

Engine Lubrication Systems

Engine Lubrication Systems

In any mechanical machine, all moving parts must be adequately lubricated to assure maximum wear and long life

Objectives of lubrication

- 1- Reduces friction and wear between moving parts
- 2- Helps transfer heat and cool engine parts.
- 3- Cleans the inside of the engine by removing contaminants
- 4- Absorbs shocks between moving parts to quiet engine operation and increase engine life.
- 5- To form good seal between piston rings and cylinder walls.

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Properties of Lubricants

- 1- Suitable viscosity
- 2- Oiliness to ensure adherence to the bearing, and for less friction and wear when the lubrication is in the boundary region , and as a protective covering against corrosion.
- 3- Should not react with the lubricating surface
- 4- A low pour point to allow flow of the lubricant at low temperature to the oil pump
- 5- No tendency to form deposit by reacting with air, water, fuel or the product of combustion
- 6- Cleaning ability
- 7- Non foaming characteristics

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SAE Number of oil

Oils are graded according to their viscosity by a series of Society of Automotive Engineers (SAE) numbers. The viscosity of the oil increases progressively with the SAE number.

An SAE 4 oil would be very light (low viscosity) and SAE 90 oil would be very heavy (high viscosity).

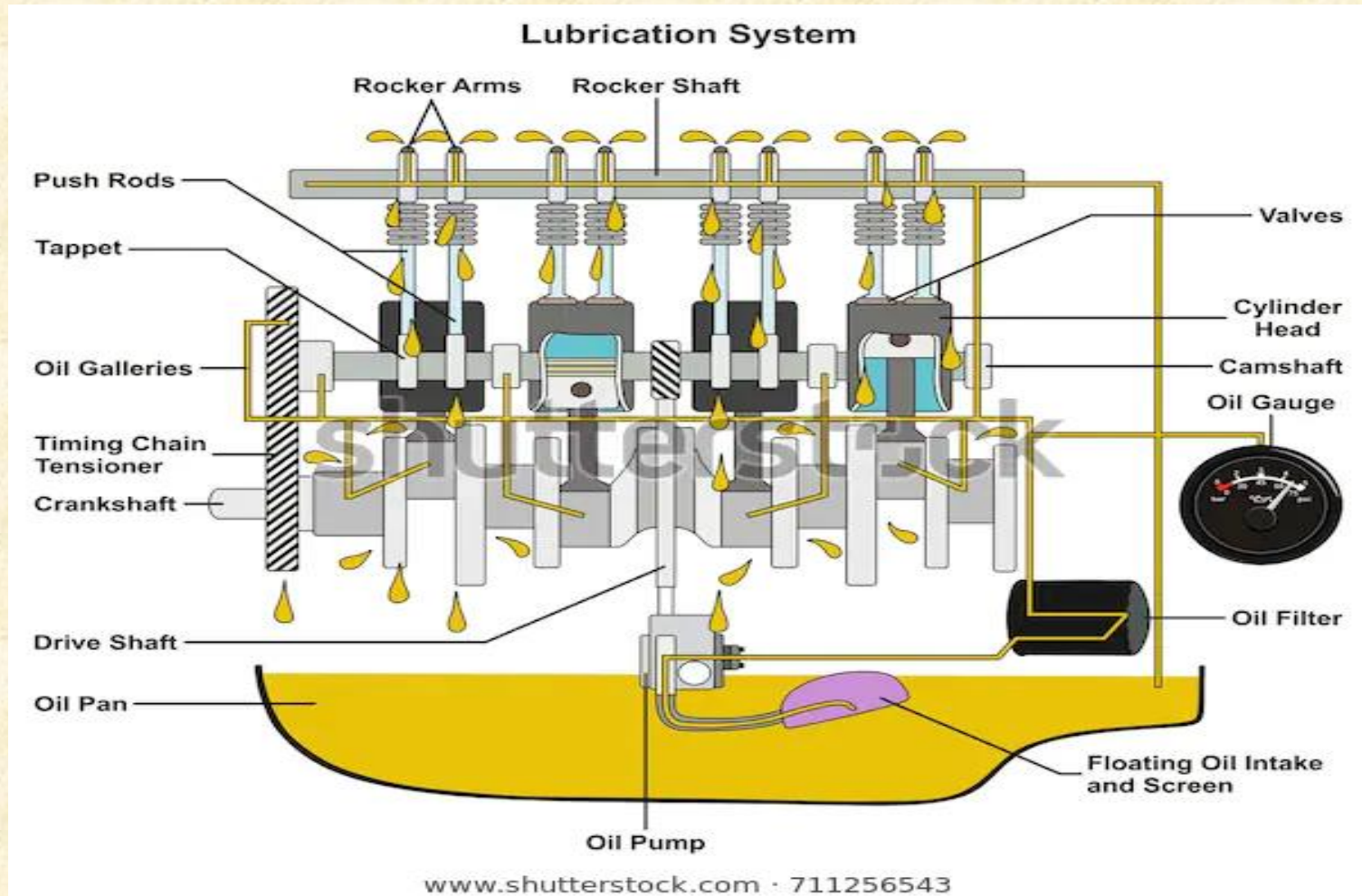
Lubricating Parts of Engine

- 1- Main crankshaft bearings
- 2- Big end small bearings of the connecting rod.
- 3- Camshaft bearings
- 4- Piston rings and cylinder walls
- 5- Valve mechanisms

Engine Lubrication Systems

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Lubricating System Components



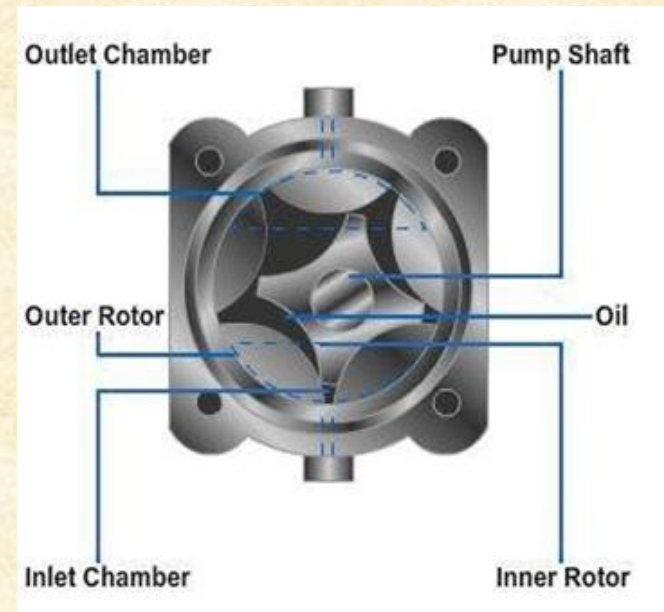
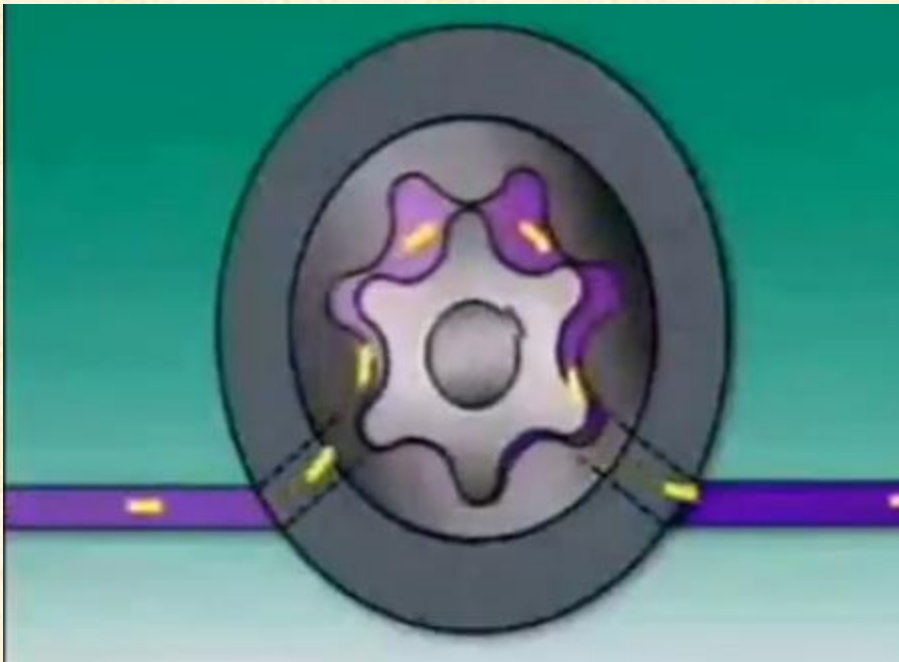
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1- Oil Pump

Oil pump forces oil out of the oil pan, through the oil filter and galleries, and to the engine bearings

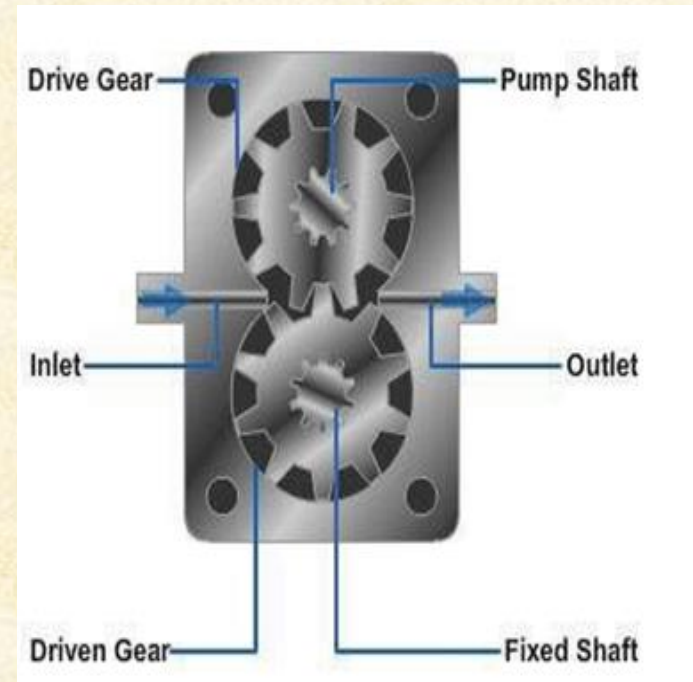
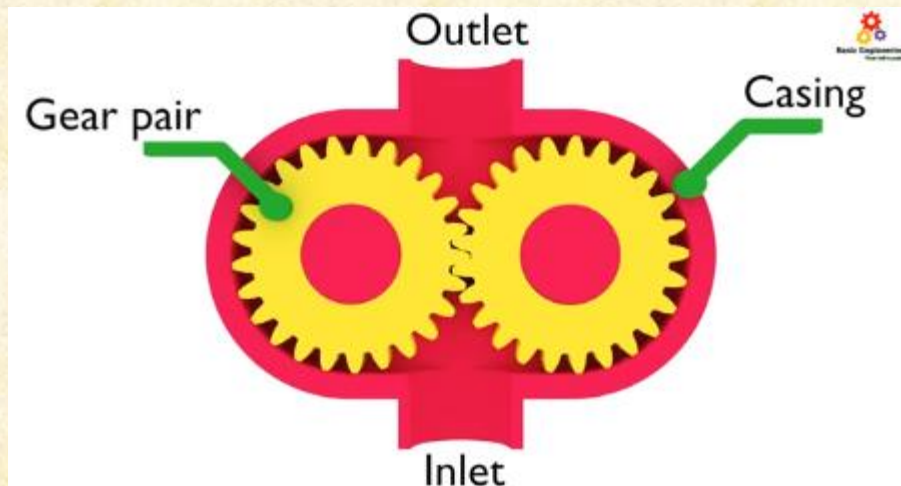
Rotary oil pump



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Gear oil pump

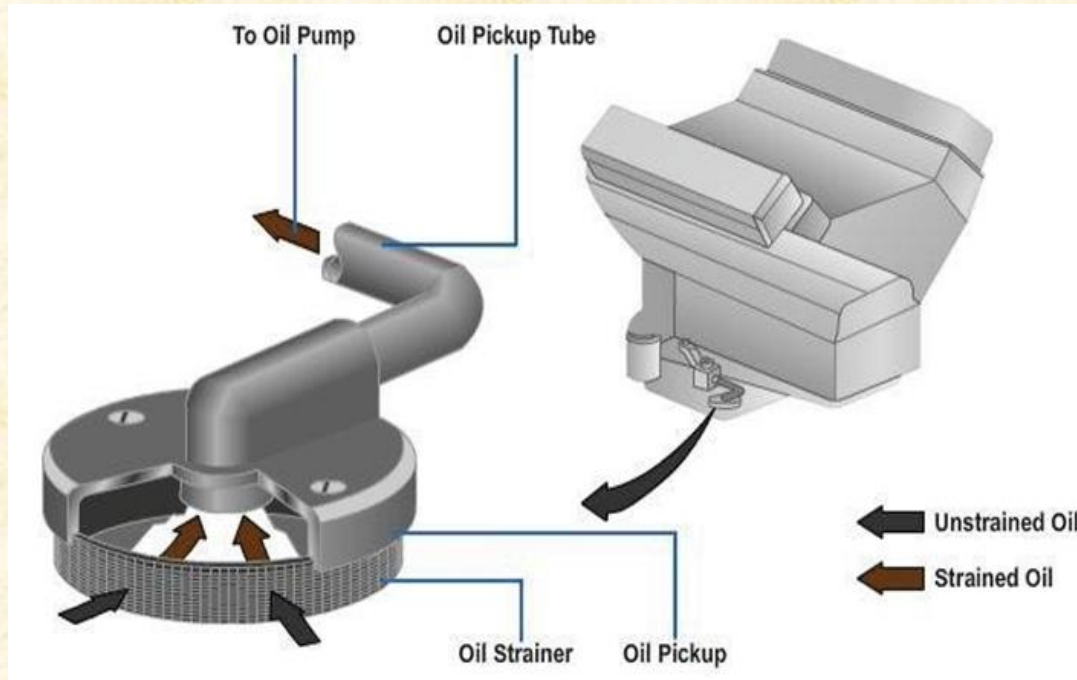


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2- Oil pick up and strainer

The oil pickup is a tube that extends from the oil pump to the bottom of the oil pan. The strainer has a mesh screen suitable for straining large particles from the oil

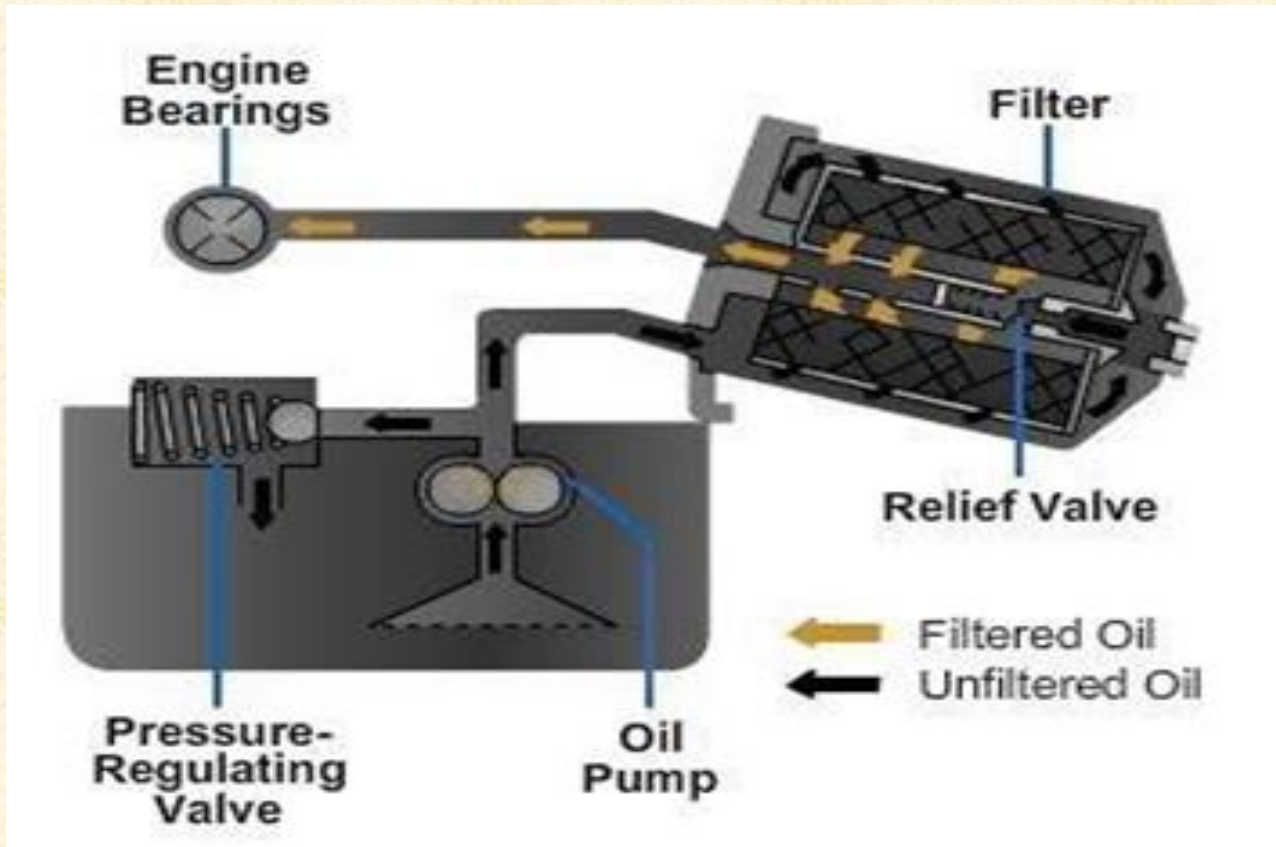


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3- Pressure Relief Valve

Pressure Relief Valve maintains lubrication pressure

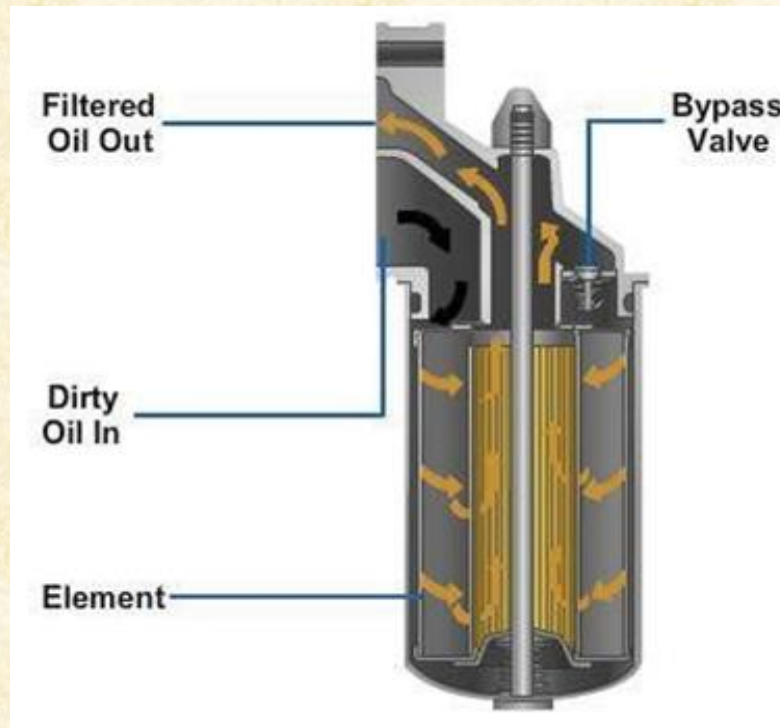


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4- Oil Filter

The oil filter removes most of the impurities that have been picked up by the oil as it circulates through the engine

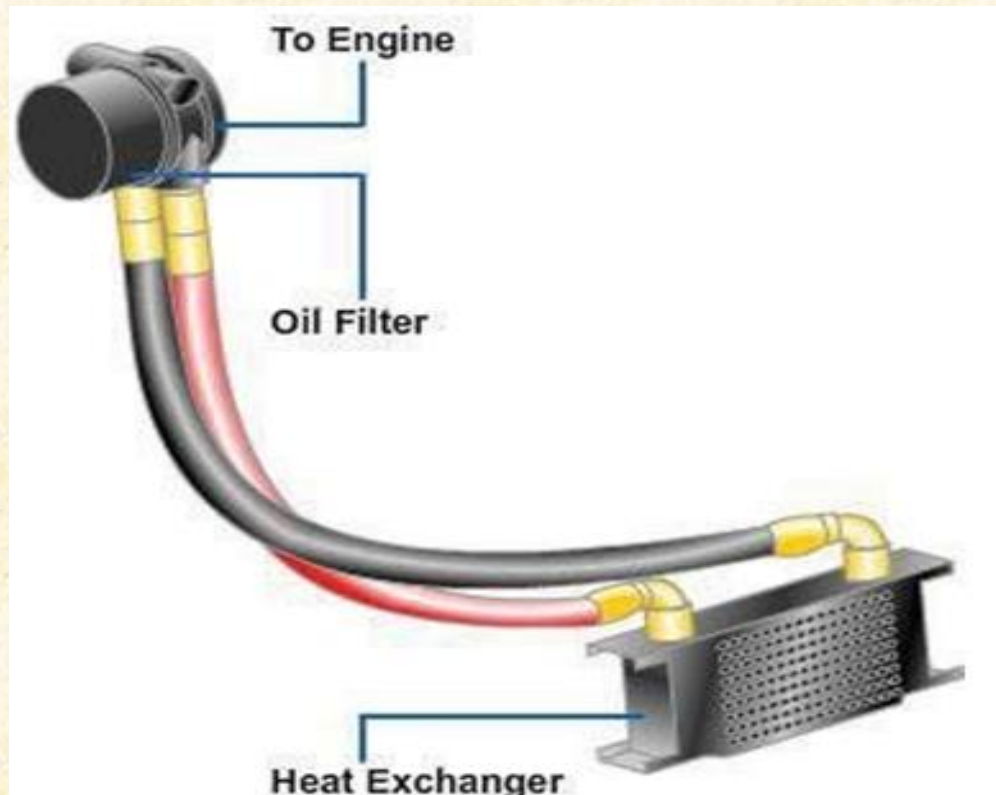


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5- Oil Cooler

This system uses To cool the lubricating oil in heavy duty engines



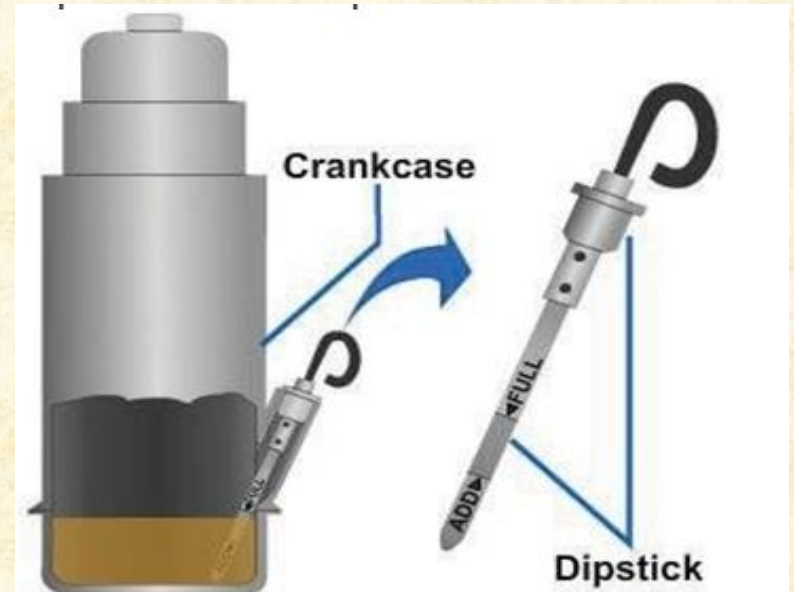
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6- Oil Pan (crankcase)



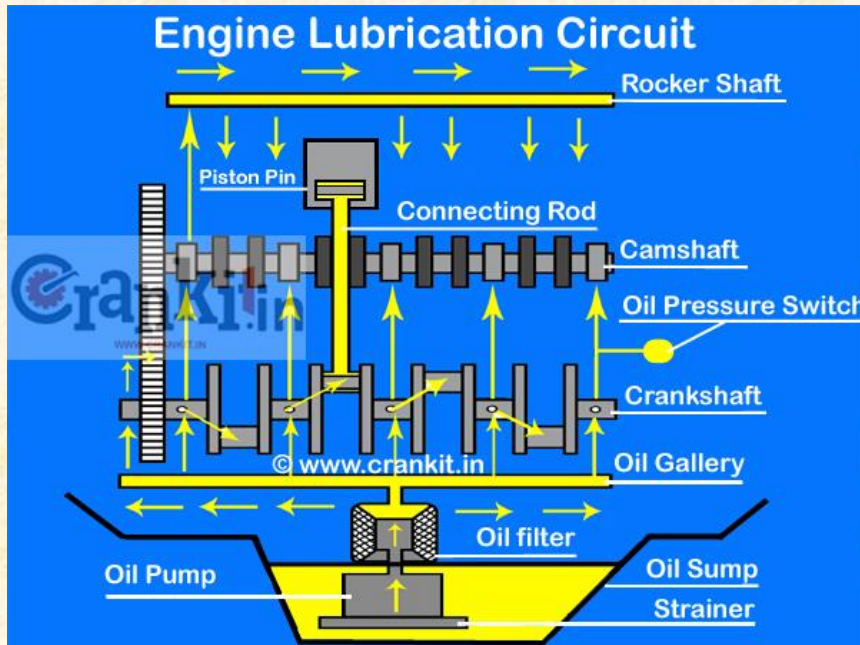
7- Oil Level Gauge



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8- Oil Galleries



9- Oil Pressure Gauge



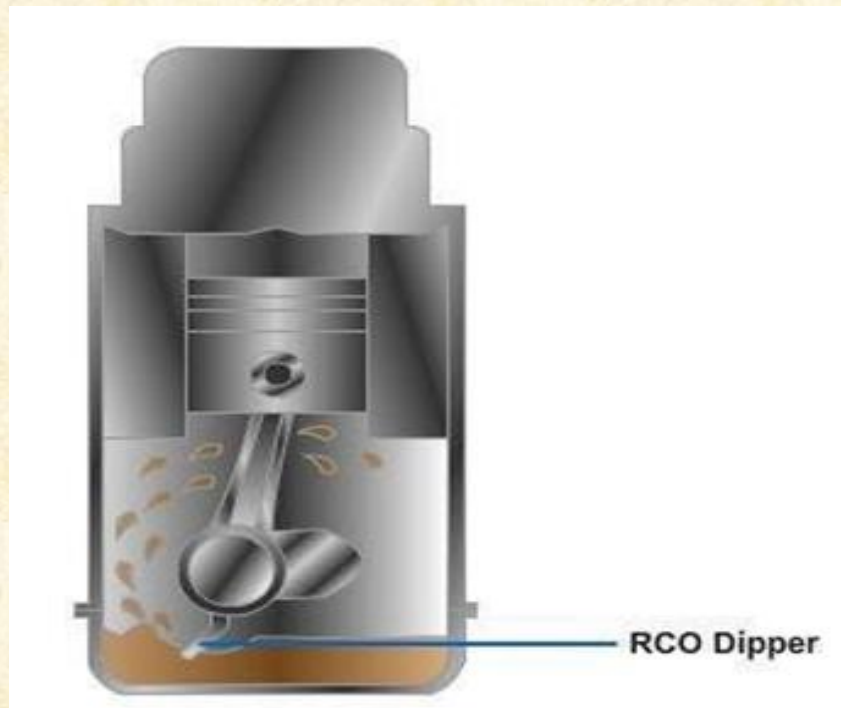
Engine Lubrication Systems

Engine Lubrication Systems

Types of Lubricating Systems

There are many types of lubricating systems used to circulate oil are known as:

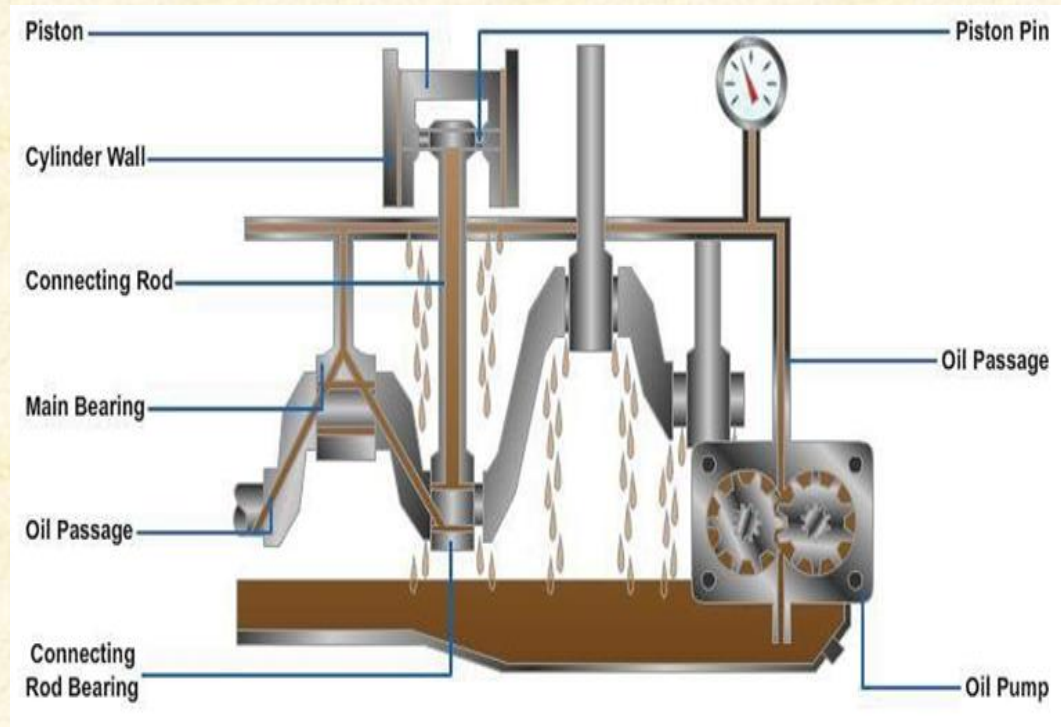
1- Splash system



Engine Lubrication Systems

Engine Lubrication Systems

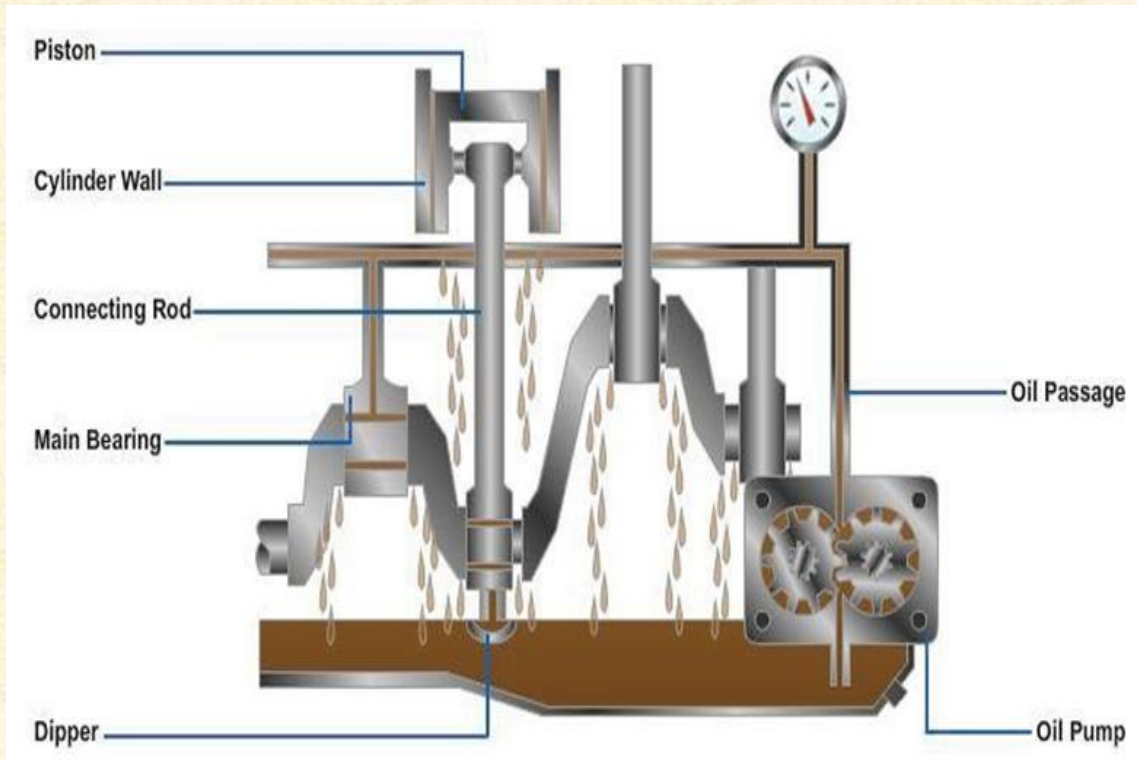
2- Force Fed system



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3- Combination Splash and Force Fed systems

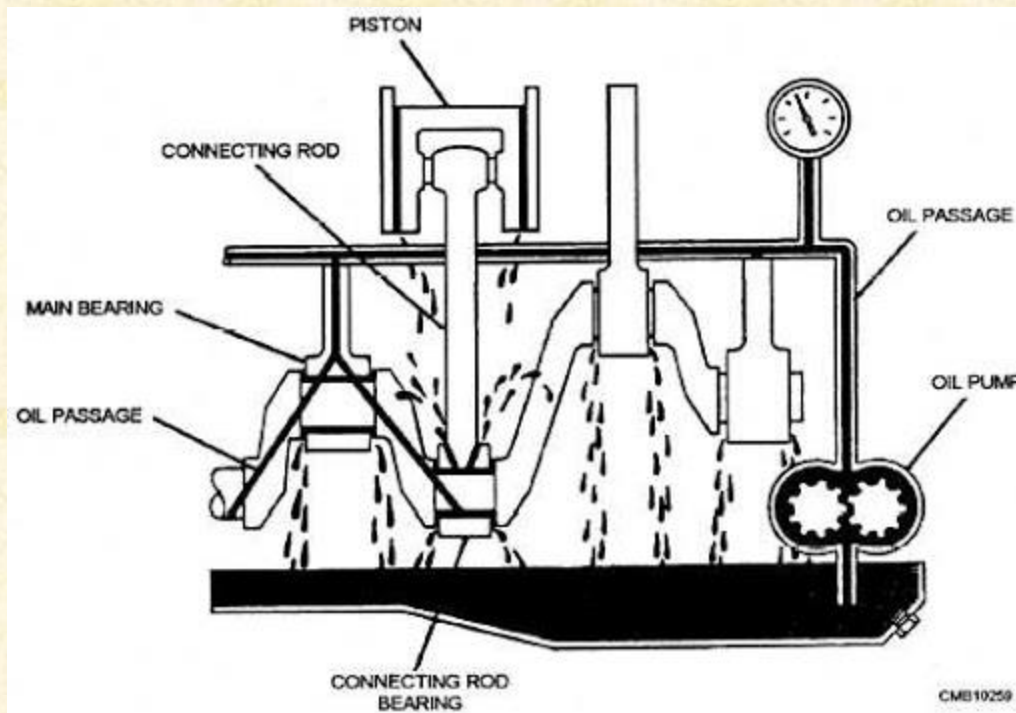


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4- Full Force Fed system

In a full force feed lubrication system, the main bearings, rod bearings, camshaft bearings, the pistons, the piston pins and the complete valve mechanism are lubricated by oil under pressure

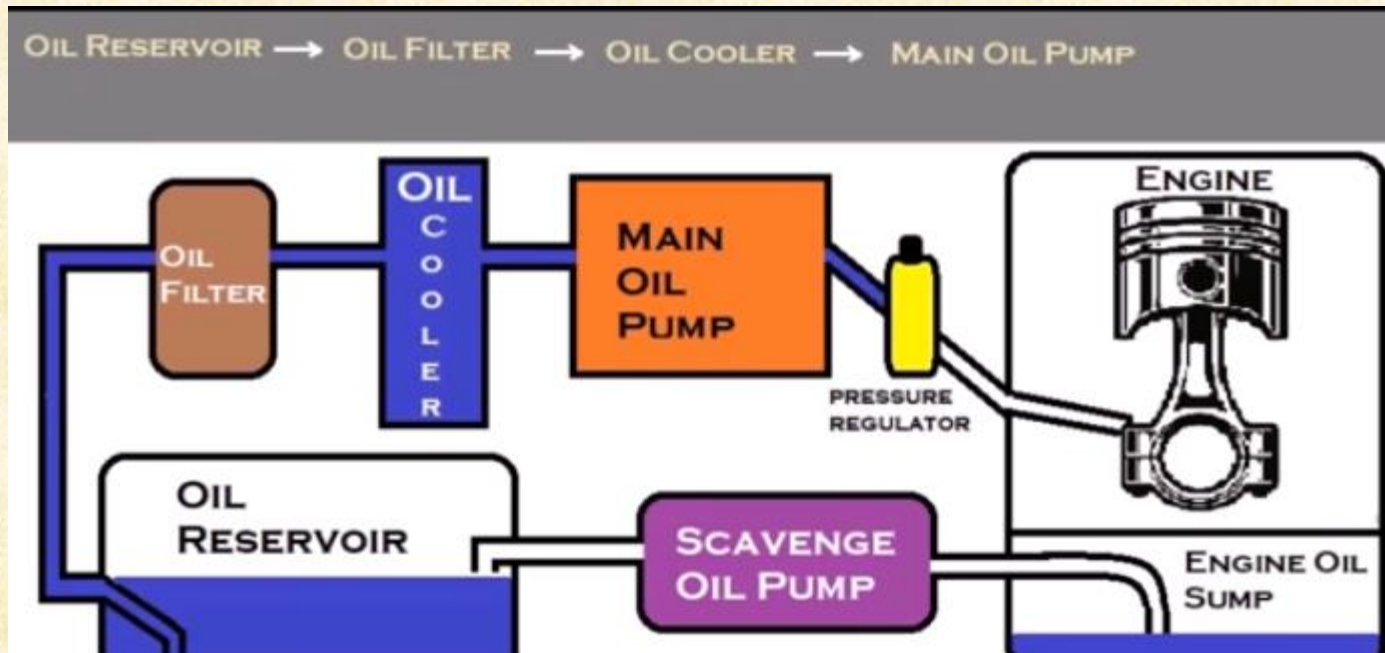


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5- Dry Sump system

The dry sump lubrication system uses two oil pumps and a separate oil reservoir. No oil is stored in the oil pan itself. The main pump pulls oil from the reservoir and pushes it into the engine bearings and other high-friction points. The second pump, called the scavenge pump, pulls oil out of the pan and sends it to the oil reservoir.



Ignition Systems (Petrol engine)

An ignition system must produce a very high voltage in order to force electric current—moving electrons—across the spark plug gap. This spark ignites the air-and-fuel mixture that surrounds it inside the cylinder. The resulting “explosion” in the combustion chamber forces the piston down and gets the crankshaft turning.

The functions of ignition system

- 1- Production of the high voltage necessary to produce a spark at the plug gap.
- 2- Distribute the spark to all the cylinders at proper time based on the firing order.
- 3- Varying the timing of the spark depending on the various operating conditions

Ignition Systems (Petrol engine)

The types of ignition systems

1- Breaker point ignition (Conventional coil ignition CI)

2- Transistorized ignition TI

- Breaker-triggered (TI-B)
- Pulse generator (TI-I)
- Hall generator (TI-H)
- Photo cell generator (TI-P)

3- Semiconductor ignition SI

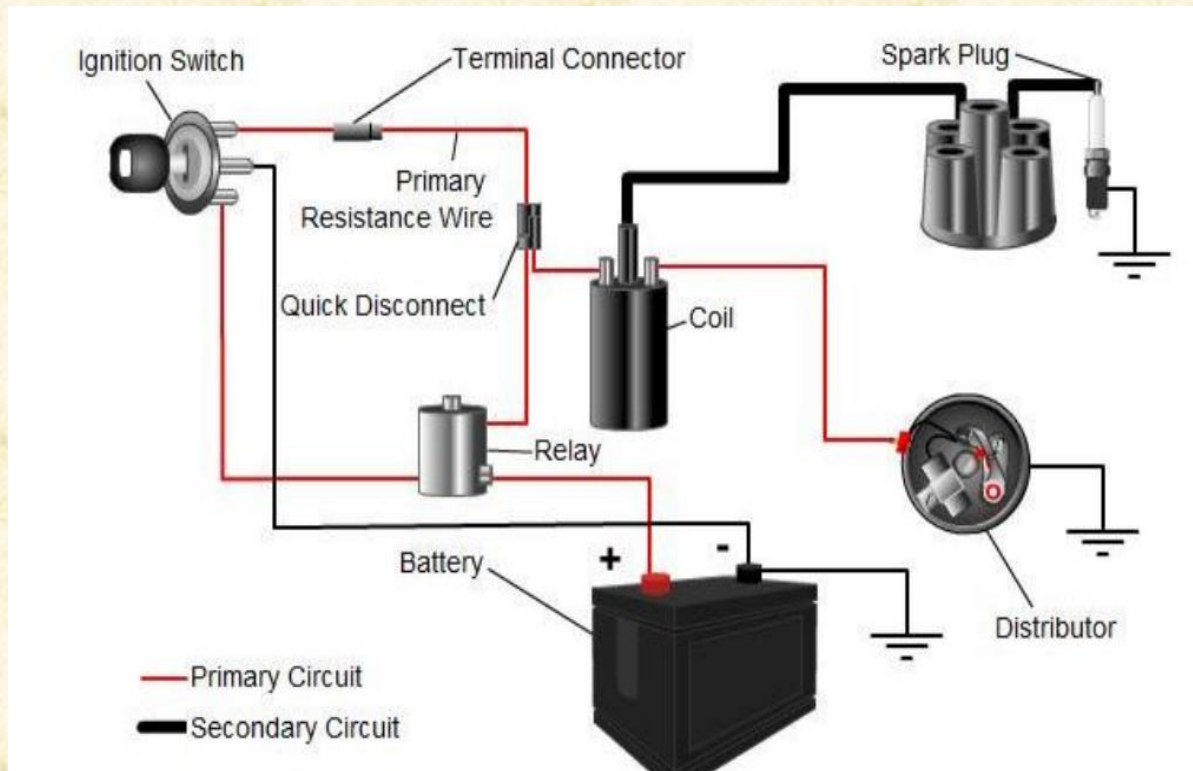
4- Electronic distributor-less ignition (DLI)

Ignition Systems

Ignition Systems (Petrol engine)

The conventional coil ignition system

This systems uses an ignition coil to perform the step up transformer action and to increase the electrical voltage.



Ignition Systems (Petrol engine)

The fundamental requirements of the high-voltage ignition source

- 1- A high ignition voltage to break down the gap between the plug electrodes;
- 2- A low source impedance or steep voltage rise;
- 3- A high energy storage capacity to create a spark kernel of sufficient size;
- 4- Sufficient duration of the voltage pulse to ensure ignition.

Components of conventional coil ignition system.

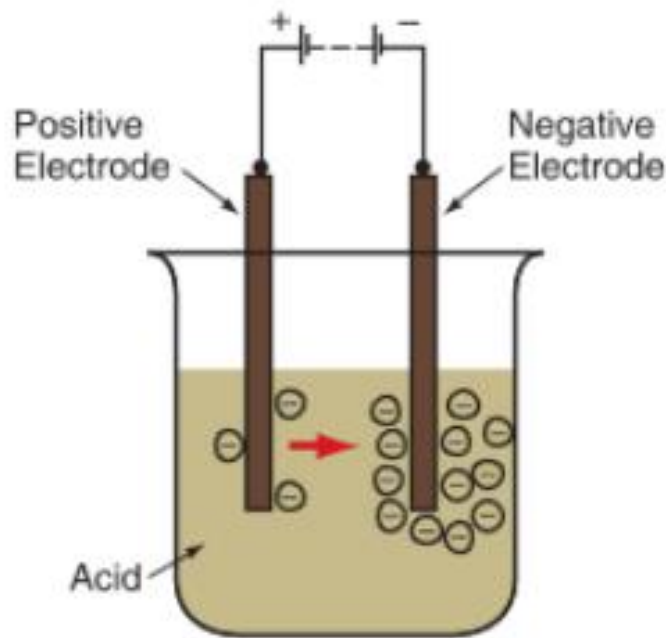
- 1- The battery supplies electricity to the system.
- 2- The ignition switch turns the system on and off.
- 3- The ignition coil strengthens the electricity from the battery.
- 4- The distributor directs the electricity to the spark plug.
- 5- The triggering device controls when the spark occurs.
- 6- The spark plug wire carries the electricity to the spark plug.

Ignition Systems

Ignition Systems (Petrol engine)

1- The Battery

Battery is the power source for the ignition . In a battery ignition system, the battery provides power to the ignition coil.



Ignition Systems

Ignition Systems (Petrol engine)

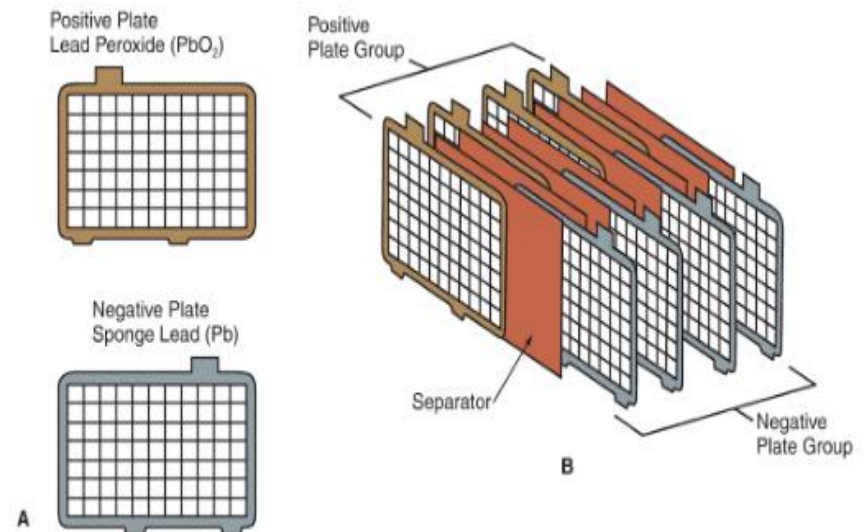
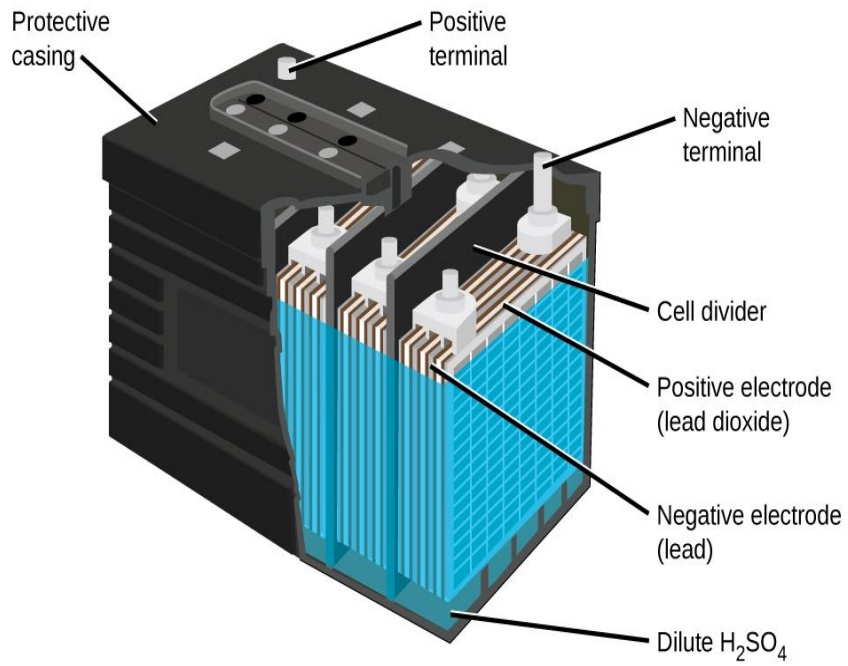
The Battery construction

Positive plates—electrodes of lead peroxide (PbO_2).

Negative plates—electrodes of finely ground or powdered lead (Pb).

Electrolyte—a solution of sulfuric acid (H_2SO_4) and water (H_2O).

Separators—material that keeps the positive and negative plates from touching and creating a short circuit.



Ignition Systems

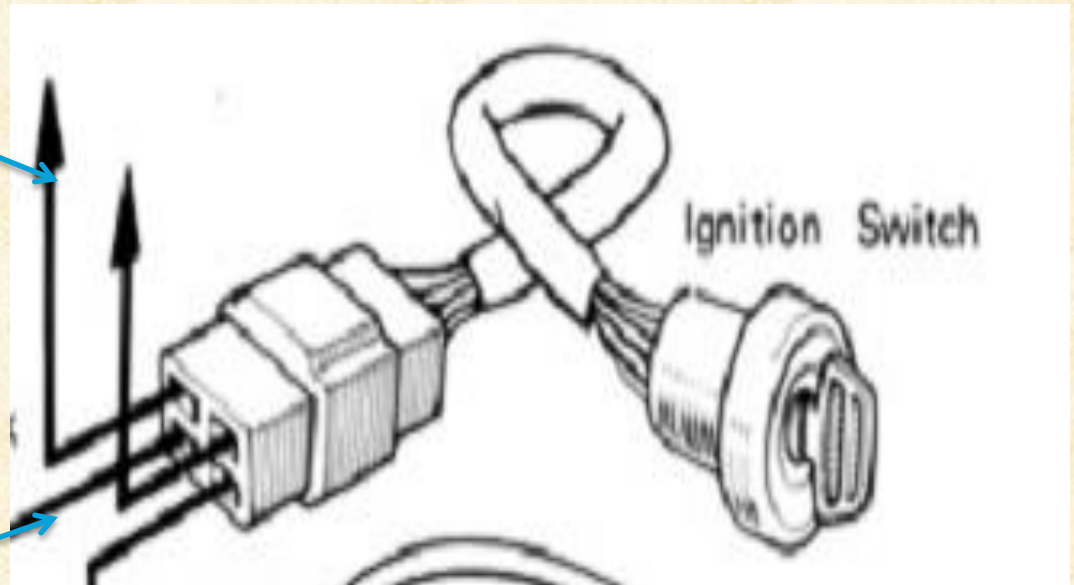
Ignition Systems (Petrol engine)

2- The Ignition Switch

The function of the ignition key is open and close the primary ignition circuit , operate the starter electrical motor.

Electrical motor circuit

Ignition circuit



Ignition Systems

Ignition Systems (Petrol engine)

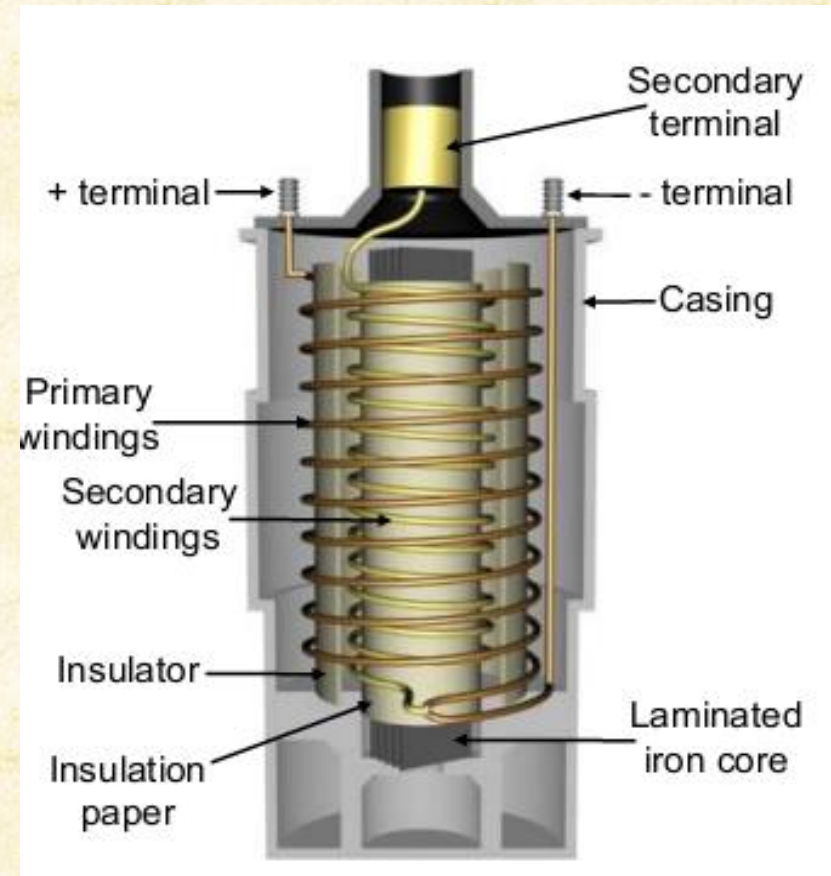
3- The Ignition Coil

the ignition coil is actually a type of electric transformer that changes low-voltage electricity to high-voltage electricity.

To distributor

From battery

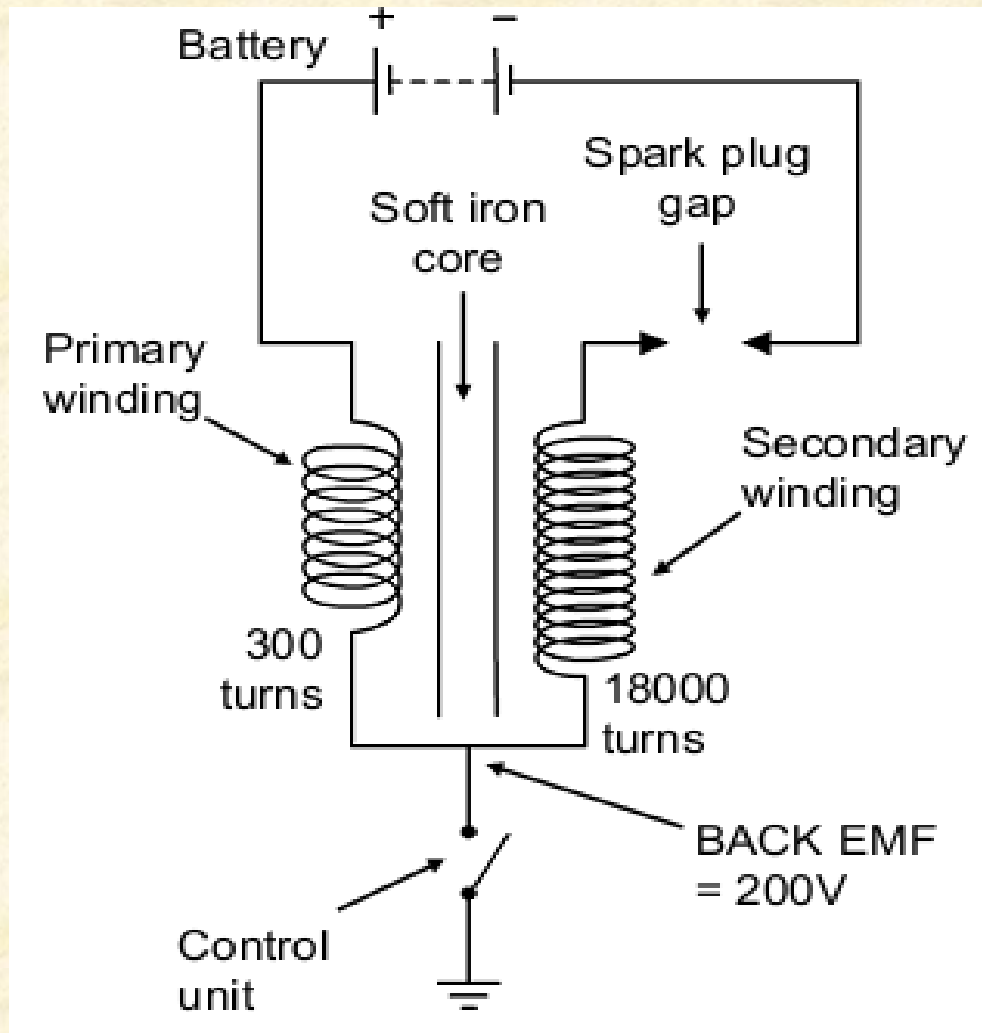
To Triggerring device



Ignition Systems

Ignition Systems (Petrol engine)

The Ignition Coil operation

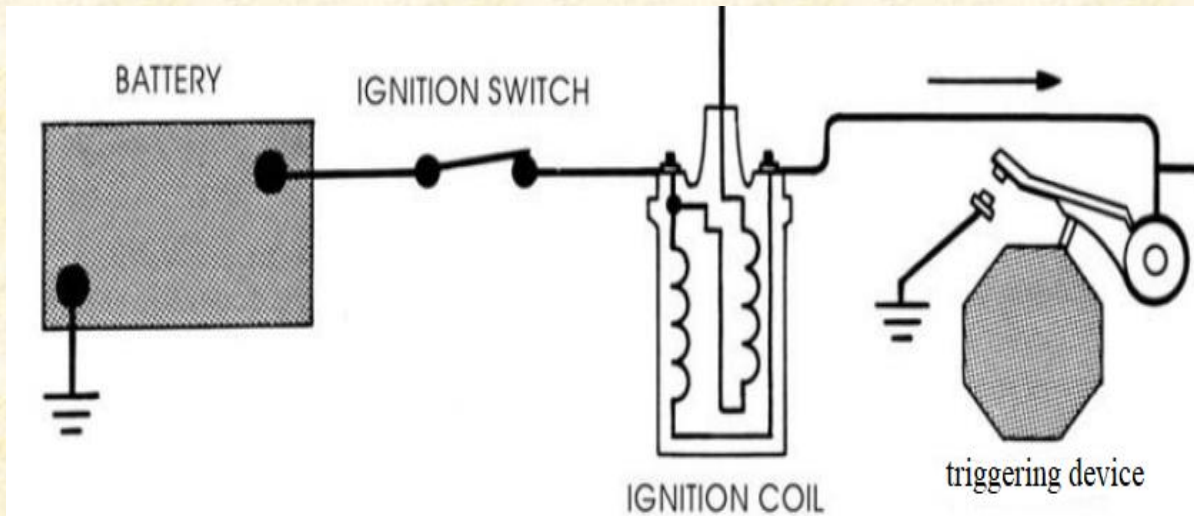


Ignition Systems

Ignition Systems (Petrol engine)

5- Triggering Device (breaker point)

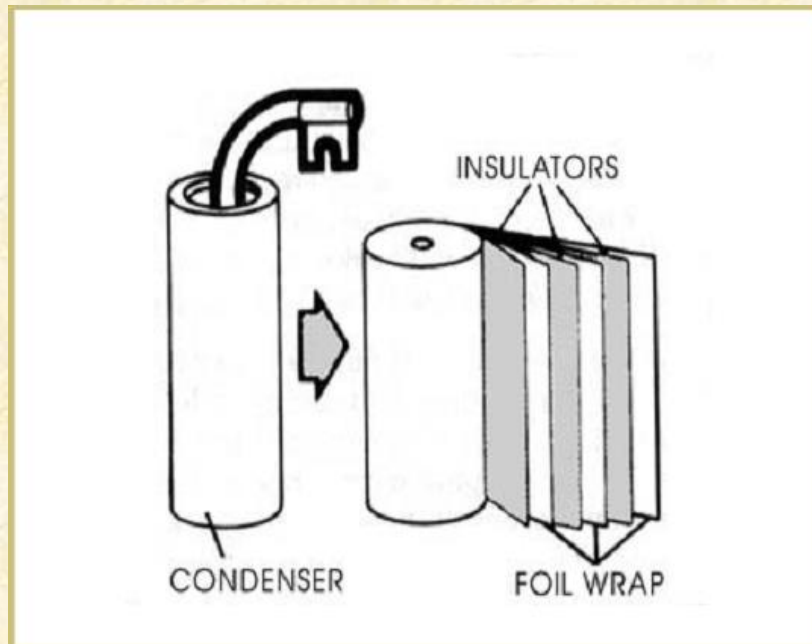
A triggering device (breaker point) works much like a switch and used to turn the primary coil winding on and off.



Ignition Systems (Petrol engine)

6- The Condenser

The construction of a condenser is quite simple. It is made of two strips of metallized paper, separated by a thin dielectric (insulator), generally of waxed paper or plastic, both rolled tightly together and fitted into a metal container.



Ignition Systems

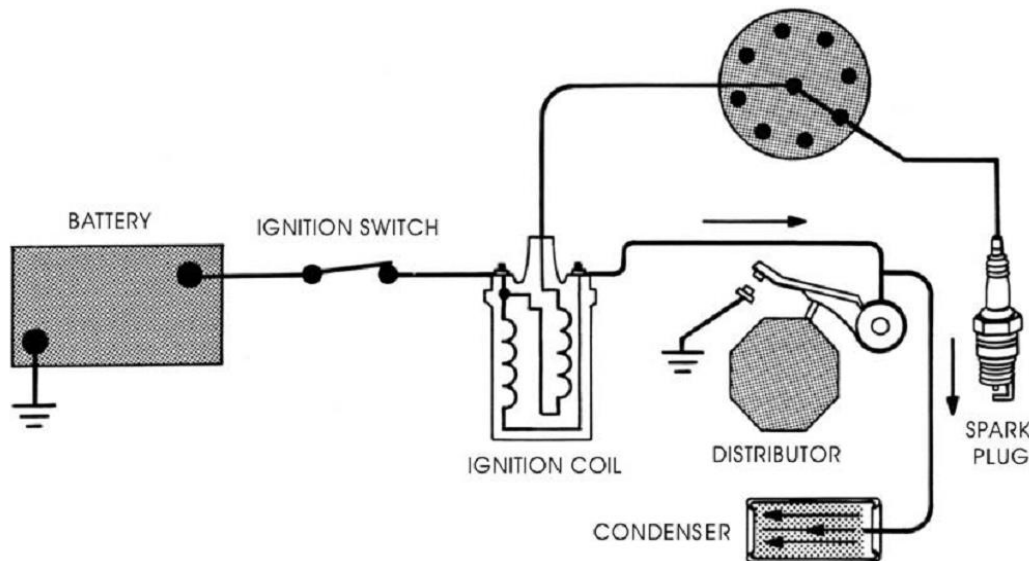
Ignition Systems (Petrol engine)

The Condenser operation

This sudden stopping of the primary current, produced by the action of the capacitor, gives an extremely fast collapse of the magnetic field. The mutually induced voltage, generated in the secondary winding at this instant will be very high.

The factors affecting the capacity of a condenser

- 1- The area of the plates holding the charges and the number of plates used.
- 2- The distance the plates are separated, i.e. the thinner the dielectric, the greater the attractive force between the charges, and therefore the higher the capacity.



- 3- The type of dielectric, e.g. plastic, mica, paper, air, etc.

Ignition Systems

Ignition Systems (Petrol engine)

7- Spark Plug wire HT Leads

Leads carry voltage from the distributor to each spark plug, constructed using a conductor and an insulator.

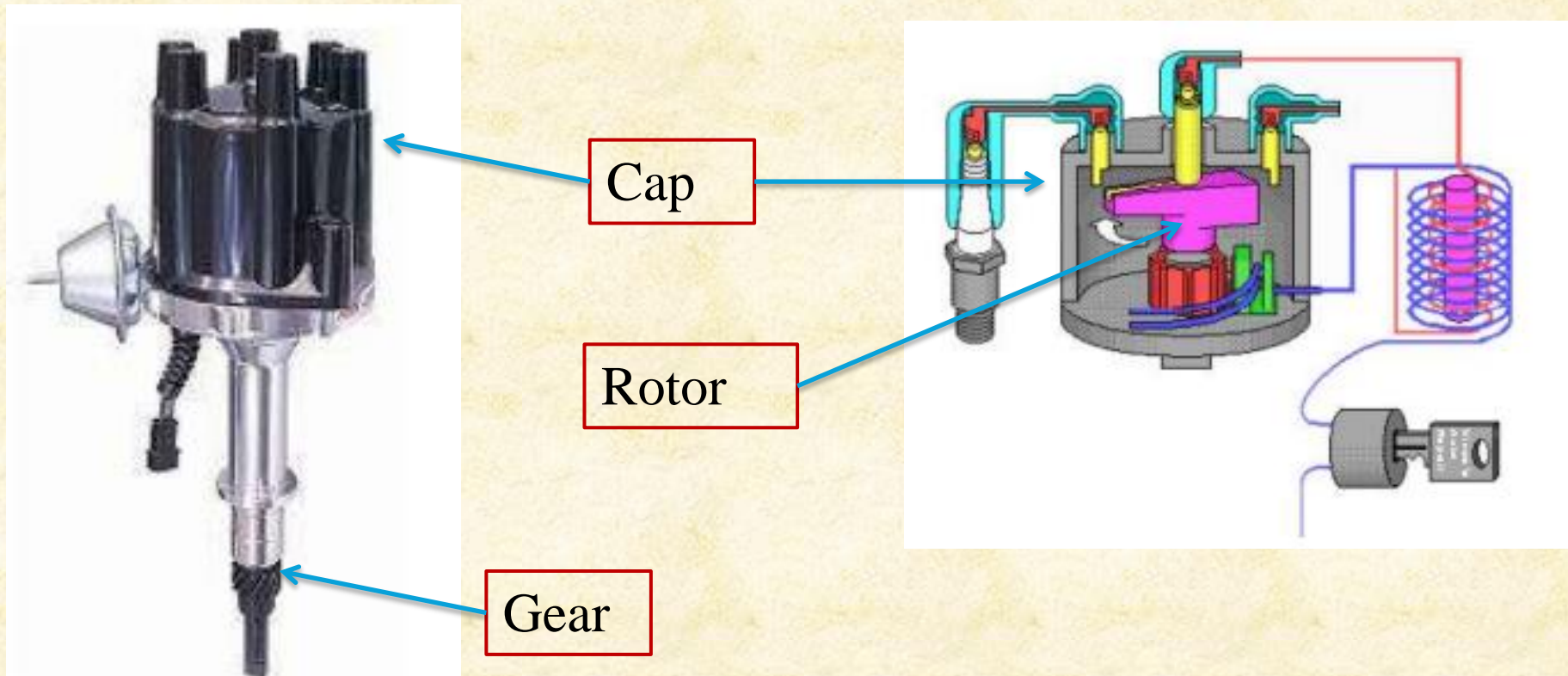


Ignition Systems

Ignition Systems (Petrol engine)

8- The Distributor

Actuates the on/off cycle of current flow through the ignition coil primary windings.
It distributes the coils high voltage to the plugs wires.

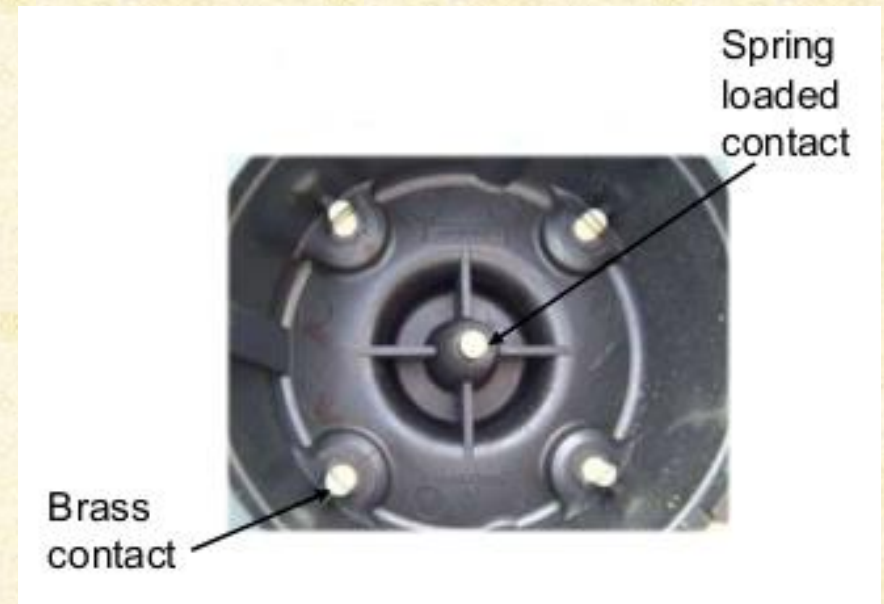
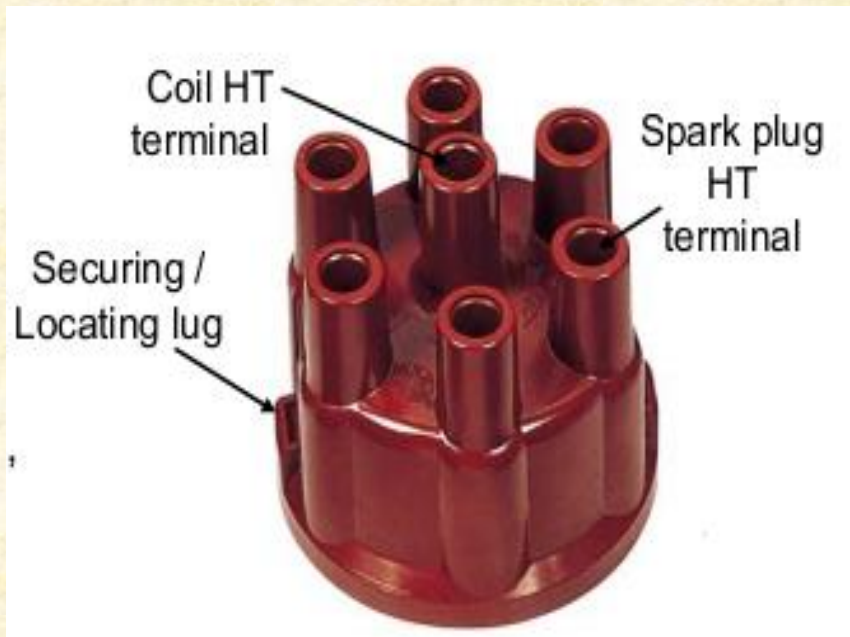


Ignition Systems (Petrol engine)

The Distributor cap

Made from hard plastic and fabricated with locating lugs or hollows to ensure accurate placement.

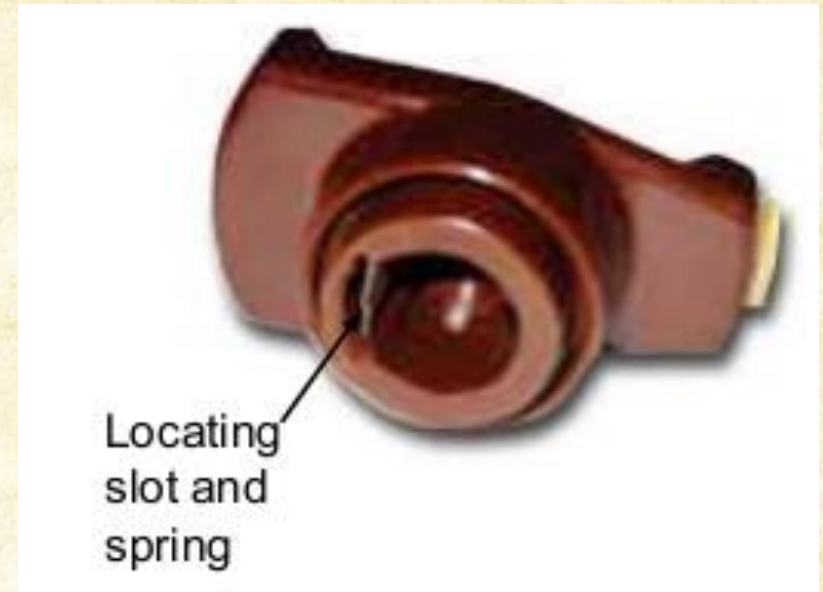
The cap has moulded HT terminals, which contain brass terminals for electrical connections to the spark plugs and the coil.



Ignition Systems (Petrol engine)

The Distributor The Rotor Arm

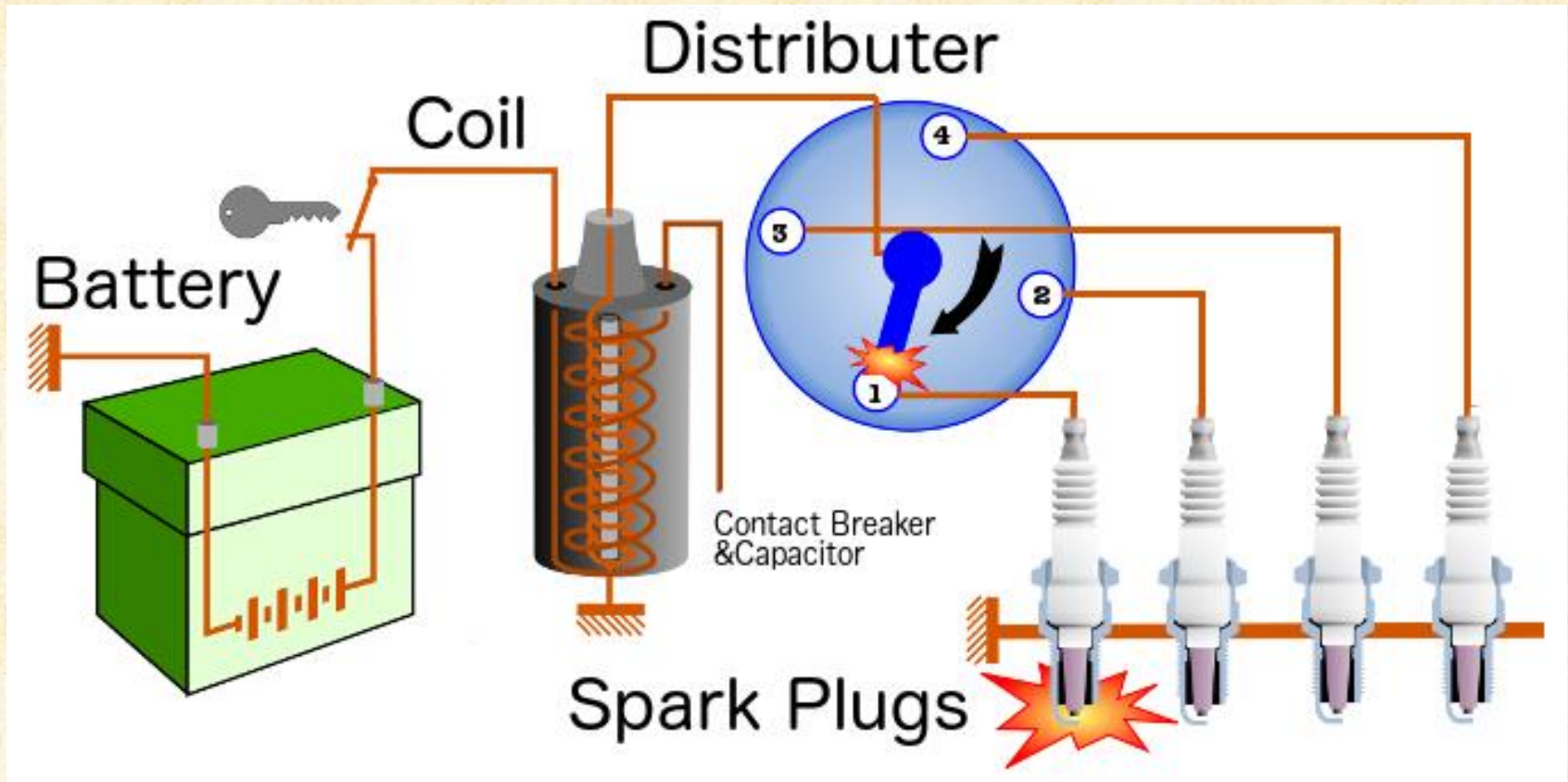
The rotor's function is to direct the high voltage from the ignition coil to the spark plugs.



Ignition Systems

Ignition Systems (Petrol engine)

The Distributor operation

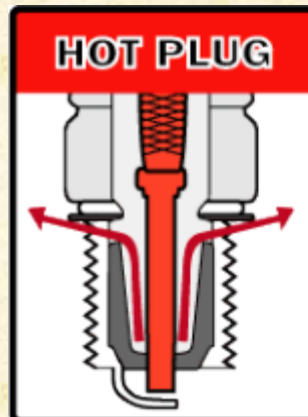
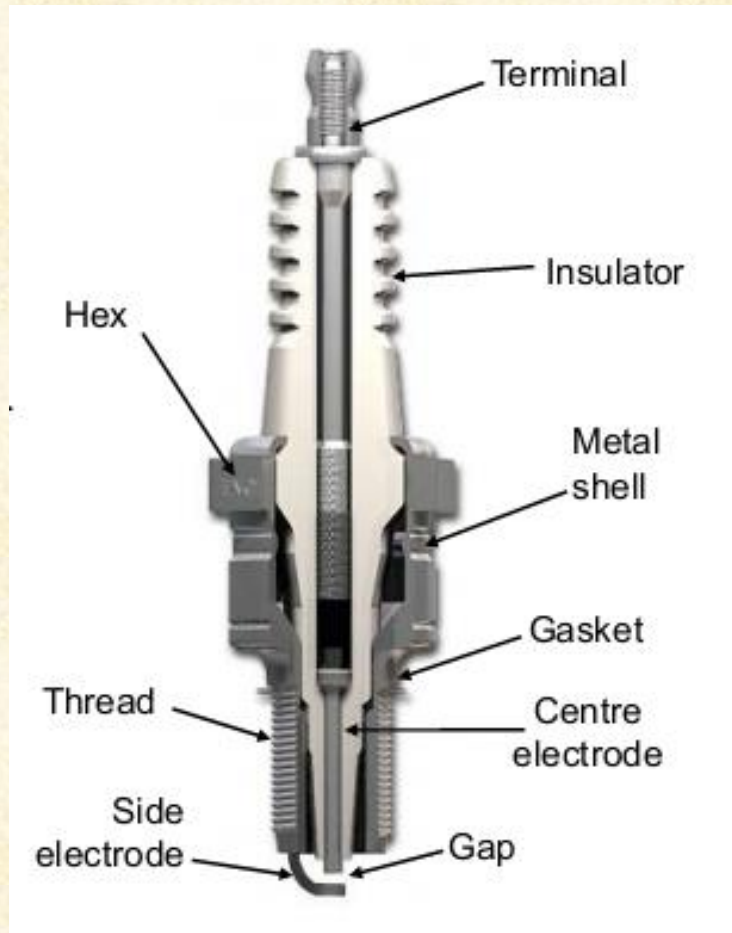


Ignition Systems

Ignition Systems (Petrol engine)

9- Spark Plugs

Spark plug is located in the cylinder head, it ignites the air and fuel mixture.



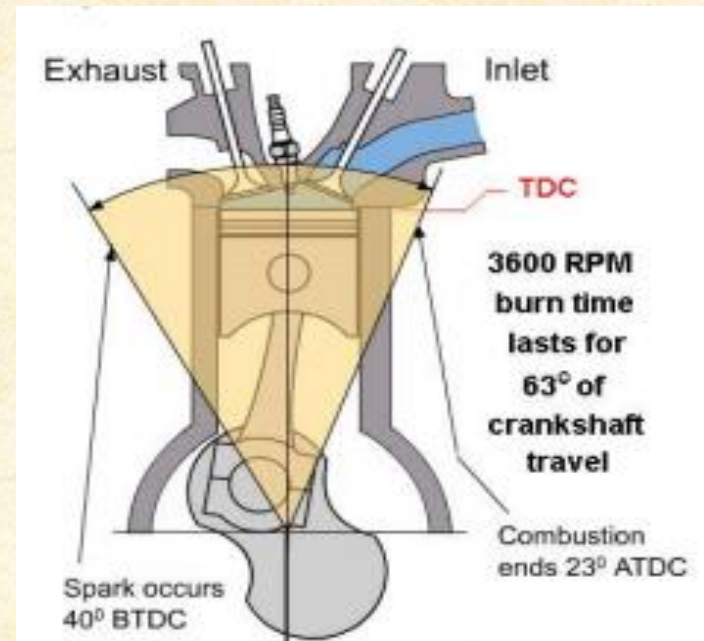
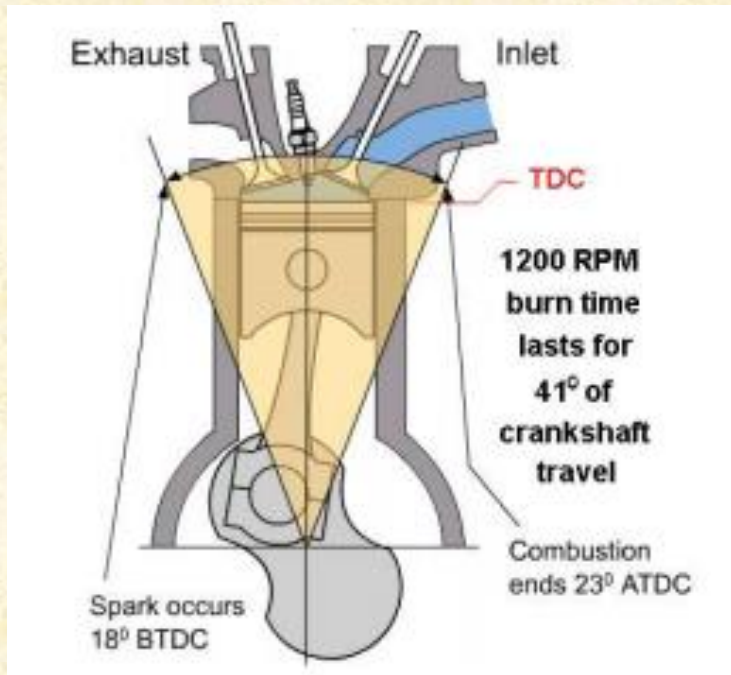
Ignition Systems

Ignition Systems (Petrol engine)

Changes ignition timing

A spark has to occur at precisely the right moment in an engine cycle, to ignite a pressurized mixture of air and fuel. This is known as ignition timing.

Ignition Timing Change Due to Engine Speed



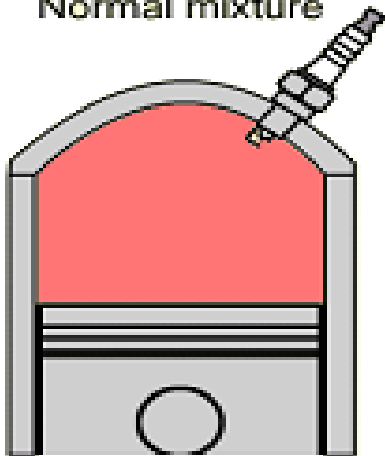
Ignition Systems

Ignition Systems (Petrol engine)

Changes ignition timing

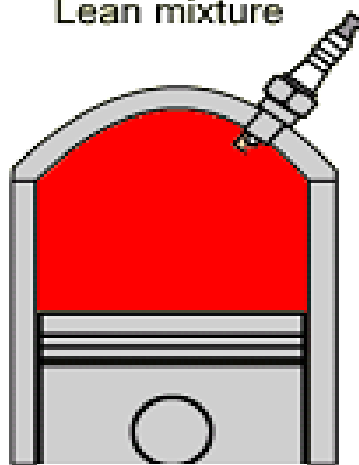
Ignition Timing Change Due to Engine Load

Normal mixture



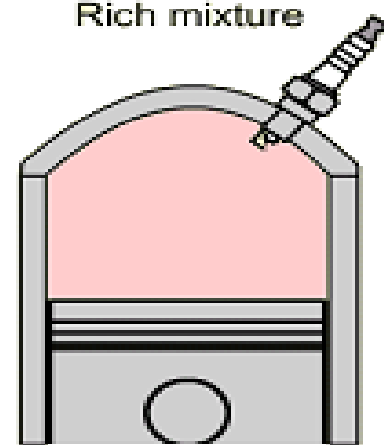
Normal burn time.
Maximum combustion
pressure a few
degrees after TDC

Lean mixture



Long burn time.
Maximum
combustion
pressure too late

Rich mixture



Short burn time.
Maximum
combustion
pressure too early

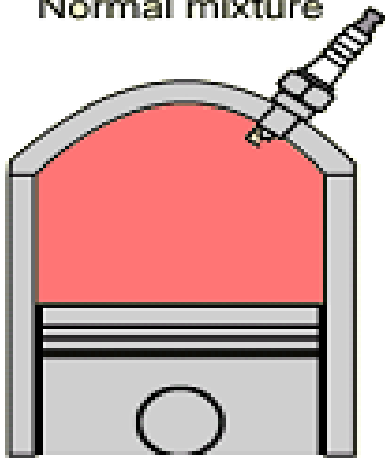
Ignition Systems

Ignition Systems (Petrol engine)

Changes ignition timing

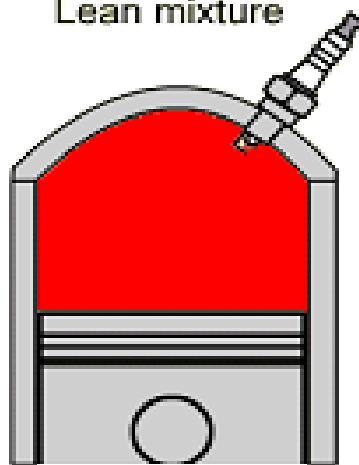
Ignition Timing Change Due to Engine Load

Normal mixture



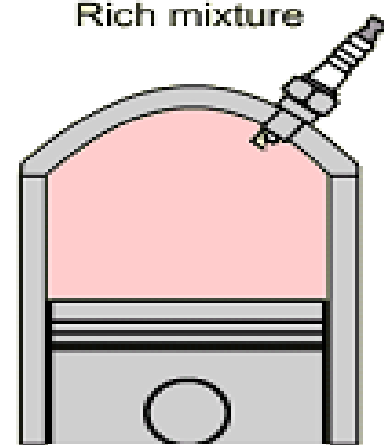
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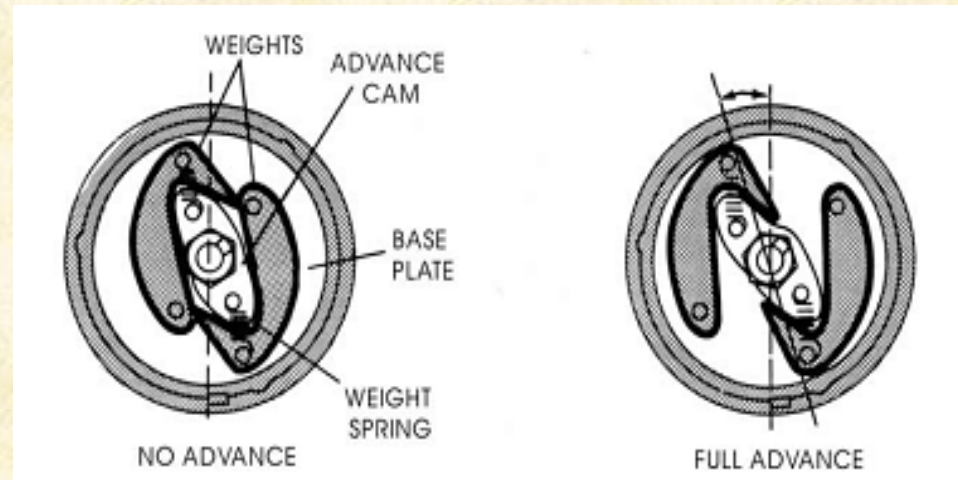
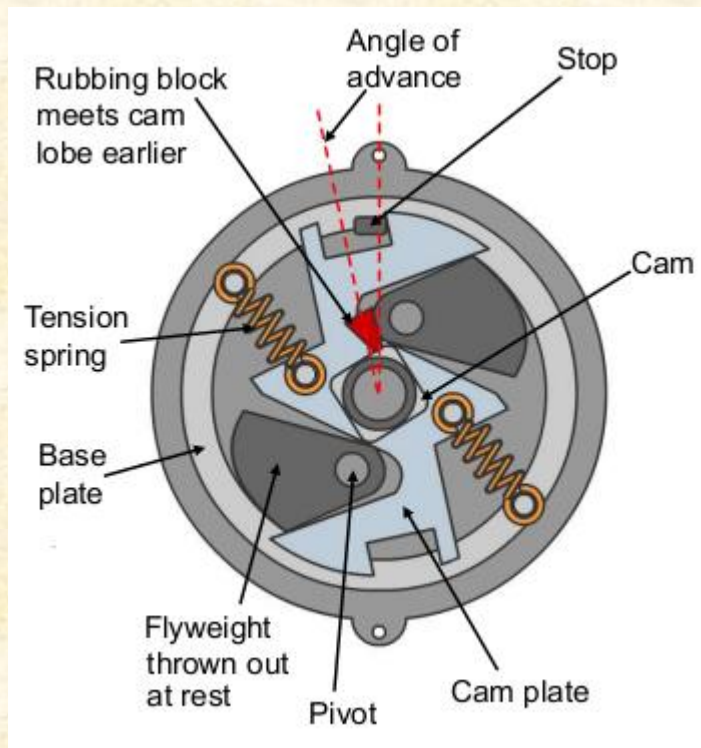
Short burn time.
Maximum
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Ignition Systems

Ignition Systems (Petrol engine)

Changes ignition timing

Centrifugal Advance Mechanisms



Ignition Systems

Ignition Systems (Petrol engine)

Changes ignition timing

Vacuum Advance Mechanisms

