

## 2 UNIT- IV

### IGNITION SYSTEM.

#### Introduction:

The Internal Combustion engines generate power by burning the air-fuel mixture in its cylinder.

There are two methods to ignite the fuel.

\* In petrol engine, electric sparks are generated at regular intervals of time for the igniting the air-fuel mixture.

\* In diesel engine, air is compressed & becomes hot, at the end of the compression stroke diesel is injected by injector so the fuel gets ignited due to compression.

#### Types of Ignition System:

- (i) Battery coil Ignition System
- (ii) Magneto coil Ignition System
- (iii) Electronic Ignition System
- (iv) Transistorized Ignition System.

# BATTERY COIL IGNITION SYSTEM.

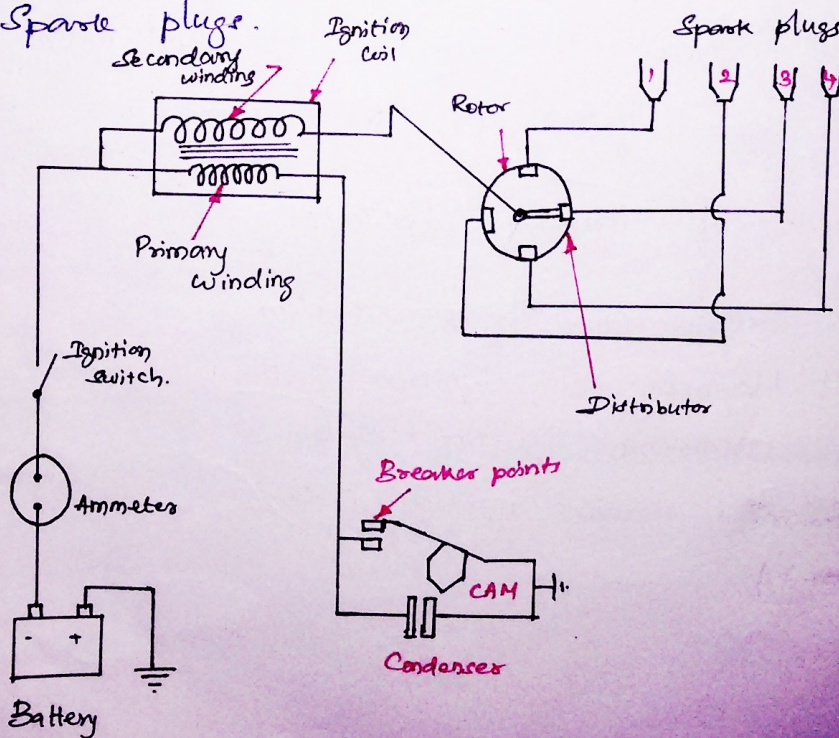
- The purpose of battery coil ignition system is to produce spark to ignite air-fuel mixture at the end of the compression strokes.

- It is used in petrol engines.

The power required produce spark is delivered by the battery.

It consists of

- \* Battery
- \* Ignition coil
- \* Distributor (breakers points, Cam, rotor, distributor cap) advance mechanisms
- \* Spark plugs.



## Battery:

The battery is the primary source for this type of Ignition System. Usually the battery used here will supply 12V (or 6V) to the Ignition coil.

## Ignition coil:

The Ignition coil is like a transformer. It consists of primary & secondary winding which is used to convert low voltage current into high voltage current.

## Contact breaker arm:

It is to break primary circuit at the correct timing so that the secondary winding of the Ignition coil produces high voltage (25,000V).

## Distributor:

### Cam:

Opens the contact breaker points depending on the Crank shaft angle for each cylinder.

### Condenser (Capacitor)

Suppresses the spark generated between breaker points upon their opening to increase the secondary coil voltage.

Centrifugal governor advances:

Advances the Ignition timing according to the engine speed.

Vacuum advances:

Advances the Ignition timing according to the engine load (intake manifold vacuum)

Distributor Cap:

Distributes high tension current from the rotor to the high tension cord of each cylinder.

Rotor:

Distributes the high tension current generated by the Ignition coil to each spark plug.

High Tension Cords:

Carry the high-tension current from the Ignition coil to the spark plugs.

Spark plugs:

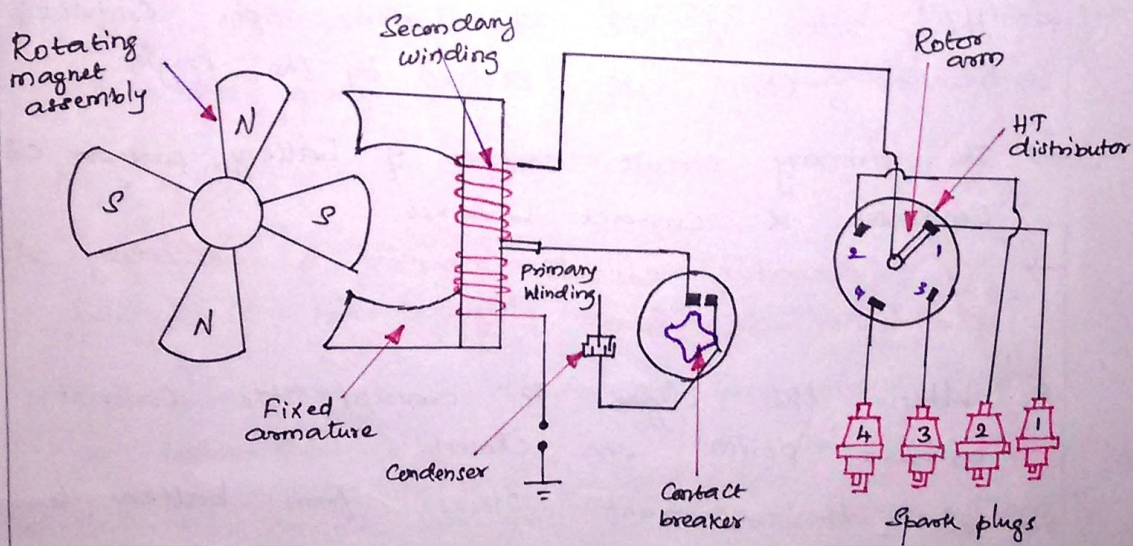
Spark plug converts high voltage into spark.

Working:

\* Generally the battery used in this system is 6V or 12V.

- \* This current flow causes a magnetic field to build up the ignition coil.
- \* When the moving contact breaker opens the contacts, the magnetic field is collapsed & a very high voltage (25000v to 30000 v) is generated in the secondary winding.
- \* This voltage is directed to the spark plugs by the distributor.
- \* This high voltage in spark plug produces spark when it tries to cross the gap of spark plug.

### MAGNETO COIL IGNITION SYSTEM :



Magneto coil ignition system for - four cylinder engine.

- \* The Ignition coil consists of two windings namely primary & secondary winding.
- \* The primary winding contains less number of winding of thick wire.
- \* The secondary winding contains more number of windings of thin wire.
- \* A Condenser is connected across the contact breaker. to avoid arcing & pitting of contact breaker points.
- \* The contact breaker is housed in the distributor and it makes and breaks the primary ignition circuit.
- \* The function of the distributor is to distribute the high voltage to the spark plugs, according to the firing order.
- \* The rotor of the distributor and contact breaker cam are driven by the engine.
- The primary circuit consists of battery, primary coil, Condenser & Contact breaker.
- The secondary circuit consists of secondary coil, distributor & Spark plugs.
- \* When the engine is cranked, the contact breaker points are closed.
- \* So the current flows from battery to the contact breaker points through the switch and primary winding & then returns to the battery through earth.

- \* This produces the magnetic field in the primary winding. When the electro magnetism in primary winding is at the peak level, the contact breaker points are opened due to cam action.

When the contact breaker points are opened.

- \* The magnetic field in the primary winding is suddenly collapsed.
- \* A high voltage of up to 15,000 V is induced in the secondary winding.
- \* The high voltage is given to the spark plug through the distributor from primary winding.
- \* The high voltage tends to jump across the air gap in the spark plug & thus producing the spark.

### Merits

- \* Battery is not required
- \* Good spark strength is obtained at higher speeds
- \* Compact & occupies less space
- \* Maintenance is not necessary

### Demerits.

- \* Initial cost is ↑
- \* Spark strength is low at low engine speed.
- \* Suitable for small capacity engine
- \* Wear of contact points is continuous.

\* It is same as battery coil ignition system

\* Instead of battery, the magnet itself generates current & delivers to the primary circuit.

Works based on the principle of electromagnetic induction.

### Construction:

\* The magneto ignition system consists of a rotating magnet assembly driven by engine & a fixed armature.

\* The armature consists of primary & secondary windings.

⇒ The primary circuit consists of a primary winding, condenser and contact breaker.

⇒ The secondary circuit consists of a secondary winding, distributor and spark plugs.

### Working:

When contact breaker points are closed.

\* The <sup>rotating</sup> magnet induces current in primary winding.

\* The current will flow from the primary winding to the contact breaker and then to the condenser.



## Spark Advance Mechanisms:

- Ignition should take place correctly at the end of the compression stroke.

- Due to this, complete combustion takes place at correct time & gives max. pressure on the piston head.

- This will happen when the piston is at TDC. But the air-fuel mixture will take some time for complete combustion to give max pressure. So ignition should take place before the piston reaches TDC.

i.e., the ignition should take place a few degrees earlier of crank-shaft rotation when the piston reaches TDC.

There are two types of Spark advance Mechanism:

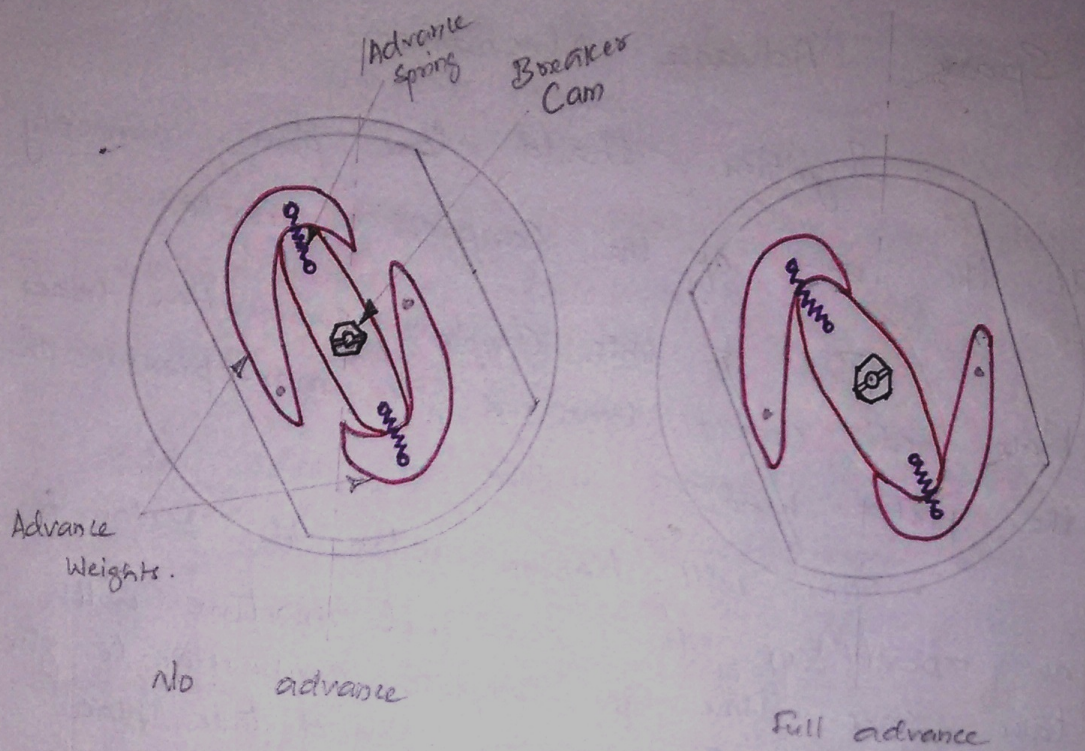
\* Centrifugal Advance mechanism

\* Vacuum advance mechanism.

### Centrifugal advance mechanism:

- The Ignition is advanced according to the speed of the engine.

- As the engine speed increases, the two weights hinged are thrown out against Spring tension.



- The weights are hinged  $x$  and are moved outwards by the centrifugal action, resulting in change of angular reaction of the driving  $x$  driven shafts.

- This movement is transmitted to the breaker cam through a toggle arrangement or to the timer core on a magnetic pick-up type of distributor.

- At high speeds, the cam opens and closes the contact points earlier due to this advance in the case of the contact points distributor and in the case of magnetic pick up distributor, the timer core advance making the pick-up coil to

Send its signals to the transistor control unit in advance.

- When the engine is running on slow speed, the weights do not fly out much and the spring keeps the cam in low advance.

- But when the engine runs at high speed, the weights will fly out due to centrifugal force making the cam to run in advance, resulting in opening the contact points in advance.

- The weights will move beyond the cam and rotates opposite to the direction of rotation of the distributor.

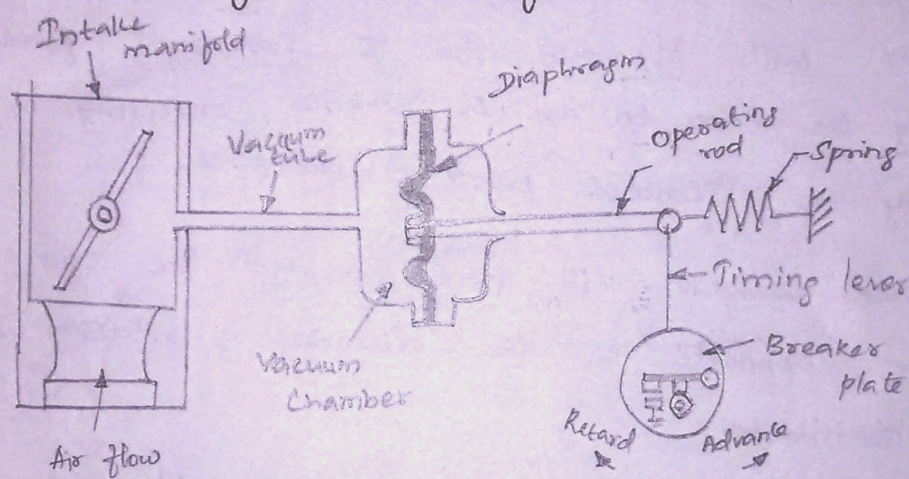
- So the contact point position will come certain before & open the circuit.

- The advance mechanism works according to various speeds of the engine & not on various load conditions!

### Vacuum Spark Advance Mechanism:

- When the engine load is increasing, the ignition timing should be adjusted to suit the load.

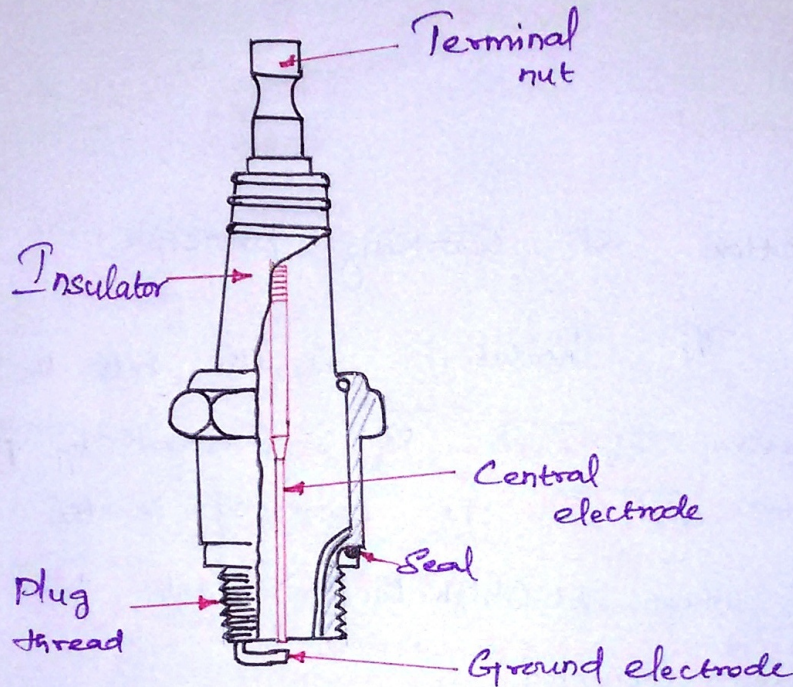
- Suppose a particular ignition timing is arranged for quarter load, the same arrangement will not be suitable for full load & a separate arrangement is required for controlling the position of advance ignition timing.



### Construction:

It consists of a diaphragm which is capable of advancing or retarding the ignition timing automatically according to vacuum created by the intake manifold of the engine.

## Spark plug:



Spark plug is a device used to produce sparks in Automobile Engines (SI). The engines (petrol) which use spark plugs for ignition during power stroke are named as Spark Ignition SI Engines.

→ In SI engines the spark plugs are used to ignite the air-fuel mixture at the end of the compression stroke.

→ The spark plugs are mounted on the top of the cylinder, so that its electrodes project in the combustion chamber.

# Types of Spark plug:

According to the purpose

\* Detachable

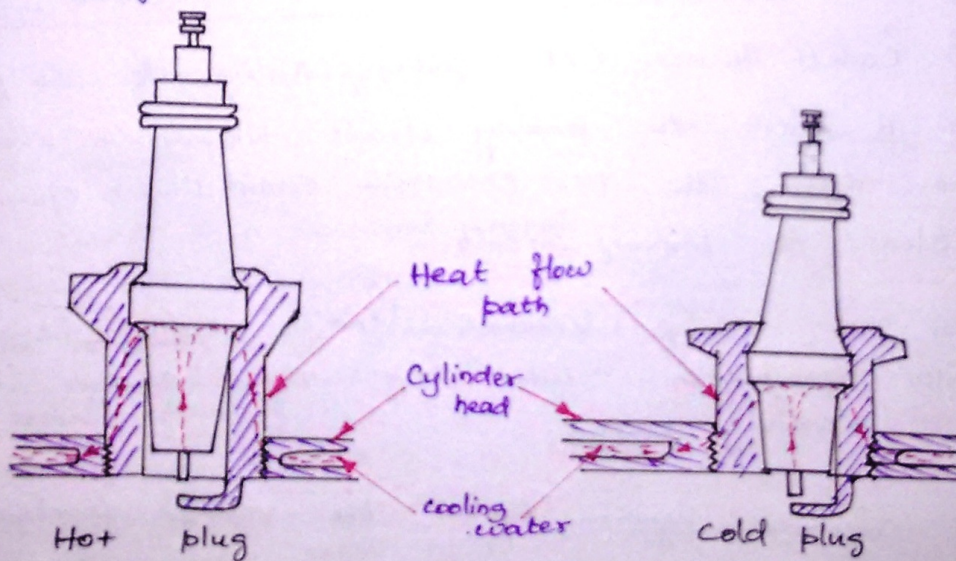
\* Non Detachable

According to the Temperature range

\* Hot plug

\* Cold plug

In automobiles detachable type spark plugs are widely used, as they require maintenance. These detachable spark plugs are cleaned after a particular time / km duration of a vehicle. They contain carbon deposits, dust etc... The gap between the central & ground electrodes are periodically checked while servicing & adjusted if required.



→ Heat transfer distance is more

less.

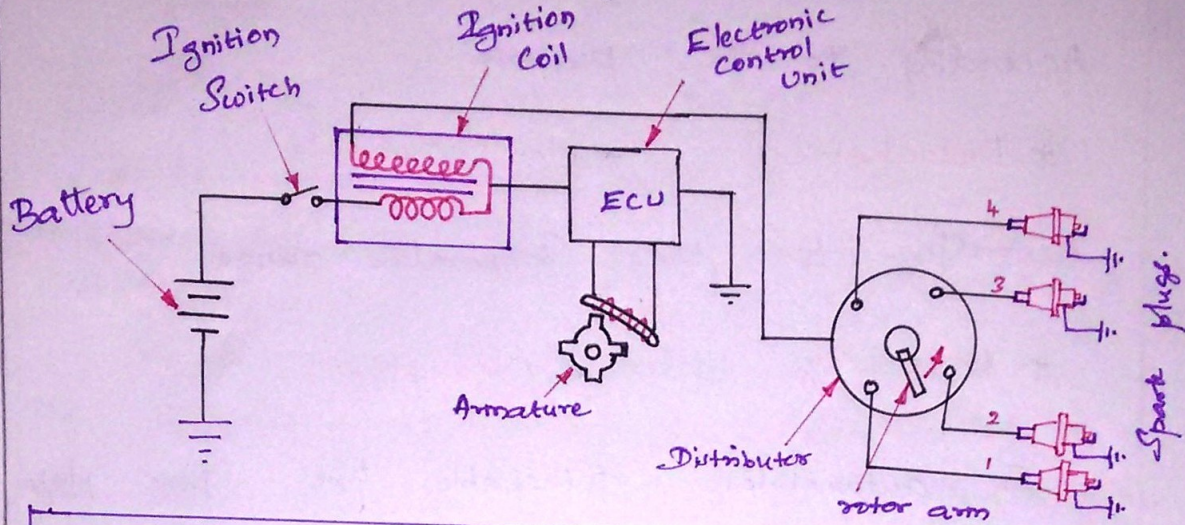
→ Takes long time to cool

less time

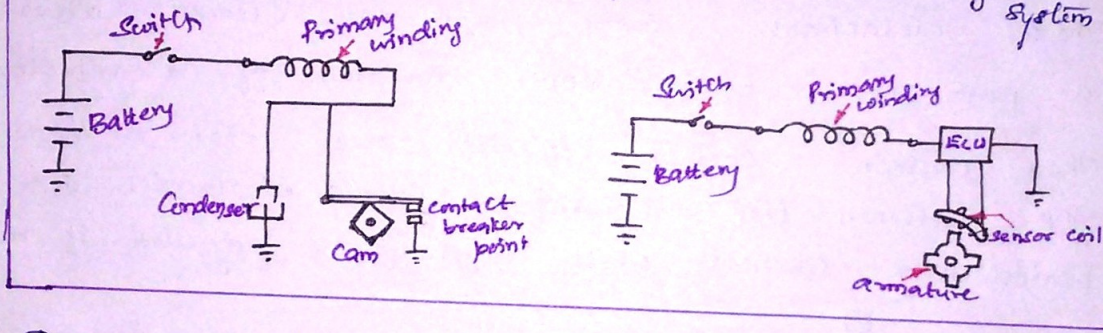
→ Used in light & medium duty vehicles

heavy duty & high-speed vehicles.

# Electronic Ignition System



## Difference between Cb Ignition & electronic Ignition System



- In Contact breaker (Cb) Ignition system, the Cb points open & close the primary circuit. Whereas in Electronic Ignition system, the ECU (Electronic Control Unit) opens & closes the primary circuit.
- Both the Cb & electronic Ignition system have similar construction with some slight changes in the secondary circuit.
- In electronic Ignition system, the voltage developed is high & sometimes 47000 volts. So the Ignition coil, distributor & wiring are such that altered to handle this very high voltage.

## Working principle - Electronic Ignition System

\* A timer is used in the distributor of EI system

\* It sends electrical pulses to ECU which switches off the flow of current to the primary winding.

as a result high voltage is induced in the secondary winding which is distributed to the spark plug in the case of the CB ignition system.

The electronic control unit later switches on the flow of current to the primary circuit so that the primary circuit current can build up for the next cycle.

The timer may be a pulse generator.

### Pulse Generator:

→ It consists of a permanent magnet, a timer coil & a reluctor.

→ The reluctor is the rotary component in the pulse generator where others remain stationary.

→ The reluctor <sup>shape</sup> consists of a wheel with teeth.

→ As the reluctor rotates along with distributor shaft, its teeth move near to the pole plates of the PM (permanent magnet), which cause strong magnetic field around timer coil.

→ Current is permitted to flow through the timer coil to ECU, where the primary current flows, which results the ignition coil builds up a strong magnetic field.

