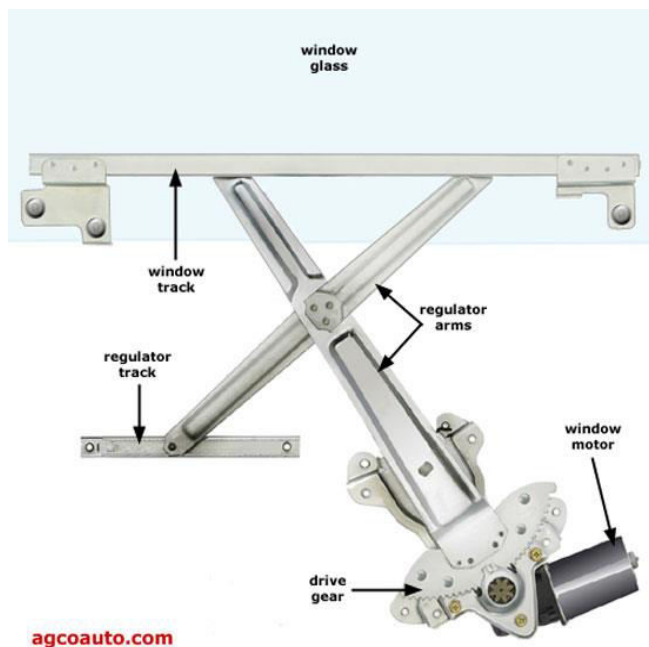
CENTRAL LOCKING

- It is a mechatronics system attached with modern automobiles. It is a security system against theft.
- It enables driver to lock the vehicle by using a keychain or at one single station.
- Most probably driver's door panel is equipped with central locking facility.
- The locking system in a vehicle must grant access only to authorized persons.
- It is the means via which the vehicle doors and boot lid are locked and unlocked and the engine is started.
- The locking system is operated with a key or remote control.

POWER WINDOW

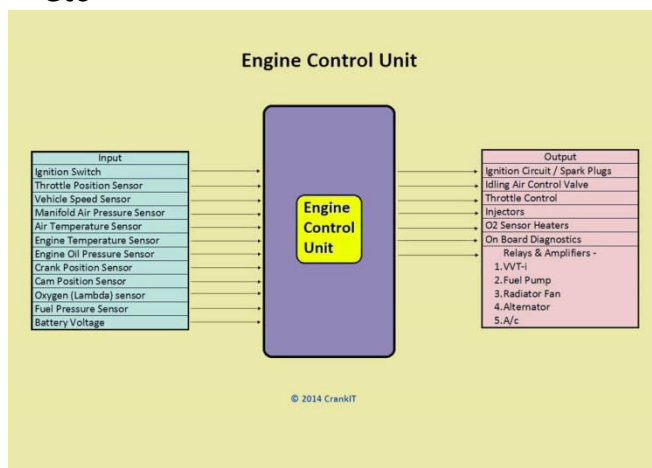
- It is a mechatronics system used in modern automobiles to operate the door window automatically or semi automatically.
- A solenoid switch is used to actuate the wind glass motor. Solenoid switch is energised by the key or switch on the door panel.
- As the name implies power windows are the mechanism provided to reduce the effort and strain to operate window.





ELECTRONIC CONTROL UNIT (ECU)

- An electronic control unit (ECU) is a embedded system that controls one or more of the electrical systems or subsystems in a vehicle.
- ECU include engine control module (ECM), Powertrain Control Module (PCM), Transmission Control Module (TCM), Brake Control Module etc.
- ECU collects different information of vehicles from different sensors and control the overall function of vehicle such as fuel system, ignition system, transmission system, braking system etc



ELECTRONIC WHEEL ALIGNMENT & BALANCING

- Wheel alignment and balancing are necessary for a smooth ride and extending the service life of tires.

WHEEL ALIGNMENT

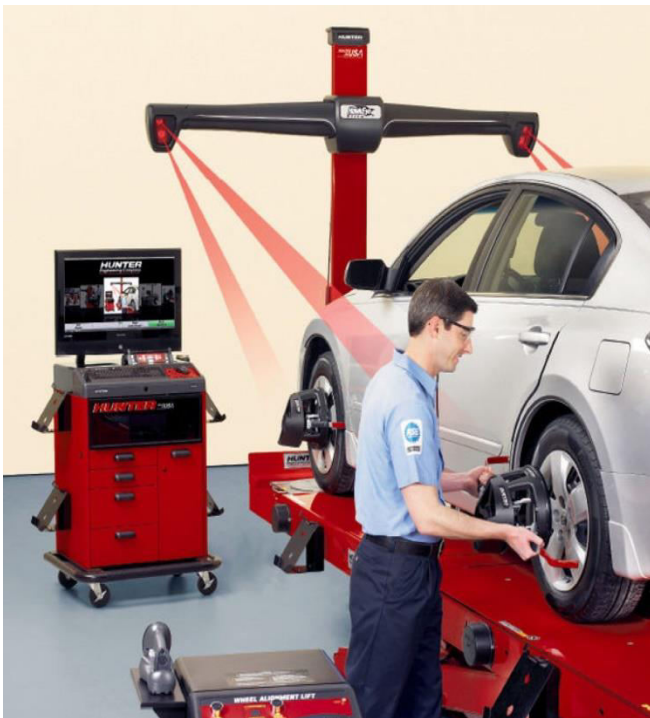
- A car that is out of alignment will experience uneven or rapid tire wear, pulling or drifting away from a straight line, wandering on a straight, level road or steering wheel spokes that stick off to one side while driving on a straight, level road.

Wheel alignment is used to correct three types of angles:

- **CAMBER** – THE ANGLE OF THE WHEEL WHEN VIEWED FROM THE FRONT OF THE VEHICLE
- **CASTER** – THE ANGLE OF THE STEERING PIVOT AS SEEN FROM THE SIDE OF THE VEHICLE
- **TOE** – THE DIRECTION THE TIRES POINT, RELATIVE TO EACH OTHER

WHEEL BALANCING

- Imperfections, blemishes in rubber and damage to a tire or rim can throw a wheel out of balance.
- This makes one section of the tire or rim heavier, which causes the tire to wobble or even jump as it rolls down the road.
- The bouncing can often be heard, as well as felt in the steering wheel.
- If car wheel is out of balance causes vibration in the steering wheel, seat or floorboard and scalloped or cupped wear patterns on the tires.
- Wheel is balanced by adding or removing weights from tyres.
- Wheel alignment and balancing is done in electronic equipment's in nowadays



Wheel alignment checking



Wheel balancing machine

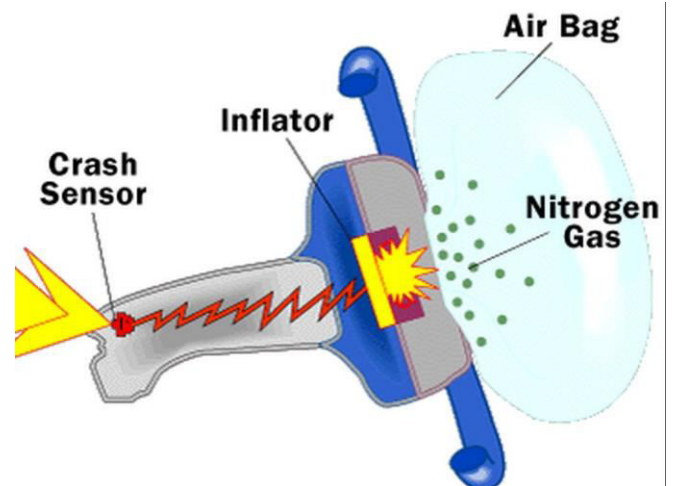
PROTECTION SYSTEM IN AUTOMOBILE AIR BAG

- Air bag is a safety device used to protect passengers and equipment's from accident.
 - It mainly consist of 3 system
1. **Air bag** made of nylon folded and placed inside the steering wheel or dash board.

2. A **Inflator** consist of a solid propellant such as sodium azide (NaN_3) and potassium nitrate (KNO_3).

3. A **crash sensor**.

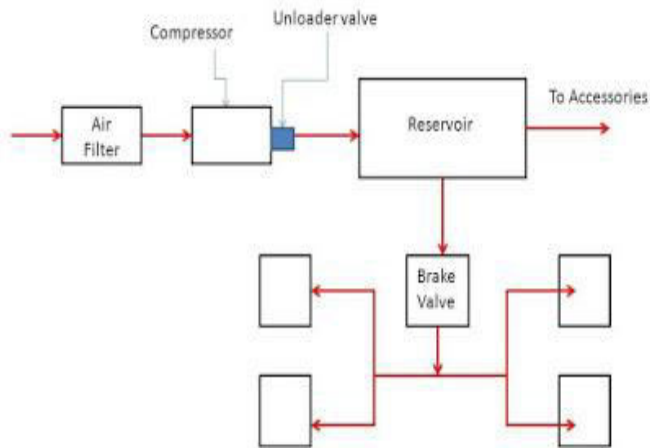
- During crashing, the sensor sent signals to the ECU and operates inflator.
- Inflator ignites the propellant and a chemical reaction takes place, produces nitrogen gas.
- This nitrogen gas is filled inside the bag and inflates outside.



AIR BRAKES

- This system mainly consist a compressor, air filter, reservoir, valves and brake pads.
- The compressor takes air from atmosphere through an filter and compressed it. This compressed air sent to a reservoir through the unloader valve, which gets lifted or opened at a predetermined reservoir pressure.
- This air supply to brake chambers which is also called the diaphragm units situated at each wheel, through the brake valve.
- The brake valve is controlled by the driver who can control the intensity of braking according to the requirement.
- When the driver pushes the brake lever, pressure in the reservoir

decreases which pushes the brake pad toward types and apply brakes.



Layout of Air Brake System

Advantage

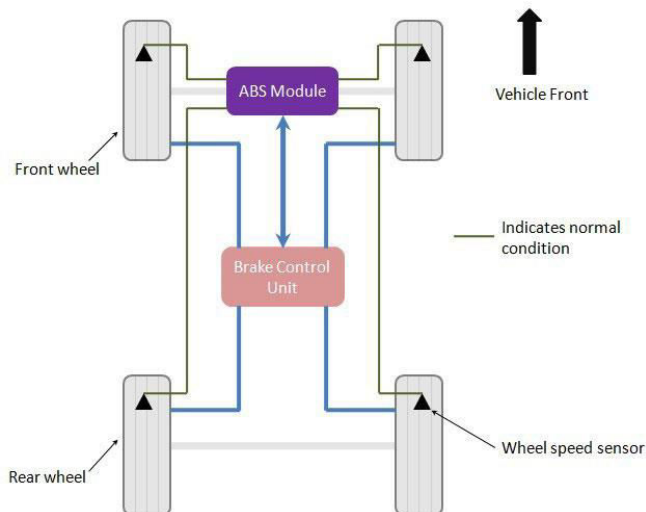
1. Air brake system are much more powerful than the ordinary mechanical or hydraulic brakes and that is the reason they are exclusively used in heavy vehicles.
2. They are easy to install on chassis because it is interconnected by pipes.

ANTILOCK BRAKE SYSTEMS (ABS)

- The locking of road wheels due to excessive braking causes skidding.
- Modern antilock brake systems not only cause the vehicle to stop without deviating from its straight line path, these also provide directional stability since there is no skidding of the wheels.
- Skidding is avoided by releasing the braking pressure just before the wheels lock up, and then reapplying the same.
- The ABS calculates the required slip rate of the wheels accurately based on the vehicle speed and the speed of the wheel, and then controls the brake fluid pressure to achieve the target slip rate.
- A modern ABS consists of an electronic control unit (ECU), one sensor on each wheel, an electrically driven hydraulic pump and a pressure accumulator.
- Accumulator is used to store hydraulic fluid to maintain high pressure in the braking system and to provide residual pressure for power-assisted braking.
- ECU monitors and controls the antilock function when required. Its function is based on inputs from the wheel speed sensors and feedback from the hydraulic unit to determine whether the ABS is operating precisely and also decide when the antilock operation is required.
- Two types of antilock brake systems are available, one is the two-wheel systems and other is the four-wheel systems.
- The two-wheel systems control rear wheel brakes only and are often used in light trucks.
- These systems can be further subdivided into one and two-channel types. In the one-channel system, both the rear wheel brakes are modulated simultaneously and have one common centrally located speed sensor for both wheels.
- In the two-channel systems, the two rear wheel brakes are controlled independently of each other.
- The four-wheel systems are, likewise, three-channel and the four-

channel type.

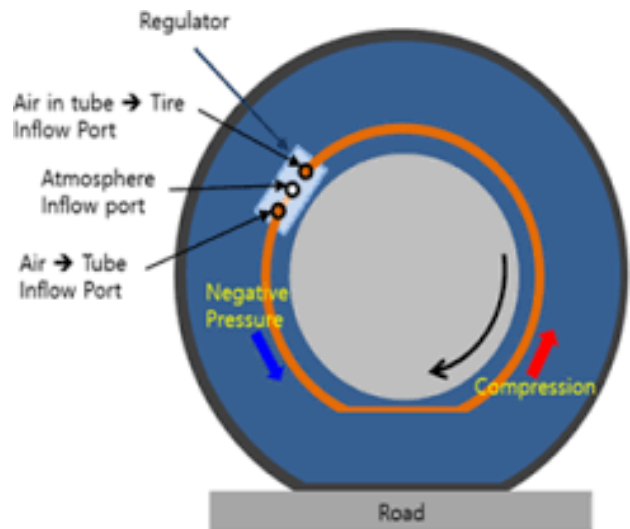
- In the three-channel systems, there are independent hydraulic circuits for each of the front wheels and a single circuit for the rear wheels.



SELF-INFLATING TYRE (SIT)

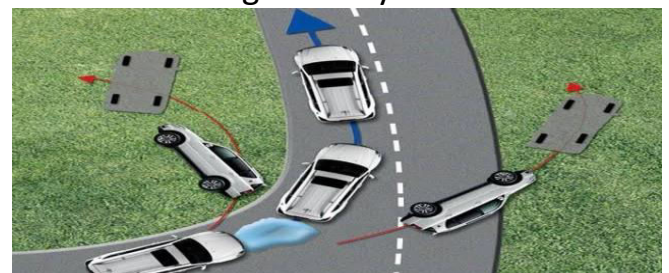
- SIT uses atmospheric air to inflate the tyre automatically when the vehicle is put in motion, compensating for natural loss of pressure.
- The inflation stops automatically once the desired pressure is reached.
- The SIT system is based on the peristaltic pump principles. It integrates a tube into the tyre carcass.
- The tube chamber is kept closed at its lowest point by the normal tyre deformation caused by the vehicle weight.
- As the tyre turns on the road, this closure moves along the tube chambers, forcing more air into the tyre with each wheel revolution.
- Simultaneously, it pulls outside air back into the chamber from the other side.
- The chamber pushes the air continuously into the tyre, till optimum pressure is reached, when a 'managing valve' stops the intake of outside air and permits inside circulation.

- Anytime the tyre pressure falls below its optimum level, the managing valve stops the internal air circulation and opens the intake of atmospheric air to restart the inflation process.
- The managing valve may be mechanical or electronic and can be set to achieve the desired tyre pressure.



ROLL OVER PROTECTION SYSTEM

- A rollover protection structure or rollover protection system (ROPS) is a system or structure intended to protect equipment operators and motorists from injuries caused by vehicle overturns or rollovers.
- ROPS are commonly fitted to 4x4's, pickup trucks, earth moving equipment, soil compactors and used in the mining industry.



ELECTRONIC STABILITY CONTROL

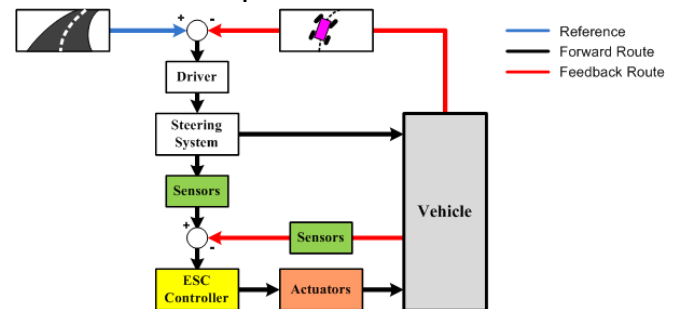
- Electronic stability control (ESC), or electronic stability program (ESP) or dynamic stability control (DSC), is a computerized technology that improves a vehicle's stability by detecting and reducing loss of traction (skidding).
- During normal driving, ESC continuously monitors steering and vehicle direction. It compares the driver's intended direction (determined by the measured steering wheel angle) to the vehicle's actual direction (determined through measured lateral acceleration, vehicle rotation, and individual road wheel speeds).
- ESC intervenes only when it detects a probable loss of steering control, such as when the vehicle is not going where the driver is steering
- When ESC detects loss of steering control, it automatically applies the brakes to help "steer" the vehicle where the driver intends to go.
- Braking is automatically applied to wheels individually, such as the outer front wheel to counter over steer, or the inner rear wheel to counter under steer
- ESC does not improve a vehicle's cornering performance; instead, it helps to minimize the loss of control.

The most important sensors are

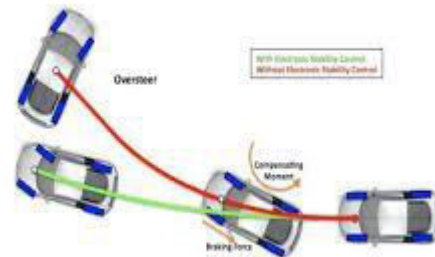
- A steering wheel angle sensor that determines where the driver wants to steer.
- A yaw rate sensor that measures the rotation rate of the car. The data from the yaw sensor is compared with the

data from the steering wheel angle sensor to determine regulating action.

- A lateral acceleration sensor that measures the vehicle's lateral acceleration. This is often called an accelerometer.
- A wheel speed sensor that measures the wheel speed.



Electronic stability control (ESC)



BLIND SPOT DETECTION

- The blind spot detection is a vehicle-based sensor device that detects other vehicles located to the driver's side and rear.
- Blind spot system uses some kind of electronic detection device(s) mounted on the sides of the car that sends out either electronic electromagnetic waves (usually in the radar wavelengths) or takes computer-processed images with a digital camera and analyses them.
- When one of these detectors notices another vehicle getting too friendly with your car, it tells about it, usually by flashing a light in the driver's peripheral vision or by making audible sounds.

- In the most advanced systems, vehicle will even try to steer itself back into the safety zone of its previous lane.



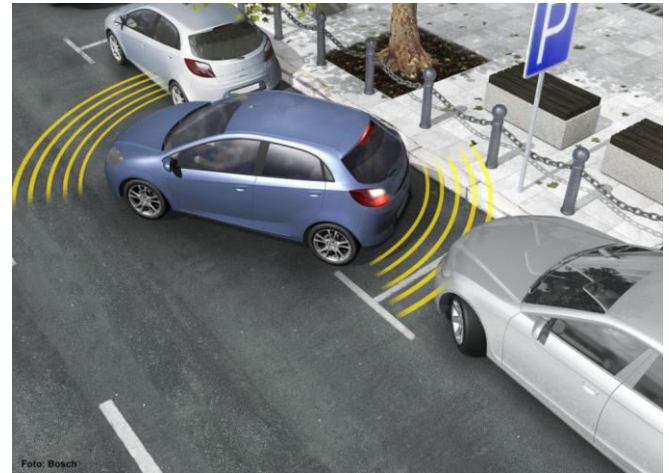
PARKING AID WITH ULTRASONIC SENSORS

- Parking aids are advanced driver assistance systems designed to make parking easier.
- Such systems monitor an area of between roughly 20 and 250 cm in front of and behind the vehicle and warn the driver about any obstacles.
- Parking aid systems are activated as soon as the driver engages reverse gear.
- Parking aid systems use ultrasonic sensors integrated into the front and rear end of the vehicle to monitor the area directly in front of and behind the vehicle.
- The sensors emit ultrasonic signals and pick up the echo of these. The system determines the distance from the obstacle and this enables parking aid systems to detect obstacles.
- Basic systems just have three or four sensors at the rear end of the vehicle.

Components

- Ultrasonic sensors

- Control unit
- Warning element



ALTERNATIVE FUEL USED IN AUTOMOBILE

1. BIODIESEL

- Biodiesel is a renewable fuel that can be manufactured from vegetable oils, animal fats, or recycled cooking grease for use in diesel vehicles.

2. ELECTRICITY

- Electricity can be used to power plug-in electric vehicles, which are increasingly available. Hybrids use electricity to boost efficiency.

3. ETHANOL

- Ethanol is a widely used renewable fuel made from corn and other plant materials. It is blended with gasoline for use in vehicles.

4. HYDROGEN

- Hydrogen is a potentially emissions-free alternative fuel that can be produced from domestic resources for use in fuel cell vehicles.

5. NATURAL GAS

- Natural gas is a domestically abundant gaseous fuel that can have significant fuel cost advantages over gasoline and diesel fuel.

6. PROPANE

- Propane is a readily available gaseous

fuel that has been widely used in vehicles throughout the world for decades.

7. ALCOHOLS
8. COMPRESSED NATURAL GAS (CNG)
9. LIQUIFIED NATURAL GAS (LNG)
10. LIQUIFIED PETROLIUM GAS (LPG)
11. BIO DIESEL

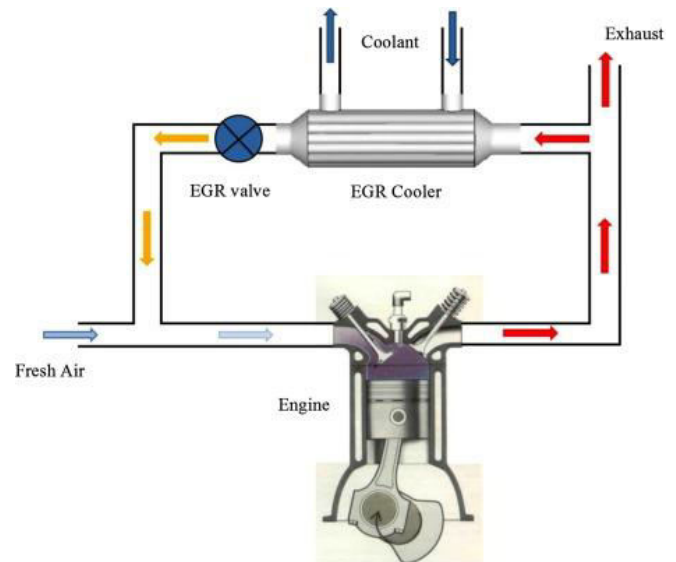
EMISSIONS IN AUTOMOBILE

REDUCTION OF FORMATION OF POLLUTANTS

1. Closed crankcase ventilation
2. Reducing evaporative emissions
3. Redesigning the engine
 - i. Combustion chamber
 - ii. Cooling system
 - iii. Valve timing
 - iv. Fuel supply system
 - v. Ignition system
4. Improved vehicle efficiency
5. Use of HCCI engines
6. Use of hybrid vehicles
7. Improving on board diagnostic system

EXHAUST GAS RECIRCULATION (EGR)

- The EGR system is widely used to reduce the NO_x emission.
- This involves recirculating a controllable proportion of the engine's exhaust back into the intake air.
- A valve is usually used to control the flow of gas, and the valve may be closed completely if required.
- The substitution of burnt gas (which takes no further part in combustion) for oxygen rich air reduces the proportion of the cylinder contents available for combustion.
- This causes a correspondingly lower heat release and peak cylinder temperature, and reduces the formation of NO_x .



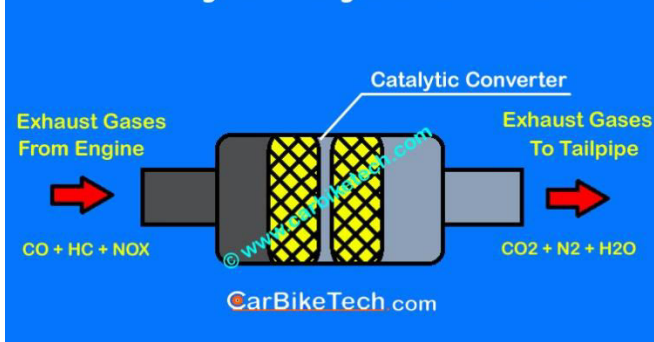
CATALYTIC CONVERTER

- The Three-way catalyst helps in converting the harmful gases exhausted from the engine into harmless gases.
- The engine exhaust gases contain hazardous substances that cause damage to the environment.
- These include the oxides of nitrogen, hydrocarbons and carbon monoxide. The three-way catalyst converts them into less harmful carbon-di-oxide, water, and nitrogen.

Working

- Three-way catalytic converter uses two catalysts; namely reduction catalyst and an oxidation catalyst.
- The oxidation catalyst is made of palladium and platinum whereas reduction catalyst is rhodium.
- Both of them come with a ceramic honeycomb structure. Besides, it is placed in a muffler like a compact unit which fits onto the exhaust pipe.
- Pollutants from exhaust such as CO , HC , NO_x is converted in to CO_2 , N_2 , and H_2O while passing through the converter.

Three-Way Catalytic Converter



EMISSION STANDARDS

- Emission standards are the legal requirements governing air pollutants released into the atmosphere.
- Emission standards set quantitative limits on the permissible amount of specific air pollutants that may be released from specific sources over specific timeframes.
- They are generally designed to achieve air quality standards and to protect human life.

Emission Standards for Light Duty Vehiclesⁱⁱⁱ

		BS-IV Norms			BS-VI Norms		
		M & N1 Class I	N1 Class II	N1 Class III	M & N1 Class I	N1 Class II	N1 Class III
Petrol Vehicles	Unit						
CO	g/ km	0.50	0.63	0.74	0.50	0.63	0.74
HC	g/ km	-	-	-	-	-	-
HC+NOx	g/ km	0.30	0.39	0.46	0.17	0.195	0.215
NOx	g/ km	0.25	0.33	0.39	0.08	0.105	0.125
PM	g/ km	0.025	0.04	0.06	0.0045	0.0045	0.0045
Diesel Vehicles	Unit						
CO	g/ km	1.00	1.81	2.27	1.00	1.81	2.27
HC	g/ km	0.10	0.13	0.16	0.10	0.13	0.16
HC+NOx	g/ km	-	-	-	-	-	-
NOx	g/ km	0.08	0.10	0.11	0.060	0.075	0.082
PM	g/ km	-	-	-	0.0045	0.0045	0.0045

M category: include motor vehicles having at least four wheels and for the carriage of passengers

N1 Class I include Power-driven vehicles having at least four wheels and for the carriage of goods (< 3.5 tonnes)

N1 Class II include Power-driven vehicles having at least four wheels and for the carriage of goods (>3.5 tonnes and < 12 tonnes)

N1 Class III include Power-driven vehicles having at least four wheels and for the carriage of goods (> 12 tonnes)

Source: http://transportpolicy.net/index.php?title=India:_Light-duty:_Emissions

- Nitric oxide- it affects the human cells and blood circulation.
- Hydro carbons - it affects the eyes.
- Photo chemical smog - This affects the plants, eyes and lungs.
- Smoke - This will affect the eyes.
- Lead - This will make affection on liver and kidney while inhaling. It will also affect the brain of children
- Particulate - It is a mixture of dust, soot and ash. Inhaling this mixture affects the human leading to lung cancer, bronchitis and allergic diseases.
- Sulphur oxide - This will affect the plants and eyes.

EFFECT OF EXHAUST GAS EMISSION

- Carbon monoxide - Oxygen in the human cell is reduced, it easily affects the human nerves, heart and eyes.