CHAPTER-06 LUBRICATION SYSTEM IN AUTOMOBILE

Functions of lubricating oil: A good lubricating oil should perform the following function.

- It reduces the friction between the moving parts.
- It cools the piston so it also acts as a cooling medium.
- It also prevents the leakage of gas between the piston and cylinder because it makes a film of lubricant between them.
- It also reduces the noise between the rubbing surfaces.

The various lubrication systems used for lubricating the various parts of engine are classified as

1. Mist lubrication system
2. Wet sump lubrication system, and
3. Dry sump lubrication system.

1. Mist lubrication system:

Mist lubrication system is a very simple type of lubrication. In this system, the small quantity of lubricating oil (usually 2 to 3%) is mixed with the fuel (preferably gasoline). The oil and fuel mixture is introduced through the carburetor. The gasoline vaporized and oil in the form of mist enters the cylinder via the crank base. The droplets of oil strike the crank base. The droplets of oil strike the crank base, lubricate the main and connecting rod bearings and the rest of the oil lubricates the piston, piston rings and cylinder.

The system is preferred in two stroke engines where crank base lubrication is not required. In a two-stroke engine, the charge is partially compressed in a crank base, so it is not possible to have the oil in the crank base.

This system is simple, low cost and maintenance free because it does not require any oil pump, filter, etc. However, it has certain serious disadvantages. Therefore, it is not popular among the lubrication system. Its disadvantages are the following:

1. During combustion in the engine, some lubricating oil also burnt and it causes heavy exhaust and forms deposits on the piston crown, exhaust port and exhaust system.

2. Since the lubricating oil comes in contact with acidic vapours produced during the combustion, it gets contaminated and may result in the corrosion of the bearings surface.
3. When the vehicle is moving downhill, the throttle is almost closed, and the engine suffers lack of lubrication as supply of fuel is less. It is a very serious drawback of this system.
4. There is no control over the supply of lubricating oil to the engine. In normal operating conditions, the two-stroke engines are always over-oiled. Thus consumption of oil is also more.
5. This system requires thorough mixing of oil and fuel prior to admission into the engine. It requires either separate mixing or use of some additives.

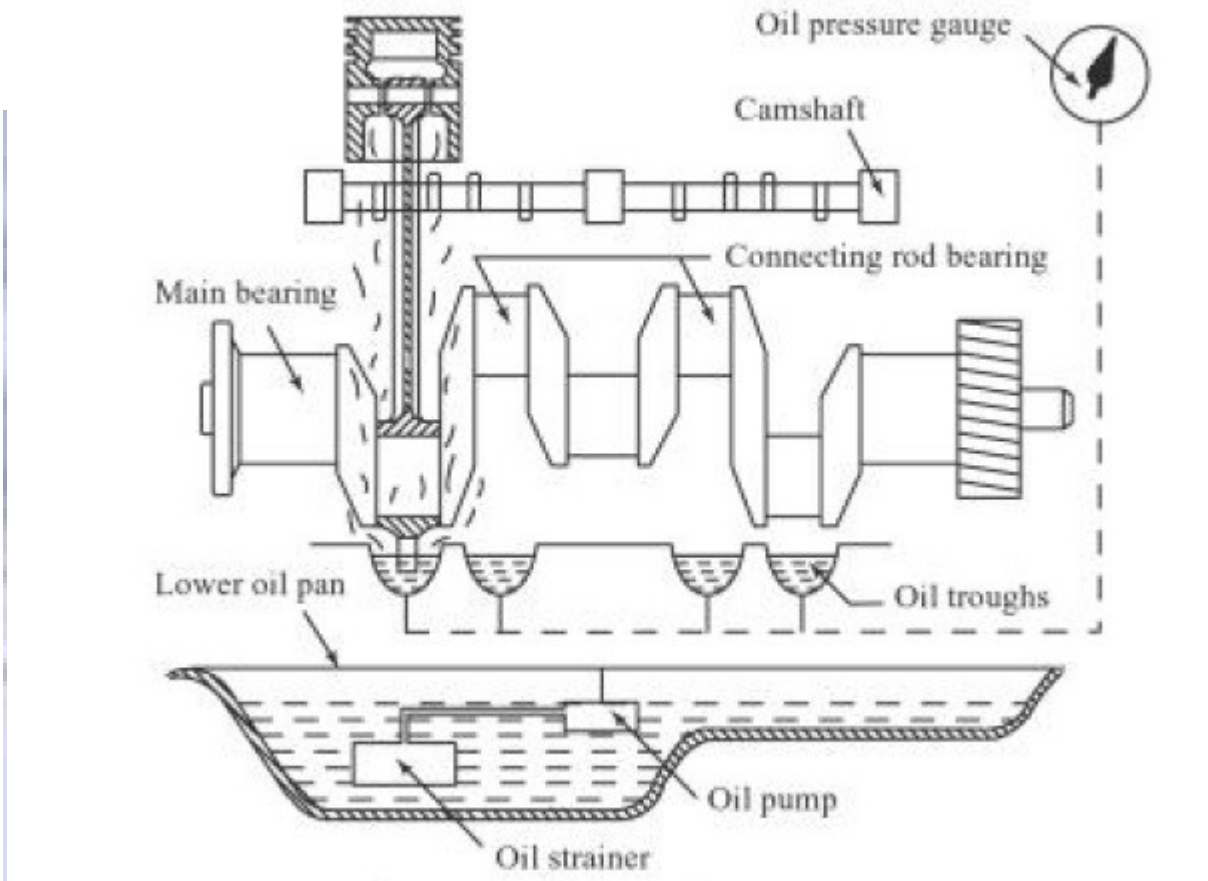
2. Wet-sump lubrication system:

In the **wet-sump lubrication system**, the bottom of the crank case contains an oil pan or sump that serves as oil supply, oil storage tank and oil cooler. The oil dripping from the cylinders, bearings and other parts, fall under gravity back into the sump, from where it is picked up by pump and recirculated through the engine lubrication system. There are three varieties in wet-sump lubrication system. They are:

1. Splash lubrication system
2. Splash and pressure system and
3. Pressurized lubrication system.

2.1 Splash lubrication System:

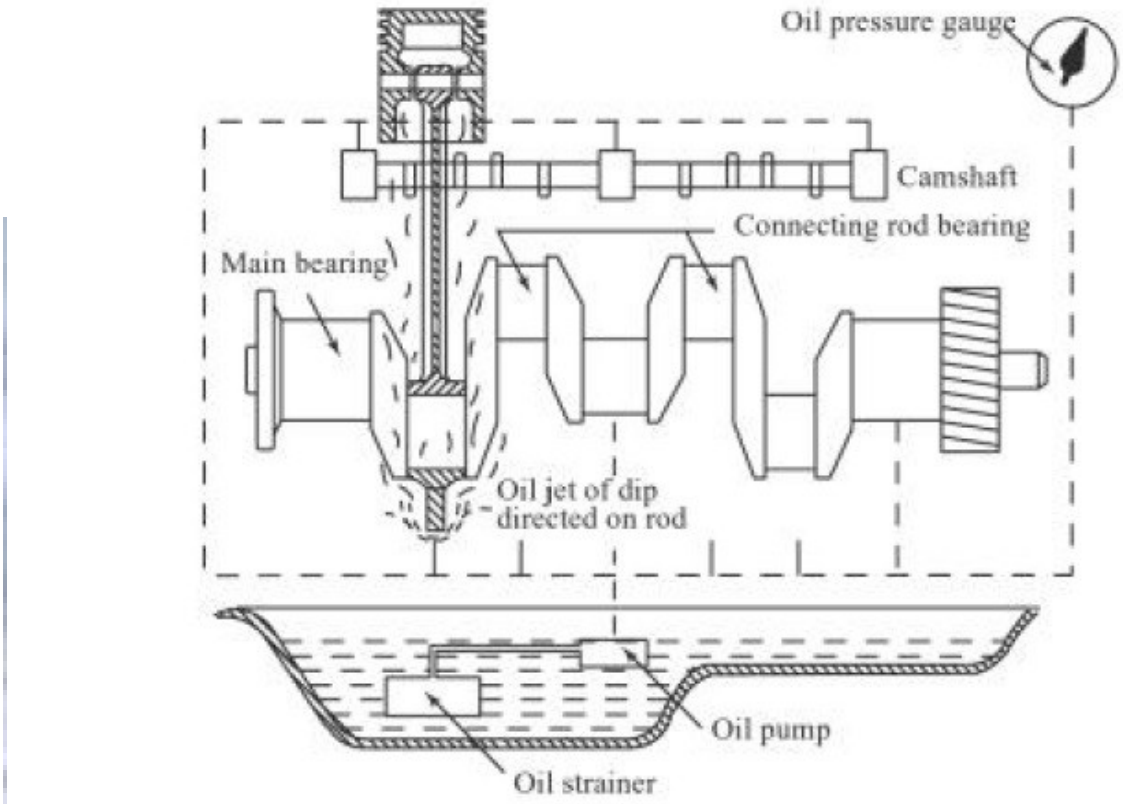
Splash lubrication system is used on small, stationary four-stroke engines. In this system, the cap of the big end bearing on the connecting rod is provided with a scoop which strikes and dips into the oil filled through at every revolution of the crank shaft and oil is splashed all over the interior of crank case into the piston and over the exposed portion of the cylinder is shown in the figure below.



A hole is drilled through the connecting rod cap through which the oil passes to the bearing surface. Oil pockets are provided to catch the splashed oil over all the main bearings and also the cam shaft bearings. From these pockets oil passes to the bearings through drilled hole. The surplus oil dripping from the cylinder flows back to the oil sump in the crank case.

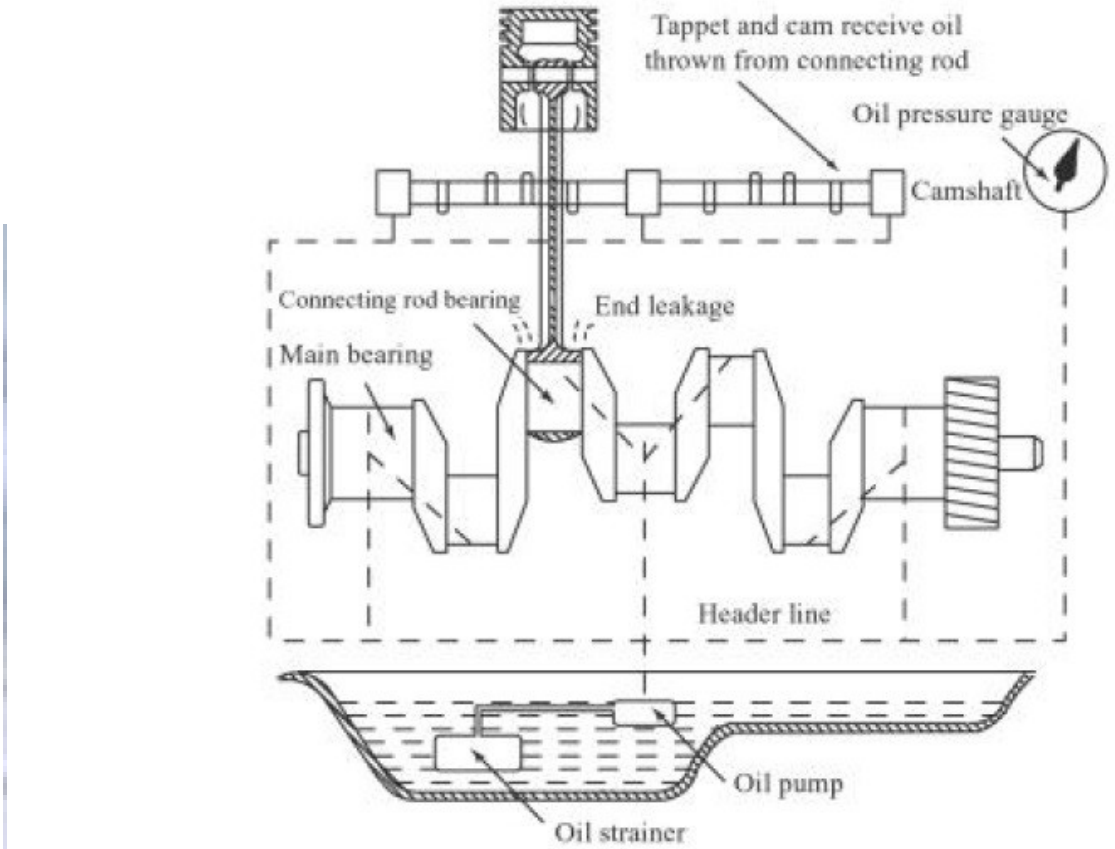
2.2 Splash and pressure lubrication system:

Splash and pressure lubrication system is combination of splash and pressure system as shown in below figure. In this system, the lubricating oil is supplied by a pump under pressure to main and cam shaft bearings. the oil is also directed in the form of spray from nozzle or splashed by a scoop or dipper on the big end to lubricate bearings at the big end of the connecting rod, crank pin, gudgeon pin, piston rings and cylinder.



2.3 Pressurized lubrication system:

In **pressurized lubrication system**, the lubricating oil is supplied by a pump under pressure to all parts requiring lubrication as shown in below figure. The oil under the pressure is supplied to main bearings of the crank shaft and camshaft. Holes drilled through the main crank shaft bearings journals, communicate oil to big end bearing and small end bearings through the hole drilled in the connecting rod. a pressure gauge is provided to confirm the circulation of oil to various parts.



This system provides sufficient lubrication to all parts and is favoured by most of the engine manufacturers. This is used in most heavy duty and high-speed engines.

3. Dry-sump lubrication system:

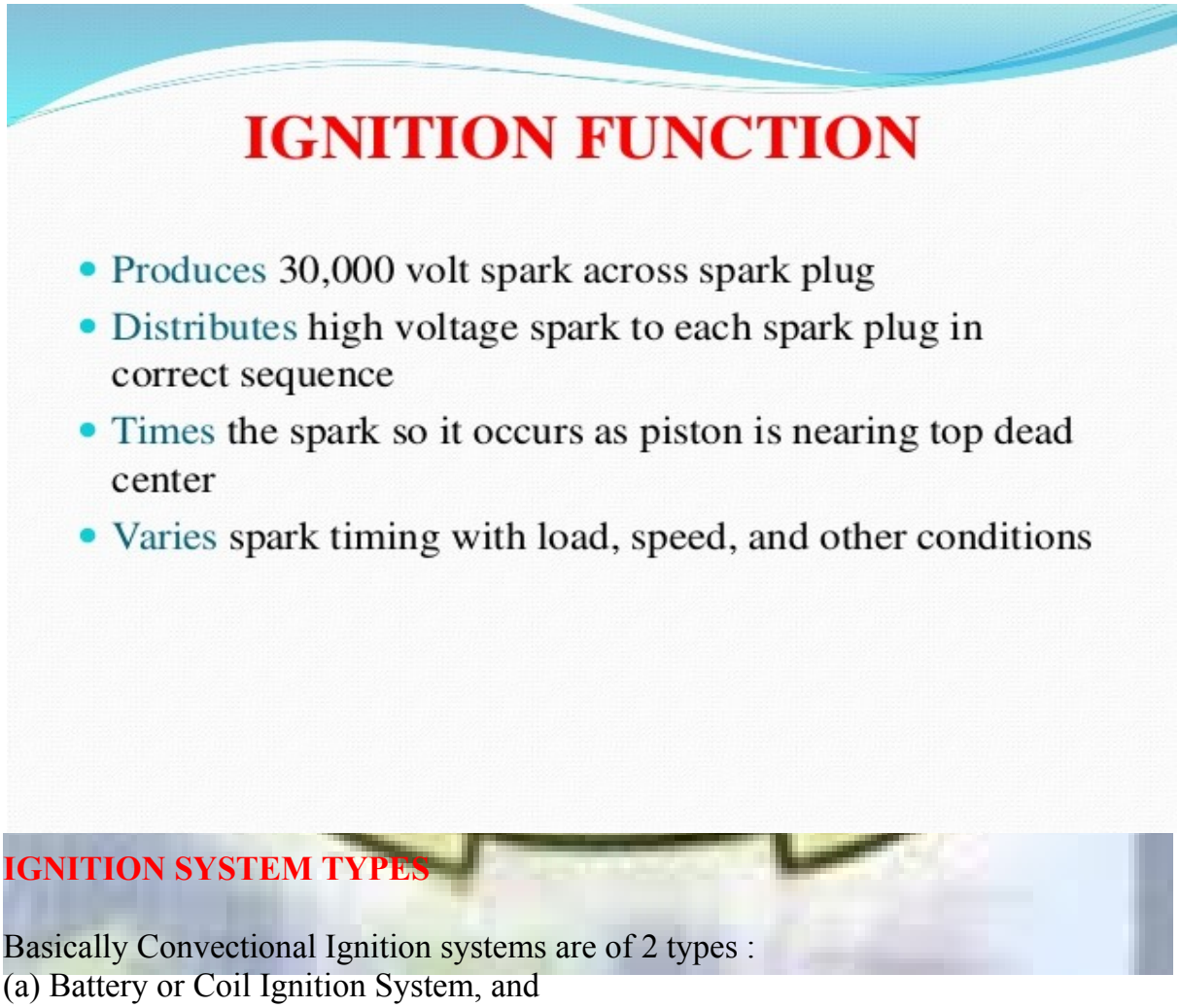
In **dry-sump lubrication system**, the oil supply is carried from an external tank. The oil from the sump is pumped by means of a scavenging pump through filters to the external storage tank, the oi from the storage tank is pumped to engine cylinder through and oil cooler. The oil pressure may vary from 3 to 8 bar.

The dry-sump lubrication system is generally used for heavy-duty engines

CHAPTER-07 IGNITION SYSTEM

An ignition system generates a spark or heats an electrode to a high temperature to ignite a fuel-air mixture in spark ignition internal combustion engines, oil-fired and gas-fired boilers, rocket engines, etc. The widest application for spark ignition internal combustion engines is in petrol (gasoline) road vehicles: cars and motorcycles.

Compression ignition Diesel engines ignite the fuel-air mixture by the heat of compression and do not need a spark. They usually have glowplugs that preheat the combustion chamber to allow starting in cold weather. Other engines may use a flame, or a heated tube, for ignition. While this was common for very early engines it is now rare.

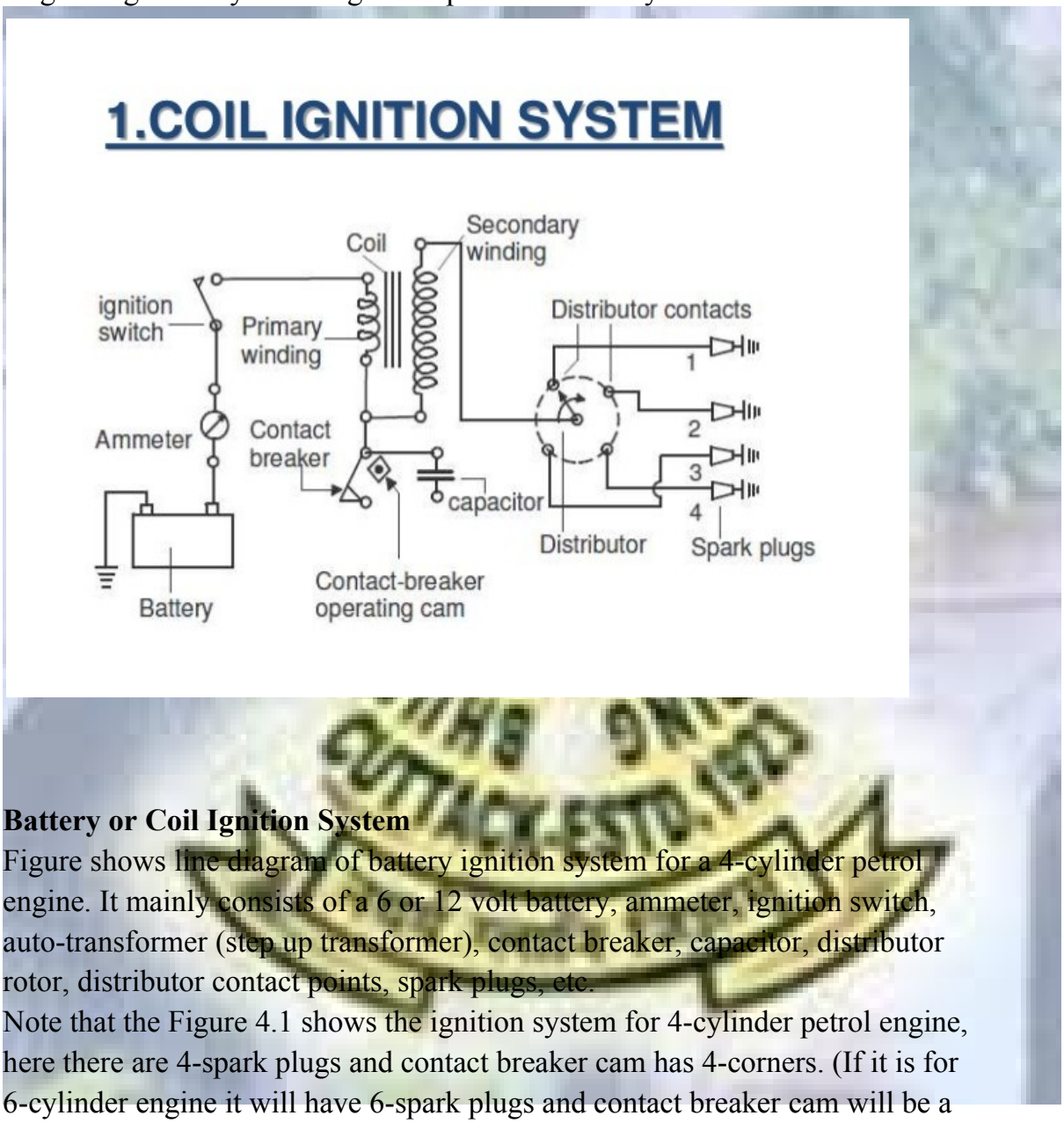


IGNITION SYSTEM TYPES

Basically Convectional Ignition systems are of 2 types :
(a) Battery or Coil Ignition System, and
(b) Magneto Ignition System.
Both these conventional, ignition systems work on mutual electromagnetic induction principle.

Battery ignition system was generally used in 4-wheelers, but now-a-days it is more commonly used in 2-wheelers also (i.e. Button start, 2-wheelers like Pulsar, Kinetic Honda; Honda-Activa, Scooty, Fiero, etc.). In this case 6 V or 12 V batteries will supply necessary current in the primary winding.

Magneto ignition system is mainly used in 2-wheelers, kick start engines. (Example, Bajaj Scooters, Boxer, Victor, Splendor, Passion, etc.).
In this case magneto will produce and supply current to the primary winding. So in magneto ignition system magneto replaces the battery.



Battery or Coil Ignition System
Figure shows line diagram of battery ignition system for a 4-cylinder petrol engine. It mainly consists of a 6 or 12 volt battery, ammeter, ignition switch, auto-transformer (step up transformer), contact breaker, capacitor, distributor rotor, distributor contact points, spark plugs, etc.
Note that the Figure 4.1 shows the ignition system for 4-cylinder petrol engine, here there are 4-spark plugs and contact breaker cam has 4-corners. (If it is for 6-cylinder engine it will have 6-spark plugs and contact breaker cam will be a perfect hexagon).
The ignition system is divided into 2-circuits :

(i) **Primary Circuit :** It consists of 6 or 12 V battery, ammeter, ignition switch, primary winding it has 200-300 turns of 20 SWG (Sharps Wire Gauge) gauge wire, contact breaker, capacitor.

(ii) Secondary Circuit : It consists of secondary winding. Secondary winding consists of about 21000 turns of 40 (S WG) gauge wire. Bottom end of which is connected to bottom end of primary and top end of secondary winding is connected to centre of distributor rotor. Distributor rotors rotate and make contacts with contact points and are connected to spark plugs which are fitted in cylinder heads (engine earth).

(iii) **Working :** When the ignition switch is closed and engine in cranked, as soon as the contact breaker closes, a low voltage current will flow through the primary winding. It is also to be noted that the contact beaker cam opens and closes the circuit 4-times (for 4 cylinders) in one revolution. When the contact breaker opens the contact, themagnetic field begins to collapse. Because of this collapsing magnetic field, current will be induced in the secondary winding. And because of more turns (@ 21000 turns) of secondary, voltage goes unto 28000-30000 volts. This high voltage current is brought to centre of the distributor rotor. Distributor rotor rotates and supplies this high voltage current to proper stark plug depending upon the engine firing order. When the high voltage current jumps the spark plug gap, it produces the spark and the charge is ignited-combustion starts-products of combustion expand and produce power.

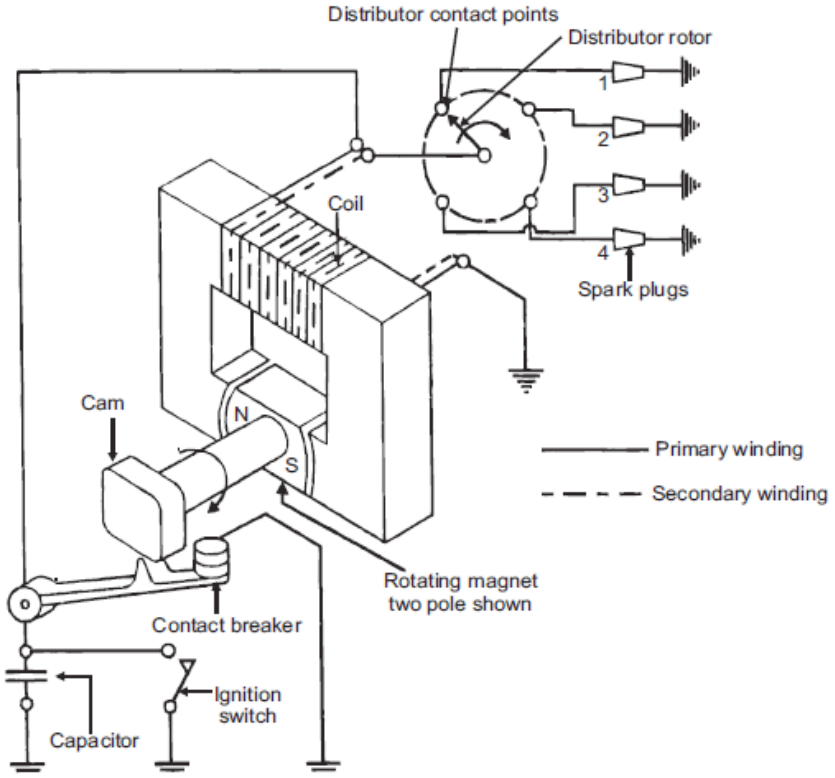
Note :

(a) The Function of the capacitor is to reduce arcing at the contact breaker (CB) points. Also when the CB opens the magnetic field in the primary winding begins to collapse. When the magnetic field is collapsing capacitor gets fully charged and then it starts discharging and helps in building up of voltage in secondary winding.

(b) Contact breaker cam and distributor rotor are mounted on the same shaft.

Magneto Ignition System

In this case magneto will produce and supply the required current to the primary winding. In this case as shown, we can have rotating magneto with fixed coil or rotating coil with fixed magneto for producing and supplying current to primary, remaining arrangement is same as that of a battery ignition system.



S.No.	Battery Ignition System	Magneto Ignition System
1.	As the name implies, battery is necessary in this type of ignition system.	No battery is needed in this type of ignition system. It has its own electric generator.
2.	It is difficult to start when the battery is discharge.	There is no such problem because no battery is used.
3.	It required high maintenance due to battery.	It required less maintenance.
4.	In battery ignition system current for primary circuit is obtain by battery.	In magneto ignition system, required electric current is generated by the magneto, which is an electric generator.
5.	Spark strength does not depend on speed of engine due to current is supplied by battery.	Spark strength depends on speed of engine due to magneto.
6.	Good spark is available at low speed.	During starting or at low speed, quality of spark is poor.
7.	Efficiency of system decreases with the reduction in spark intensity as engine speed rises.	Efficiency of the system improves as the engine speed rises due to high intensity spark.
8.	Battery ignition system occupies more space.	Compare to battery ignition system, magneto ignition system requires less space.
9.	Commonly employed in cars and light commercial vehicles.	It is mainly used in racing cars and two wheelers.

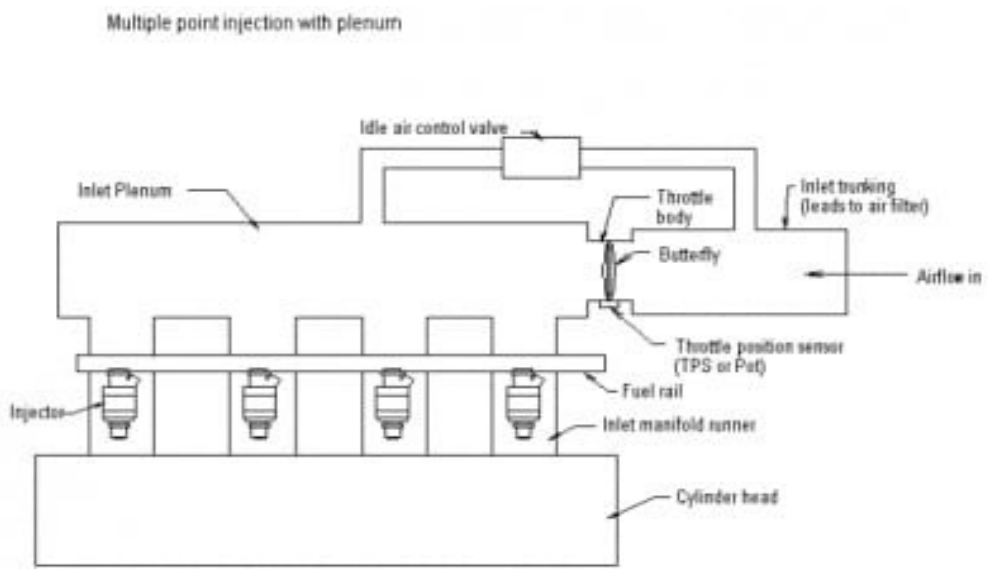
ADVANTAGES OF ELECTRONIC IGNITION SYSTEM

Following are the advantages of electronic ignition system :
(a) Moving parts are absent-so no maintenance.
(b) Contact breaker points are absent-so no arcing.
(c) Spark plug life increases by 50% and they can be used for about 60000 km without any problem.
(d) Better combustion in combustion chamber, about 90-95% of air fuel mixture is burnt compared with 70-75% with conventional ignition system.
(e) More power output.
(f) More fuel efficiency

What is multi point fuel injection (MPFI) system?

The MPFI is a system or method of injecting fuel into internal combustion engine through multi ports situated on intake valve of each cylinder. It delivers an exact quantity of fuel in each cylinder at the right time. There are three types of MPFI systems – Batched, Simultaneous and Sequential.

In the batched MPFI system fuel is injected to the groups or batches of the cylinders without bringing their intake stroke together. In the simultaneous system, fuel is inserted to all cylinders at the same time, while the sequential system injection is timed to overlap with intake stroke of each cylinder.



How fuel injection system works?

MPFI includes a fuel pressure regulator, fuel injectors, cylinders, pressure spring and a control diaphragm. It uses multiple individual injectors to insert fuel in each cylinder through intake port situated upstream of cylinder's intake value. The fuel pressure regulator, connected to the fuel rail by means of an inlet and outlet, directs the flow of the fuel. While the control diaphragm and pressure spring controls the outlet valve opening and the amount of fuel that can return. The pressure in the intake manifold significantly changes with the engine speed and load.

Advantages of multi point fuel injection system?

- The multi-point fuel injection technology improves fuel efficiency of the vehicles. MPFI uses individual fuel injector for each cylinder, thus there is no gas wastage over time. It reduces the fuel consumption and makes the vehicle more efficient and economical.
- The vehicles with MPFI automobile technology have lower carbon emissions than a few decades old vehicles. It reduces the emission of the hazardous chemicals or smoke, released when fuel is burned. The more precise fuel delivery

cleans the exhaust and produces less toxic byproducts. Therefore, the engine and the air remain cleaner.

- MPFI system improves the engine performance. It atomizes the air in small tube instead additional air intake, and enhances the cylinder-to-cylinder fuel distribution that aid to the engine performance.
- It encourages distribution of more uniform air-fuel mixture to each cylinder that reduces the power difference developed in individual cylinder.
- The MPFI automobile technology improves the engine response during sudden acceleration and deceleration.
- The MPFI engines vibrate less and don't require to be cranked twice or thrice in cold weather.
- It improves functionality and durability of the engine components.
- The MPFI system encourages effective fuel utilization and distribution. .

FUEL SUPPLY SYSTEM IN SPARK IGNITION ENGINE

The fuel supply system of spark ignition engine consists of:

Fuel tank (ii) Fuel filter (iii) Sediment bowl (iv) Fuel lift pump (v) Carburettor (vi) Fuel pipes (vii) Inlet manifold In some spark ignition engine, the fuel tank is placed above the level of the carburettor. The fuel flows from the fuel tank to the carburettor under the action of gravity.

(i) There are one or two filters between the fuel tank and the carburettor.

(ii) A transparent sediment bowl is also provided to hold the dust and dirt of the fuel. If the tank is below the level of the carburettor, a lift pump is provided in between the tank and the carburettor for forcing fuel from the tank to the carburettor of the engine.

(iii) The fuel comes from the fuel tank to the sediment bowl and then to the lift pump. From there the fuel goes to the carburettor through suitable pipe. From the carburettor, the fuel goes to the engine cylinder, through the inlet manifold of the engine.

CARBURETTOR:

The process of preparing an air-fuel mixture away from the cylinders of an engine is called carburetion and the device in which this process take place is called carburettor.

Principle of carburettor:

The basic principle of all carburettor design that when air flows over the end of a narrow tube or jet containing liquid, some liquid is drawn into the air stream. The quantity of liquid drawn into the air stream increases as the speed of air flow over the jet increases and also the quantity is greater if the jet is made larger.

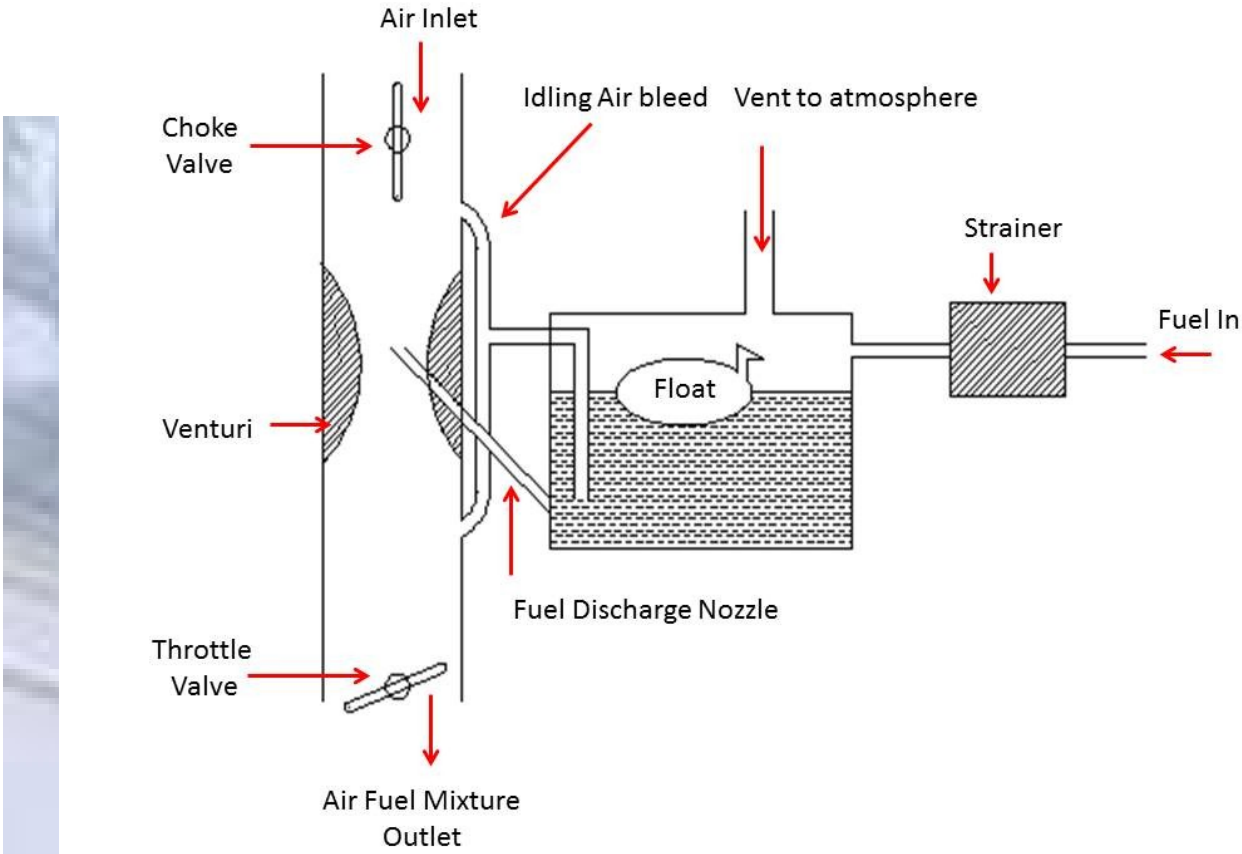
In practice, the fuel level in the jet is maintained by a float chamber. The fuel levels in the jet and in the float chamber are always the same. As the fuel is consumed, the level in the float chamber goes down. The float in the float chamber also goes down and the needle valve comes off its seat allowing more fuel into the chamber from the fuel tank. When the fuel level rises to its correct level, the float presses the needle valve back to its seat and cuts off the fuel flow.

The velocity of the air flowing over the jet is increased by a constriction in the induction pipe known as venturi. A throttle butterfly valve provides an adjustable obstruction in the induction pipe. It is used to control the flow of air-fuel mixture to the engine. As the butterfly valve is turned into the accelerate position, the airflow over the jet increases and more fuel is drawn out into the air stream, keeping the mixture strength constant. A second butterfly valve called choke is used to provide a richer mixture for the engine to start in cold condition. The choke controls the volume of air entering into the venturi. A second jet is fitted near the throttle butterfly, which is used when the engine is idling. Fuel is delivered to the float chamber through fuel pipe either by gravity or by a pump. The float chamber is connected with the mixing chamber (venturi) via fuel nozzle equipped with fuel jet.

Function of Carburettor:

The main functions of the carburettor are:

i)To mix the air and fuel thoroughly (ii) To atomise the fuel (iii) To regulate the air-fuel ratio at different speeds and loads and (iv) To supply correct amount of mixture at different speeds and loads.


Air Inlet
Choke Valve
Idling Air bleed
Vent to atmosphere
Strainer
Fuel In
Float
Venturi
Fuel Discharge Nozzle
Throttle Valve
Air Fuel Mixture Outlet

FUEL SYSTEM OF DIESEL ENGINE

During engine operation, the fuel is supplied by gravity from fuel tank to the primary filter where coarse impurities are removed. From the primary filter, the fuel is drawn by fuel transfer pump and is delivered to fuel injection pump through second fuel filter. The fuel injection pump supplies fuel under high pressure to the injectors through high pressure pipes. The injectors atomise the fuel and inject it into the combustion chamber of the engine. The fuel injection pump is fed with fuel in abundance. The excess fuel is by-passed to the intake side of the fuel transfer pump through a relief valve.

The main components of the fuel system in diesel engine are: (1) fuel filter (2) fuel lift pump (3) fuel injection pump (4) atomisers and (5) high pressure pipe.

FUEL LIFT PUMP (FEED PUMP OR TRANSFER PUMP)

It is a pump, which transfers fuel from the fuel line to the fuel injection pump. It is mounted on the body of fuel injection pump. It delivers adequate amount of fuel to the injection pump.

The pump consists of: (I) body (2) piston (3) inlet valve and (4) pressure valve. The valves are tightly pressed against their seats by springs. The piston is free to slide in the bore. The fuel contained in the space below the piston is forced to flow through secondary fuel filter to the injection pump. At the same time downward movement of the piston creates a depression in the space above the piston which, causes the fuel to be drawn in the transfer pump from the fuel tank through the inlet valve and the primary filter.

FUEL INJECTING PUMP

It is a pump, which delivers metered quantity of fuel to each cylinder at appropriate time under high pressure. Tractor engines may use two types of fuel injection pump:

(i) Multi-element pump and (ii) Distributor (Rotary) type pump.

Fuel Injector:

It is the component, which delivers finely atomised fuel under high pressure to the combustion chamber of the engine. Modern tractor engines use fuel injectors, which have multiple holes. Main parts of injector are: nozzle body and needle valve. The nozzle body and needle valve are fabricated from alloy steel. The

needle valve is pressed against a conical seat in the nozzle body by a spring. The injection pressure is adjusted by adjusting the screw.

FUEL INJECTION SYSTEM

Diesel fuel is injected in diesel engine through injectors with the help of fuel injection pump. The system using injectors, fuel injection pump, fuel filter, and fuel lines is called fuel injection system.

The main functions of fuel injection system are:

(i) To measure the correct amount of fuel required by engine speed and load,
(ii) To maintain correct timing for beginning and end of injection,
(iii) To inject the fuel into the combustion space against high compression pressure.
(iv) To atomise the fuel for quick ignition.

Process of fuel injection in diesel engine is of two types:
(i) Air injection (ii) Solid injection.

Air injection:

In this process, the engine uses compressed air to force the fuel into the cylinder. It is a bulky system and hence it is not considered very suitable for vehicles and tractors. It is mostly used on heavy-duty stationary engines.

Solid injection:

A high-pressure pump is used for forcing the fuel into the combustion chamber.

MODEL-01

AUTOMOBILE ENGINEERING(MET-602)

FULL MARK-80 TIME -3HOURS

SECTION-A

ANSWER ALL QUESTIONS (2×10)

Q1.

a)What is self propelled vehicle?

b)Name different types of differentials

c)Name different types of brakes

d)What is the function of spark plug

e)Define flange and gutter for tyre

f)Define flash point and fire point

g)Name different factors influencing carburetion

h) List any four components of a chassis.

i) List major types of automobiles according to the fuel used.

j) List any four characteristics of a good chassis.

SECTION –B

ANSWER ANY SIX (5x6)

Q.2

a) Write down the technical specification of maruti 800 and discuss the specification of auto engines.
b) Advantages of hydraulic and vacuum braking system
c) Discuss cause and remedies of tire wear
d) Advantages and disadvantages of electronic fuel injection system
e) Explain water cooling system in detail
f) Explain battery ignition system
g) Describe sliding contact gear box

Answer any three of the following (10x3)

Q.3 Explain single plate clutch system with diagram.

Q.4 Draw and explain about the automobile chassis and describe all its parts.

Q.5 Explain about the vacuum braking system and its application

Q.6 Describe lubrication system of I.C engine

Q.7 Describe the working principle of fuel injection system for multi-cylinder diesel engine

MODEL-2

AUTOMOBILE ENGINEERING

6^{TH} SEM -MECHANICAL ENGINEERING FM-80 TIME-3HR

1. (2X10)

a) What is the function of clutch
b) What is vacuum bake?
c) What is use of spark plug?
d) State tyre specification.
e) What are the needs of cooling of IC engine.
f) What is A/F ratio.
g) Define automobile.
h) What is the purpose of transmission?
i) What is slip joint?
j) What is universal joint?
k) Function of propeller shaft.

2. (5x6)

a) Describe working of spark plug.
b) Describe layout of chassis.
c) What is A/F ratio? describe its classification. explain Carburation and its needs.
d) What is the requirement of cooling system, describe its types and advantages
e) Draw and explain universal joint.
f) Classification of auto engines.
g) Explain about mechanical brake with diagram.
h) Explain Magneto ignition system.

ANSWR ANY THREE (10X3)

3. Draw and explain about differential in briefly.

4. What is 4speed gear box system , explain with diagram.

5. Describe multi point fuel injection system of petrol engine.

6. What is lubrication, states all the important properties of good lubricant.

7. Draw and explain about the carburetor system.