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Automobile: An Insight into its Working and Development

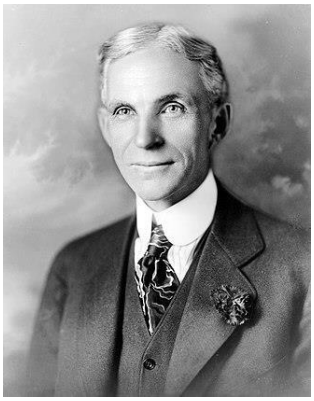
Prakhar Sharma*[1], Navneet Kumar Pandey[2]
[1] Final Year, B.Tech (Mechanical Engineering), JSS Academy of Technical Education, Noida
[2]Associate Professor, Mechanical Engineering Department, JSS Academy of Technical Education, Noida

***Abstract*: The technical brief presents an insight into the history and development of Automobiles over the years. The working of various parts combined with their indigenous transformations leading to significant enhancement of their applications as well as increase in effectiveness and efficiency has always prompted designers to look into enhanced variations. The world is endless and leaves ample opportunities for scientists and researchers to put forward their best foot forward and come up with variations leading to aesthetic an ergonomic development, making the entire process of driving more enjoyable. The major parts have been discussed alongwith their history, working and subsequent development over the years, which helps us getting better insights into the exciting world of automobiles.**

HISTORY

An automobile can be considered as modified cart used for transportation but instead of using the traditional animals an automobile uses an Engine to drive the wheels. It was the 19th century that gave birth to the automobile industry. When in the year 1878 Karl Benz gave birth to the modern car industry by inventing the first ever internal combustion engine which he got it patented on 1879. Later the year 1890 gave birth to a new name in the market DMG (Diamler Moteren Gesellschaft) which was founded by Diamler and Maybach in Cannanshaft. This manufacturer sold its first car in the year 1892 under the brand name Diamler .Till 1895 the company had sold around 30 vehicles. Later in the year 1924 after the First World War when the conditions were drastic there was co-operation between Benz, Cie & DMG and they signed an agreement until 2000 that they would standardize the design/production/purchasing and sales of their products. They marketed their models as a company, although keeping their respective brands. In the year 1926 Benz and Cie & DMG merged together as Diamler Benz Company. They baptized that all their cars would be named as Mercedes Benz as a brand honoring of DMGs most important model. As the gasoline powered engine were getting into dominance in the 19th century. Simultaneously during this period in the year 1892 an engineer named Rudolf Diesel got him patent to an another type of engine (Piston less Rotary Engine) which was able to generate power using another fuel instead of gasoline. This fuel was named after the inventors name as Diesel.

Karl Benz: Founder of an Internal Combustion Engine



Henry Ford: Founder of the Chain Production

1- CHASSIS

A chassis is basically a load bearing framework of an object on which the final assembly of the object takes place. A chassis is basically designed to bear all the forces exerted by the object and on the object by the surrounding. There are a number of objects which require chassis example automobiles, aircrafts, ships and even buildings.

Components:

STRUT BAR =A strut bar is an automotive suspension accessory which is basically designed for McPherson strut type suspension but can also be used on a double wishbone setup. This is a high tensile strength bar which connects the two strut towers together this helps in increasing the ride quality of the automobile.

FENDER BARS =These are installed on each side of the vehicle's wheel arch. Fender bars provide extra support to the chassis especially during cornering. It has a number of advantages like it increases handling, stability and cornering at high speeds.

ANTI ROLL BARS = It is a part of suspension which is found in most of our common cars. It is used to prevent rolling of a vehicle during cornering at high speed. It connects the adjacent wheels through a short lever arm linked by torsion spring. It

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prevents the rolling of a vehicle by forcing the opposite wheels shock absorber suspension rod to lower of rise to similar level as the other wheel.

Development:

In the early days when automobiles were invented there was only one way to assemble a car and this was the human labor. So to make the life of a workers easy a special type of chassis was developed or inherited by the early horse driven carriages. This type of chassis was known as Ladder Frame Chassis. It consists of two long high strength steel rod which are interconnected to each other using similar material small length rods. Later engineers developed an another type of chassis which was better than the ladder frame in various aspects as it had better impact bearing capacity ,it was light in weight which improved the overall efficiency of the car. This type of chassis was known as the monocoque /unibody design.

ALUMINIUM/CARBON FIBRE Monocoque Chassis = The monocoque chassis which is specifically made out of aluminum/ carbon fiber are known as ALUMINIUM/CARBON FIBRE Monocoque Chassis.

Ladder on frame chasis

Monocoque type of chasis

2 SUSPENSION

Suspension is that part of an Automobile that basically connects the chassis and the wheel together. It is basically suspensions responsibility to Diminish the bumps of the road make sure that the car is well maintained on the road.

Technical Components:

Rolling centre =It is the centre line along which if the force acts creates a moment and causes an Automobile to overturn. . The distance between the RC and the COG multiplied by the net force acting at the COG is equals to the moment produced.

Caster =Caster angle is the angel between the steering axis and the vertical axis of the cars wheel.

Positive Caster = Positive Caster is the case in which the steering axis is in front of the vertical axis of the wheels. Positive caster in modern cars runs to be around 3-5 degree for good highway stability and steering wheel feedback.

Negative Caster =Negative caster is when the steering axis makes an angle that is behind the vertical axis of the car. It will make the steering wheel lighter and will cause unwanted movement of the car on the road.

Camber = Camber is the measurement of center line of your wheel relative to road surface.

Negative Camber = Negative camber happens when the upper part of the wheel is pointing toward the inside. Normal cars maintain a slight amount of negative camber (0.5 - 1°) to maintain good balance.

Positive Camber =It is observed when the top part of the tire bulges outward as compared to the base of the tire. It is seen on the Tuk-Tuks in the Indian sub-Continent.

Spring Rate=It is the amount of weight it takes to compress a spring a certain distance. As the spring rate increases, it gets stiffer. The non-linear spring gets stiffer the more you compress it. Most vehicle uses springs that are coil. Leaf springs are different than both in that they have some built in dampening (shock absorber) due to friction leafs rubbing on each other.

Jacking Forces = It is the sum of all the vertical forces acting on the suspension links. The resultant force helps to produce a lift in the car along the rolling center of the car if the roll center is above the ground.

Development:

Independent Suspension

This type of suspension system comprises of a number of component which are directly attached to the main chassis of the car. These components include the upper control arm and the lower control arm. The lower control arm is attached to the chassis. It is also attached to the wheel hub via a control arm ball joint. These two arms have a wheel hub and a knuckle in between. The knuckle is a non-rotatory part of the suspension system. The hub is mounted onto the knuckle. Behind the knuckle setup the shock absorber is directly connected between the lower control arm and upper control arm at specified points.

Dependent Suspension

In this type of suspension system the rear two wheels are connected to each other via an axel which means that if any of the rear tire faces an abrupt shock due to road disturbances the tire on the other end is also affected because of it.

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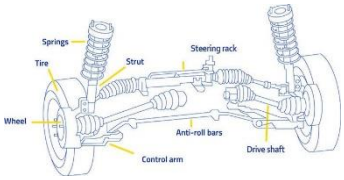


Normal Independent Type

Automobiles using Air suspension

3 STEERING SYSTEM

A steering is circular device used in a car to rotate the tires. It is sole way using which we can control the maneuverability of the car. In general when we rotate the steering by 4 rounds (approx. 5m) the tires of the car is rotated by 300mm.Hence we can say that a steering is type 1 machine which takes in more input and does a smaller output.

Types:

The rack and pinion system is a combination of a circular and linear gear merged into one another. This arrangement causes movement in the linear direction if the pinion is rotated on it.

Power steering System has a electric BLDC Motor attached to steering column. In this system the steering column has planetary gear system attached to worm screw of the motor. This is done to prevent steering lock in case of a motor failure. When the motor is working the ECU decides the amount of power to be given to the motor for steering assistance. The ECU decides this with respect to the vehicle speed, steering wheel angle, and torque applied by driver. When the system is working properly the power from the motor is transmitted via the worm screw to the sun gear through worm gear, outer gear and planet gears. This assist the driver. If the motor fails due to any reasons the worm screw in it jams the worm gear. In this case the driver can steer the car since the steering shaft is directly attached to main sun gear which is attached to the pinion.

Problems:

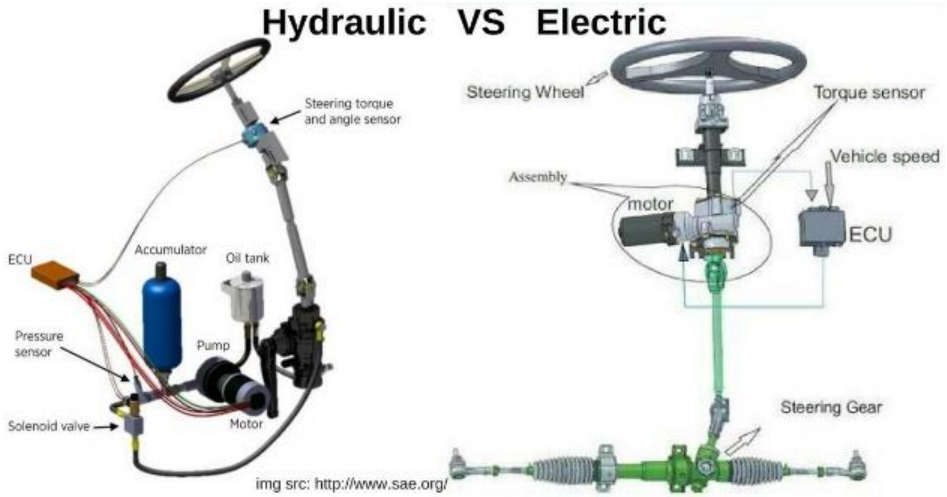
Under / Over Steer

Oversteer is a scenario in which an automobile usually takes a larger turn as compared to the amount of turn commanded by the driver using the steering. This happens usually in a rear wheel drive car when the driver gives comparatively more power input that the traction on the cars wheel can handle which causes the the rear of the car to slip out.

Understeer is a situation in which the car does not takes the amount of turn which it was asked by the driver to. This is caused if the car goes through a turn at a very high speed which causes the front tire to slip and not go through the specified direction.

Development:

In the early days when people used to ride in bullock carts. Whenever the cart went through any round corner the outer wheels of the cart had to travel a larger distance as compared to the ones on the inside. This extra spinning of the inner wheels caused the breakdown of the inner wheels. To overcome this problem a different steering system was invented by a person of Deutschland named Georg Lankensperger in Munich in 1817 who build a different carriage carrier and then got it patented in England by Rudolph Ackermann (1764–1834) in 1818 for driving horse carriages. In this system Georg Lankensperger thought if all the wheels of the car are rotated around a single imaginary point by varying the angle between the specific wheel and that point. Then all the wheels would rotate at different angular speed since the distance between the specific wheel and that point would vary.



Development in the field of Steering system can be seen as the systems are now Electric Dependent rather than Hydraulic Dependent.

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4 TRANSMISSION SYSTEM

It is the most the essential part of an Automobile because it contains all the Mechanical Components which are used to transmit the power generated in a channelized form to the wheels. Without a proper transmission the power generated by the engine can never be converted into useful Rotational Energy.

Components:

Flywheel = A flywheel is an energy storing device similar to a capacitor that stores kinetic energy as rotational energy. The energy stored in a flywheel is proportional to the square of the rotation speed and mass.

Flywheels are often used for providing continuous power output from a situation where the power production is not continuous.

Clutch= It is one of the main part of a transmission. It main function is create a free time travel of the engine. It consist of a plate which has a huge amount of friction to offer. It sticks next to the flywheel and when a force is applied to it using a pressure plate it sticks to the flywheel and transmits power to the drive shaft.

Types:

1 Single plate Clutch

2 Multi plate Clutch = It is used to increase the amount of torque generated.

3 Centrifugal Clutch = It works on the principle of centrifugal force which means the when the automotive engine's RPM reaches a certain limit point due to the centrifugal force the brake shoe attached to the spider of the clutch gets engaged to the friction lining.

Cone Clutch = It is a clutch mechanism in which there are two cones one which is a female and the other which is a male cone there is a friction lining on the male cone.

In a transmission system the clutch shaft is attached to the clutch gear which is then connected to the lay Shaft. The lay shaft consists of rigid gears which rotate with the same speed as that of the clutch shaft. These rigid gears are of different sizes. Above the Lay Shaft there is the main shaft with varying sizes of gears.

Development:

Constant Mesh Gearbox = This was the earliest type of gearbox system. In this the gear is engaged with the help of clutch dog mechanism. These clutch dogs are allowed to move freely on the main shaft over the splines. When due to the movement any of the clutch dog is meshed with a gear on the main shaft that main gear tends to drive the car at that speed. The reversing of the car is done via a ideal gear.

Sliding Mesh Gearbox = In the sliding mesh gearbox the gears are engaged by their actual movement on the main shaft to engage with the lay shaft. Therefore this system had nothing like dog clutch mechanism. This system had a lot of disadvantages such as in these the gears were spur where as in the constant and the synchro mesh they are helical which reduces gear meshing failure.

Synchromesh Gearbox = In the sliding mesh gearbox the gears are engaged by their actual movement on the main shaft to engage with the lay shaft. Therefore this system had nothing like dog clutch mechanism. This system had a lot of disadvantages such as in these the gears were spur where as in the constant and the synchro mesh they are helical which reduces gear meshing failure.

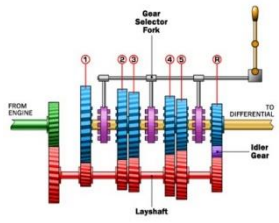
Types of Transmission

With the passage of time different types of transmission systems were created but all of them basically uses the concept of the same manual transmission.

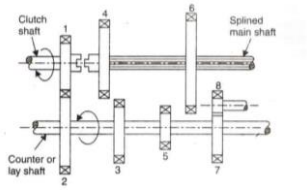
Semi-Automatic transmission

Automatic Transmission

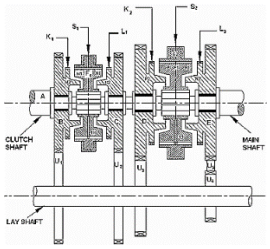
Continuous Variable Transmission (CVT)



Constant Mesh Type Gearbox.



Sliding Mesh Type Gearbox.



Synchromesh Type Gearbox

5 BRAKES

As we all must have experienced, there is a certain force which automatically jumps in the opposite direction of motion as we let any moving particle to move on its own. This magical force has been known as friction. It is the only reason why we are able to walk. The Brakes are a mechanical device which inhibits motion by absorbing energy of a moving system.

The first type of brake was a wooden block brakes which were used in horse driven carts they were capable of stopping any cart moving at a maximum speed of 20MPH.

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COMPONENTS:

Backing plate: The backing plate acts as a base for the setup of the drum brake mechanism. This plate increases the rigidity of the system, protects the components from dust and other debris. This plate also absorbs the torque generated at the time of the braking. Hence this plate is also called the "Torque Plate".

Brake drum: It is generally made from cast iron which is heat-conductive as well as wear-resistant. It rotates along with the wheel & axle. As the brakes are applied, the outer lining of the brake shoe pushes radially against the inner hard surface of the drum, and friction produced slows the rotation of the wheel. Therefore stopping the vehicle. This friction generates substantial heat.

Wheel Cylinder: Each wheel cylinder is used to operate the brake on each wheel. Numerous pistons operate on the shoes. The shoe which is closest to the front of the vehicle is referred as the primary shoe. The trailing shoe also known as the secondary shoe. Pressure from the master cylinder acts on the piston, this pushes the pistons toward the shoes thus forcing them to produce friction against the drum. As the brakes are released, the springs in the brake shoe restore the shoes to the original position.

Brake shoe: A brake shoe consists of two steel parts welded together. The crescent shaped part is called WEB it has a number of holes on it for the placement of the placement of return spring, parking brake linkage etc. The friction material is either riveted or stuck using an adhesive to the lining table.

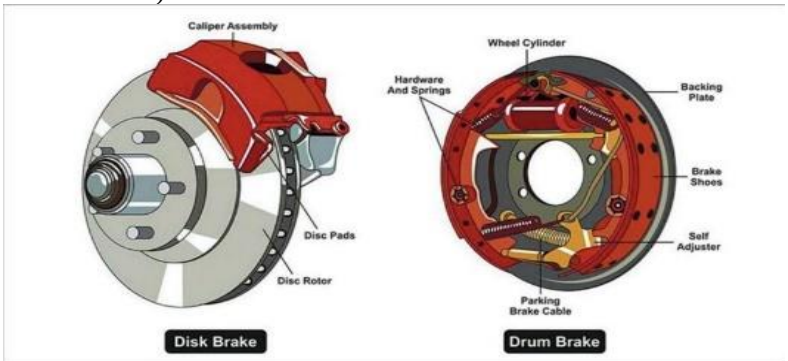
Development:

The earliest type of brakes were the drum braking system but later with the advancements in the technology more advanced braking systems were developed.

Disc Brakes: This Brake system converts kinetic energy of the rotor wheels into heat energy to providing a stop force. This system consists of a caliper, piston, seal, dust bot, noise shim, brake pads, anti-rattle clips. In this system the fluid exerts a force on the face of the piston which in turn forces the brake pads against the rotor causing the rotation of the wheel to slow down.

Electromagnetic Brakes: An electromagnetic brake consist of a coil(consist of lead wire, friction material, Brake field), armature and hub. On a normal scenario the the armature and the hub rotates about their axis and the coil is stationary. When the hub is rotating and the OFF switch is pressed a current passes through the lead wire producing a electromagnetic field in the coil which makes the coil act as a magnet for the time the switch is pressed. Thus this magnetism causes the armature to get attracted to the coil's friction material causing the armature and the hub to stop suddenly.

Vacuum Brakes: This type of braking system was founded in the year 1870 by the British and is usually followed by the countries which had British rule in them. In this system a brake pipe line flows throughout the length of the train having brake pipe hoses in the middle. This array of brake pipes is connected directly to the locomotive's cabin where multiple equipment's are connected to make this braking system work. This system has an ejector (In steam power driven locomotives) and an exhauster (in modern electric locomotives). The main function of the exhauster is to create a vacuum in the brake line.



Developments in the braking technologies:

ABS Anti-Lock Braking system

This is one of the most renowned safety system till date. Due to government norms it has been compulsory nowadays for all the newly manufactured cars to have it installed. What this system basically does is that in case of a panic braking it prevents the wheels from locking and allowing the driver to control the car via steering inputs. This system consist of an ECU, four wheel sensors, at least two hydraulic valves inside brake system. In the case of an emergency if the any of the wheel sensor detect lower speed of that particular wheel as compared to the speed with which the car is moving it sends a signal to the ECU which in response reduces the area of the valve opening hence reducing hydraulic pressure and unlocking that wheel. Conversely if any of wheels is rotating at a much higher speed as compared to the other wheels, the ECU demands a higher brake force on that particular wheel.

Electronic Stability Control: This is a different type of safety system which has the same concept as that of the ABS but this system has two more types of sensors

1 Steering wheel angle sensor

2 Gyroscopic sensor

In this system as the gyroscopic sensor detects that the direction headed by the car is not the same as that of steering wheel sensor, the ESC will detect the necessary individual wheel and apply brakes to that particular wheel so that the vehicle goes the way the driver intends.

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Traction Control System: A traction control system is an electronically controlled system which is used by car manufacturers to minimize wheel slip in case of an urgent head start or in case of loose gravel drive. This system uses the same Hall Effect sensor as that of the anti-lock braking system. When the cars ECU detects that any of the wheel is rotating at a much faster speed as compared to the other wheels. It either automatically applies brake to that particular wheel or it decreases the speed of the engine while in doing so it produces a pulsation effect at the gas pedal.

Tire Pressure Monitoring System: A TPMS is a unique type of system which tells the driver without even stepping out of the car whether there is a low pressure in any of the respective wheel. There are two types of tire pressure monitoring system:

Direct TPMS System

Indirect TPMS System

6 FUEL SUPPLY SYSTEM

As we all are well aware that a car runs on a fuel. Therefore to make a car a long distance cruiser it is necessary for the automakers to design the fuel system in such a manner that the car uses the least amount of fuel and do very long distances.

In a fuel system the fuel tank acts as a fuel reservoir. When the engine is switched ON then the fuel pump, pumps up fuel from the tank and via fuel lines the fuel is brought to the fuel filter where it gets filtered. After the fuel is filtered from impurities it is mixed with air in certain ratio and then injected in the cylinder in certain spray pattern where the combustion process takes place.

Components:

Fuel Filter: A fuel filter is a specially designed filter that is placed in the fuel line so as to screens out dirt and Rusted metal particles from the fuel. They are commonly found in most of the internal combustion engines.

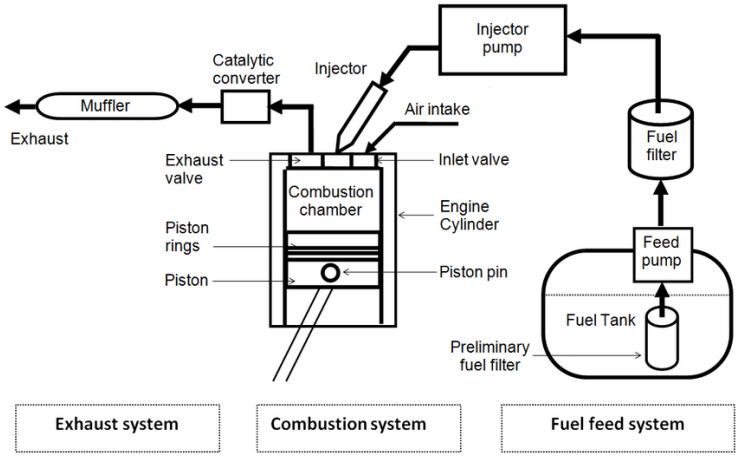
Fuel filters play an important role in today's high performance Engines systems. As Unfiltered fuel may contain elements that can bring abrasive effects on the internal linings of the fuel system as well as creating disturbing effects on internal diameter of the IC Engine's cylinder.

Carburetor: A carburetor is a mechanical device whose air inlet is controlled via mechanical hinges. The main function of this system is to produce a fine mixture of air and fuel for perfect combustion. This mechanical device has a butterfly valve which is connected to the accelerator cord. A carburetor is mainly used in petrol engine and not in diesel cars because diesel does not evaporate like petrol does so a carburetor cannot be used and the fuel has to be injected into the intake air under very high pressure in order to get it to atomize.

Choke: A choke is a device that helps in starting the car when the engine is at very cold temperature. In cold start, when normal flow of air and fuel is not able to start the engine then the choke comes up automatically and decreases the flow of air in the intake manifold and increases the fuel in it .This is done by reducing the air intake before reaching the venture by using a choke valve. This produces a very rich air fuel mixture which is very easy to ignite and heat up the engine easily.

Fuel Injection: This system is mainly used in Diesel engines. It is the introduction of fuel into the Combustion Chamber. This system atomizes the fuel as they are sprinkled inside the cylinder. One of the most useful points about the fuel injection system is that they make the engine highly fuel efficient as they spray very less amount of fuel and produces the same amount of power as that of a similar capacity engine.

Spark Plug: It is a device that is used to generate electric spark in the spark ignition engine. The spark plug is responsible for any petrol engine car to work at all. This spark plug produces a voltage of about 20000-40000V. This high voltage is produced at the terminal point and is transmitted downwards through the central electrode via passing through the resistors which are used to reduce electromagnetic interference. The high voltage is brought between the ground electrode and the central electrode this is what produces the spark. The distance between the ground and the central electrode decides the amount of voltage to be given at the terminal point to produce the spark. This distance is known as the electrode gap.



Fuel Injection System

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Development:

PGMFI: This is a type of fuel injection system developed hero MotoCorp. It stands for Programmed Fuel Injection system. Furthermore engine sensors measure the temperatures of the engine coolant, engine oil and outside air whereas the pressure sensors monitor engine oil and atmospheric pressures. Based on this data and the position of the throttle, the ECU calculates the correct quantity and timing of the fuel to be injected. This system helps in achieving optimum fuel efficiency and lower emission. It also reduces the engine knocking and improves the drive ability as claimed by Hero.

CRDI: Common Rail Direct Injection as the name suggests in this technology direct injection of the fuel is done into the cylinders of a diesel engine using a single/common line which is connected to all the fuel injectors.

Unlike the normal diesel direct fuel-injection systems that have to build pressurefor each and every injection cycle, the common rail injection system maintains a constant pressure regardless of the injection sequence. This pressure then remains permanently available throughout the fuel line. The electronic control unit (ECU) alters the injection pressure as per the need, it makes decision based on data obtained from sensors on the Crank/Camshaft. This technology allows the fuel to be injected as per the need hence saving fuel and lowering emissions.

VTVT – Variable Timing Valve Train Hyundai

This technology is also similar to the VVT-I/VVT. It is also used to improve the Engine's performance while trying to keep the fuel consumption as low as possible. It was developed by the South Korean car manufacturer Hyundai.

VVT-I – Variable Valve Timing

This technology was developed and introduced by Toyota in the year 1995. It is actually an improvement in the already existing Technology. In this Technology the variation in the valve timings is controlled using the camshaft which is dependent on the engine oil pressure for its function. Further improvement in this technology is widely known as dual VVT-I.

I-VTEC – Intelligent Variable Valve Timing and Lift with Electronic Control System

The I-VTEC system is on the upper hand in comparison to the other valve timing system. In this system not only the valve timings but also the valves capability to open and close are operated using the ECU. This system can increase or decrease the valve opening/closing with respect to the requirement. It is majorly used by the manufacturer Honda.

TFSI – Turbo Fuel Stratified Injection Audi

It is first ever built turbo direct injection system which can provide best performance in acquaintance with higher fuel efficiency and very less amount of emissions.

TDI – Turbo Direct Injection

It is a technology that was first unveiled in an Audi 100 model in the year 1989. It is the combining of two well-known technologies. The Direct injection in which the fuel is directly injected inside the combustion chamber and the Turbocharging which helps in better mixing of the fuel with air.

D4-D

This is the type of fuel injection technology used by Toyota in their Diesel Engines. The D4-D stands for direct injection four cylinder diesel Engines. This technology is implemented so as to receive the best fuel efficiency as well as the best Torque and Power output for Diesel Engine.

CRDI Technology injects fine drops of fuel into the combustion cylinder at an extreme pressure. This result in power and refinement as same as petrol engine, but having better fuel efficiency and lower emissions.

All the technologies in the list except i-VTEC, vary only the valve timing in accordance with the engine RPMs. That is, advancing the opening of intake valves or providing valve overlap between intake and exhaust for optimum performance. The i-VTEC actually changes the valve lift to a greater extent for more flexibility. Variable valve timing and lift not only makes the engine more responsive but also produces more power in comparison to the same capacity engines lacking this technology.

7 ENGINE

Types of IC engines:

Spark Ignition System (Petrol engine):

These are the type of engine which operate on a 4 stroke cycle. The produce power in the power stroke by compressing the air-fuel mixture to high temperature and igniting it using an additional spark plug. In spark ignition engine the temperature of the gas on compression does not rise to temperature so as to auto ignite so there is a spark plug in it to produce the combustion required.

The compression ratio of a petrol engine is about 10:1 to 14:1.Since the compression ratio of a petrol engine is comparatively low and the weight of the connecting rod, crankshaft and Piston is also low the Petrol engines runs at higher rotation speeds than diesels Engines.

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Compression Ignition System (Diesel Engine):

A diesel engine works on the same 4 stroke cycle as that of the petro engine. The only difference between the petrol and a diesel engine is that it has a larger compression ratio which means that it compresses the air and fuel mixture to much higher temperature as that of the petrol engine. This high temperature mixture is auto ignited when fuel in atomized state is sprayed on it by fuel injection system. The compression ratio of a diesel engine is 18:1, 23:1. The efficiency of a diesel engine is much higher than the petrol engine reason being the higher compression ratio.

Process:

A four-stroke engine is an internal combustion (IC) engine in which the rotation of the crankshaft is done due to the Four separate strokes of the Piston. A Stroke refers to the movement of the Piston along the internal lining of the cylinder. The four separate strokes are termed:

Intake: This is also known as the induction or suction stage. In this stroke the piston begins its movement from the top dead center (T.D.C.) and ends at bottom dead center (B.D.C.). In this stroke the intake valves are in the open position and the Air-Fuel mixture is suced due to the suction created by the piston moving toward the (B.D.C).

Compression: In this Stroke the Piston Moves from the (B.D.C) to the (T.D.C). In this stroke the piston compresses the air-fuel increasing the pressure and the temperature inside the cylinder. Both the intake and exhaust valves are closed during this stage.

Combustion: This stage is also known as power or ignition. At this point the second revolution of the four stroke cycle begins. While the piston is at T.D.C. the compressed air-fuel mixture is ignited by spark Plug or is ignited due to the Reaching of Self igniting temperature. This mechanical work from the engine is created at this stage.

Exhaust: During this stroke the piston moves from B.D.C. to T.D.C. while the exhaust valve is open. This action forces the used air-fuel mixture to move out of the cylinder.

A typical W16 type Engine.

8 ENGINE COOLING SYSTEM

The working of an internal combustion engine produces a lot of waste heat in it due to the movement of mechanical components which causes friction in them and its nature of working in high temperature and pressure. Thus it becomes a very essential thing to cool this heating engine because if it is not done the failure of the whole system can take place. The cooling of the engine can be done either by water or by air.

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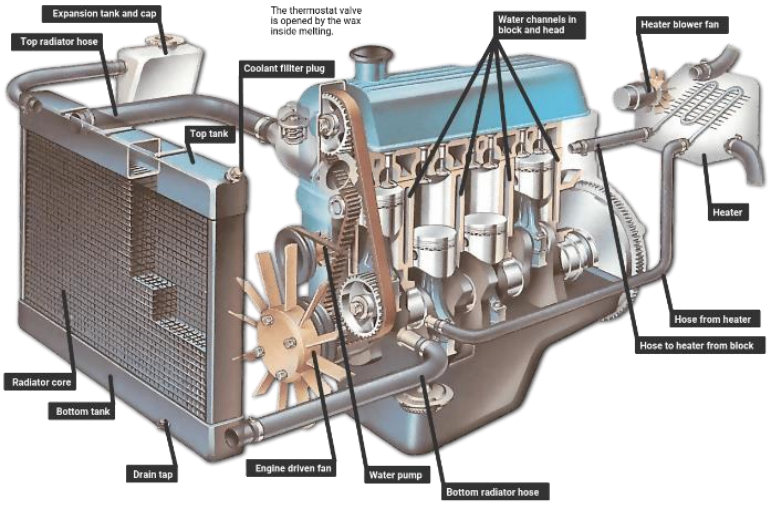
A type of Air Cooled Engine Block.



An Engines Cooling System using Radiator & other Equipment's like sensors used in modern Cars. In engines with small capacity the cooling process is done only by the air and thus to carry out this, the engines have fins around them which increases the area of contact of the engine with air. Hence the engine is cooled only by air. This system is used in lawnmowers and small capacity motorcycles etc.

Components:

Waterpump is the most important part of the engine cooling system. It consist of an impeller pulley flange and an O-ring. This impeller is rotated via a pulley using the crankshaft. Radiator acts as a heat exchanger which has an inlet port, outlet port, drain port, radiator pressure cap.

Thermostat is a valve which permits a specific amount of coolant to flow into the radiator. This allowance is decided by the temperature the engine wants to run on. The main components of the thermostat are Frame, main spring, secondary spring, main valve, bypass valve, charge cylinder.

Coolant temperature sensor is an electronic device which measure the temperature of the engine and sends that data to the ECU. This data is used by the ECU to determine the fan speed and driver console meter. The coolant temperature sensor has a sensor probe at one end an electrical connector the other. The engine has a specific flow lines inside it which are known as water jacket. The water flows through these jackets without mixing with the lubricating oil and getting inside the cylinder.

Working:

When the engine is at cold temperature and it is required to be heated the expansion valve in the valve housing remains open creating a bypass of the radiator. In this situation the warming up coolant is passed directly from the engine outlet port to the impeller inlet valve and is circulated throughout the engine until it gets heated up to the temperature of about 160 degree Fahrenheit.

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When coolant is so much heated the expansion valve closes the bypass route of the coolant. This creates a new route for the coolant in which the coolant flows from thermostat housing to the upper radiator hose and from the lower radiator hose to the engine via the impeller. When the temperature of the coolant becomes too hot the fan behind the radiator is switched ON by the coolant temperature sensor and thus the heat accumulated at in the radiator is passed onto the atmosphere. Therefore cool coolant from the lower radiator hose is now passed to the engine via the impeller. When the pressure inside this closed system reaches beyond 15 psi (pound square inch) the radiator pressure cap comes into play. This cap has a spring mechanism fitted to it if excess pressure is created the high pressure coolant is passed onto the expansion tank leading them to expand. When the pressure is literally very high and the expansion tank is full the excess coolant flows out through the overflow hose.

9 DEVELOPED TECHNOLOGIES

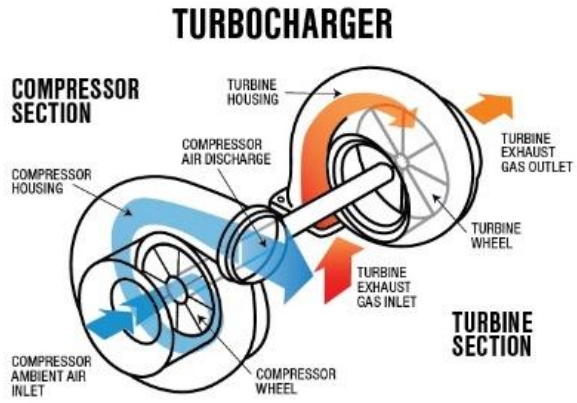
Turbocharger:

A turbocharger also known as a turbo, is a turbine driven using the Exhaust gas. It is a forced induction device which increases an engine's efficiency to create power by forcing additional compressed air into the IC chamber. This improves the performance over a naturally aspirated engine's power due to the fact that more Air is forced into the IC chamber causing more Combustion and power stroke.

The main purpose of a turbocharger is to improve Engine's volumetric efficiency by increasing the intake density of gases allowing more power per engine cycle.

The turbocharger has a compressor as a part which draws in ambient air and compresses it to an increased pressure before forcing it into an IC chamber. This causes greater mass of air entering the cylinders per intake stroke. The power required to spin the centrifugal compressor is taken from the KE of the engine's exhaust gases.

Turbocharger lag (turbo lag) is the time required for the turbo to kick in this basically is the time which the Compressor requires to compress the Air and feed it to the intake manifold.



A Turbocharged System using Turbine and Suction Turbos.

Supercharger:

A supercharger is a high quality air compressor which drives in compressed air of high density into the intake manifold using the engine's power. This system is not quite Pocket friendly as it uses the engines power to generate more power rather than using exhaust waste gas as in the turbo charger.

Power to a supercharger can be transmitted by means of a belt, gear, shaft, or chain connected to the engine's crankshaft.

An example of a supercharged performance is seen in a Rolls-Royce Merlin engine, in which it uses about 150 HP. The 150 HP which is taken from the engine to drive the supercharger generates an additional. A gain of about 250 HP. The disadvantage of a supercharger is that the engine must at a minimum produce the power required to drive the supercharger to get its benefit's.

Twin Charging is a combination of a turbocharger driven using exhaust gas and a supercharger driven using engine's power. This Conglomeration can mitigate the weaknesses of both the systems.

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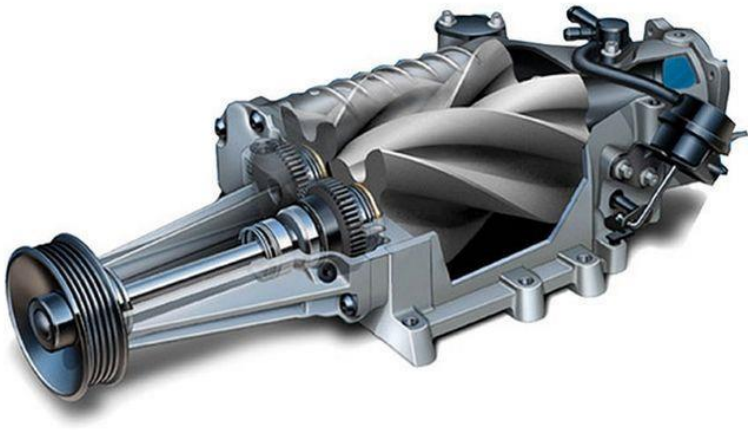

Top View of a Super Charger

AIRBAGS

The airbags are also known as supplementary restraint system (SRS).The word supplementary here signifies that the airbag acts as an additional safety device for the passenger with the seat belt and not a replacement of it.
When a car going at high speed hits something it starts to decelerate. This deceleration is measured using an accelerometer (electronic chip to measure acceleration). If the deceleration is comparatively higher than normal deceleration the accelerometer activates the airbag circuit. This circuit passes electric current to the heating coil which reacts and produces chemical explosion which in turn creates sodium Azide and nitrogen gas. These gases produced in the explosion flow into the nylon bas placed inside the steering rupturing the steering cover and coming out as a safety measure.

CONCLUSION

Finally I would like to conclude my Technical Brief by analyzing the profits that the years of perseverance and hard work of the Engineer's in the field of Automobile Engineering has brought. Firstly, with respect to the Department of the Chassis it has seen a wide variety of improvement with the passage of years. The Technology used nowadays are far more advance, Safer, light weight, Stronger as well as Cheaper due to the presence of different elements in the composite. Despite the fact that the new technologies are better, the technologies like the ladder frame are still in function with the minor tweaks in them like better Vehicle Controlling/Stabilizing Systems. This shows that the initially designed technology was not on the lower hand but still they required little amount of betterment in them.

Secondly, the improvement in the Suspension or the Ride Quality of an Automobile is also a major field improvement. Earlier when the Technology was not that Advance most of the Caravans had no suspension system to alter the road inequalities which not only gave a bad ride experience but also reduced the life of a machine due to unwanted extra Damage. Nowadays with the improvement in the suspension technology the Automobiles not only provide better ride quality but also but also saves the internal parts from unwanted damage due to high speed irregularities.

Thirdly with the improvement in the steering and the braking system the ride of an Automobile has not only improved in the driving perspective but have also improved in the safety perspective. With the developed technology of brakes and steering system an Automobile can provide with a better sense of safety and pleasure when behind the wheel. The advancements in the steering technology has brought a heavy relief to the modern Automobile users as it has made the maneuverability of the Automobile far easier.

Fourthly, the improvement in the fuel injection technologies and the engine's build has been a very major improvement as the sole reason for the better sales in the Automobile industry is better fuel economy and the nice pricing of the vehicle. If the improvement in technology were not their and the vehicle continue to give the poor fuel economy it would have affected in the number of car owners that we see today.

Finally, the improvement in engine cooling system and introduction of various technologies like Turbocharging, Airbags, Sensors, Immobilizers, ABS, EBD etc. not only provide better ride quality with multiple amenities at your hand but also provide with a sense of safety to the Driver and the Passenger's that they are being driven in a reliable machine and that they won't face any trouble even on the hardest terrain that they drive.