TWO AND THREE WEELERS

UNIT I The Power Unit

INTRODUCTION

Heat engine is a machine for converting heat, developed by burning fuel into useful work. It can be said that heat engine is equipment which generates thermal energy and transforms it into mechanical energy.

CLASSIFICATION OF HEAT ENGINES

1. Based on combustion of fuel:

(i) External combustion engine

(ii) Internal combustion engine.

External combustion engine

Here, the working medium, the steam, is generated in a boiler, located outside the engine and allowed in to the cylinder to operate the piston to do mechanical work.

Internal combustion engine

In internal combustion engine, the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high-pressure air moves the piston which rotates the crank shaft and thus mechanical work is done

2. Based on fuel used

1. Diesel engine 2. Petrol engine 3. Gas engine

Diesel engine – Diesel is used as fuel Petrol

engine – Petrol is used as fuel

Gas engines – propane, butane or methane gases are used

3. Based ignition of fuel

1. Spark ignition engine (Carburetor type engines)

2. Compression ignition engine (injector type engines)

Spark ignition engine — a mixture of air and fuel is drawn in to the engine cylinder. Ignition of fuel is done by using a spark plug. The spark plug producesa spark and ignites the air- fuel mixture. Such combustion is called constant volume combustion (C.V.C.).

Compression ignition engine — In compression ignition engines air is compressed in to the engine cylinder, Due to this the temperature of the compressed air rises to 700-900 C. At this stage diesel is sprayed in to the cylinder in fine particles. Due to a very high temperature, the fuel gets ignited. This type of combustion is called

constant pressure combustion (CP.C.) because the pressure inside the cylinder is almost constant when combustion is taking place.

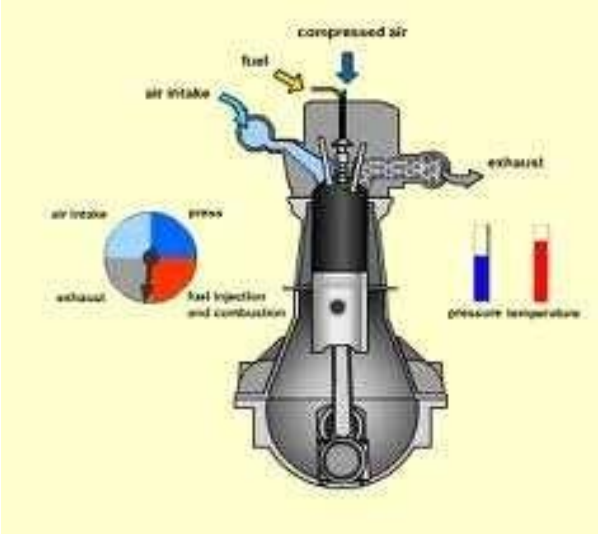
4. Based on working cycle

1. Four stroke cycle engine - When the cycle is completed in tworevolutions of the crankshaft, it is called four stroke cycle engines.

2. Two stroke cycle engines. - When the cycle is completed in onerevolution of the crankshaft, it is called two stroke cycle engines

CONSTRUCTION OF AN IC ENGINE

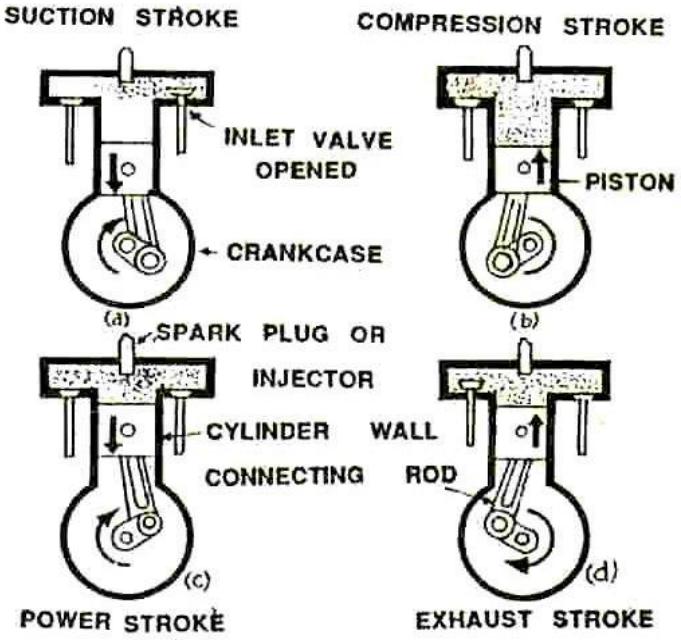
I.C. engine converts the reciprocating motion of piston into rotary motionof the crankshaft by means of a connecting rod. The piston which reciprocatingin the cylinder is very close fit in the cylinder. Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides ofthe piston. Usually, a cylinder is bored in a cylinder block and a gasket, made of copper sheet or asbestos is inserted between the cylinder and the cylinder head to avoid ant leakage. The combustion space is provided at the top of the cylinder head where combustion takes place.



The connecting rod connects the piston and the crankshaft. The end of the connecting rod connecting the piston is called small end. A pin called gudgeon pin or wrist pin is provided for connecting the piston and the connecting rod at the small end. . The other end of the connecting rod connecting the crank shaft is called big end. When piston is moved up and down, the motion is transmitted to the crank shaft by the connecting FOUR STROKE ENGINE rod and the crank shaft makes rotary motion. The crankshaft rotates in main bearings which are fitted the crankcase. A flywheel is provided at one end of the crankshaft for smoothing the uneven torque produced by the engine. There is an oil sump at the bottom of the engine which contains lubricating oil for lubricating different parts of the engine.

FOUR STROKE ENGINE

A four-stroke engine (also known as four-cycle) is an internal combustion engine in which the piston completes four separate strokes which comprise a single thermodynamic cycle. A stroke refers to the full travel of the piston along the cylinder, in either direction. While risqué slang among some automotive enthusiast's names these respectively the "suck," "squeeze," "bang" and "blow" strokes, they are more commonly termed



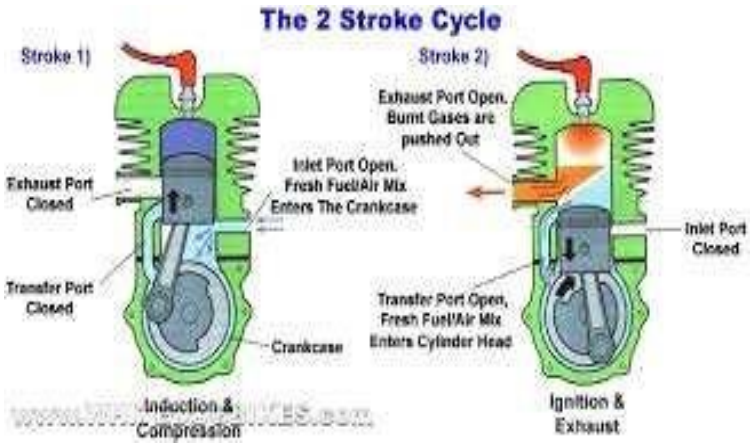
1. INTAKE: this stroke of the piston begins at top dead center. The piston descends from the top of the cylinder to the bottom of the cylinder, increasing the volume of the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port.

2. COMPRESSION: with both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the air or fuel-air mixture into the cylinder head.

3. POWER: this is the start of the second revolution of the cycle. While the piston is close to Top Dead Centre, the compressed air–fuel mixture in a gasoline engine is ignited, by a spark plug in gasoline engines, or which ignites due to the heat generated by compression in a diesel engine. The resulting pressure from the combustion of the compressed fuel-air mixture forces the piston back down toward bottom dead center.

4. EXHAUST: during the exhaust stroke, the piston once again returns to top dead center while the exhaust valve is open. This action expels the spent fuel-air mixture through the exhaust valve(s).

Two Stroke Engine



In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. One revolution of the crankshaft. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcaseof the engine is air tight in which the crankshaft rotates.

Upward stroke of the piston (Suction + Compression)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air- fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a sparkplug (Fig 2 c &d). Thus, during this stroke both suction and compression events are completed.

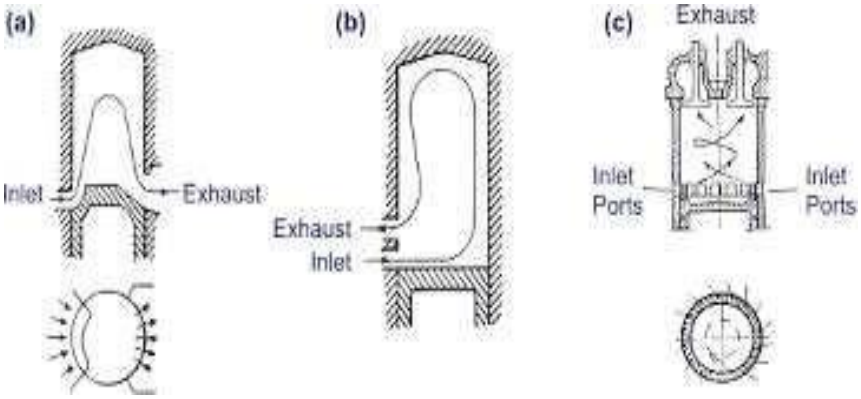
Downward stroke (Power + Exhaust)

Burning of the fuel rises the temperature and pressure of the gases whichforces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port. Now fresh charge in the crankcase moves in to the cylinder through the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflects the incoming mixture up around the cylinder so that it can help in driving out the exhaust gases. During the downward stroke of the piston power and exhaust events are completed.

SCAVENGING PROCESS

A basic part of the cycle of an internal combustion engine is the supply offresh air and removal of exhaust gases. This is the gas exchange process.
Scavenging is the removal of exhaust gases by blowing in fresh air. Charging isthe filling of the engine cylinder with a supply or charge of fresh air ready for compression. With supercharging a large mass of air is supplied to the cylinder by blowing it in under pressure.

Efficient scavenging is essential to ensure a sufficient supply of fresh airfor combustion. In the four-stroke cycle engine there is an adequate overlap between the air inlet valve opening and the exhaust valve closing. With two- stroke cycle engines this overlap is limited and some slight mixing of exhaust gases and incoming air does occur.



The number of different scavenging methods are in use in slow-speed two-stroke engines. In each the fresh air enters as the inlet port is opened by the downward movement of the piston and continues until the port is closed by the upward moving piston. The flow path of the scavenge air is decided by the engine port shape and design and the exhaust arrangements.

CROSS FLOW SCAVENGING (Fig a)

In cross scavenging the incoming air is directed upwards, pushing theexhaust gases before it. The exhaust gases then travel down and out of the exhaust ports. Figure above illustrates the process.

LOOP FLOW SCAVENGING (Fig b)

In loop scavenging the incoming air passes over the piston crown then rises towards the cylinder head. The exhaust gases are forced before the air passing down and out of exhaust ports located just above the inlet ports. The process is shown in Figure below.

UNIFLOW SCAVENGING (Fig c)

With uniflow scavenging the incoming air enters at the lower end of the cylinder and leaves at the top. The outlet at the top of the cylinder may be portsor a large valve. The process is shown here.

Rotary Valve Engine

A rotary valve engine is always a two-stroke engine. Most rotary valve engines are rotax engines. Although other rotary engines such as Suzuki and Kawasaki have been made.

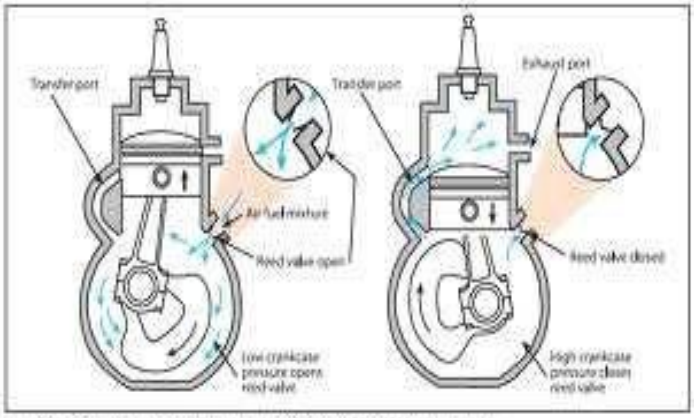


Figure 4-1. Reed valve is open with low pressure and closes when the pressure increases.

Rotax engines are used in snowmobiles, jet-skis and motorcycles and aircraft engines. A rotary valve refers to the intake of a two-stroke engine.

There are three types of intake designs for two stroke engines. Simplistic two strokes are piston port, meaning that the piston movement past the port controls the incoming air timing. The piston port engine doesn't do a very goodjob of keeping the airflow to stay in the engine. The air can simply travel back out of the engine. The most popular intake air induction is the reed port engine.

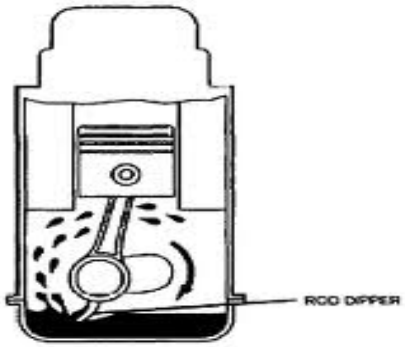
uses reed petals to allow the intake air in the engine and traps it there. The tension of the reed petals can change with the use of different petals and can provide some power improvement at certain rpm ranges. A rotary valve engine has the best intake air control

UNIT II FUEL AND IGNITION SYSTEMS

Splash Lubrication System

The splash system is no longer used in automotive engines. It is widelyused in small four-cycle engines for lawn mowers, outboard marine operation,and so on.

In the splash lubricating system, oil is splashed up from the oil pan or oil trays in the lower part of the crankcase. The oil is thrown upward as droplets or fine mist and provides adequate lubrication to valve mechanisms, piston pins, cylinder walls, and piston rings.



In the engine, dippers on the connecting-rod bearing caps enter the oil pan with each crankshaft revolution to produce the oil splash. A passage is drilled in each connecting rod from the dipper to the bearing to ensure lubrication.

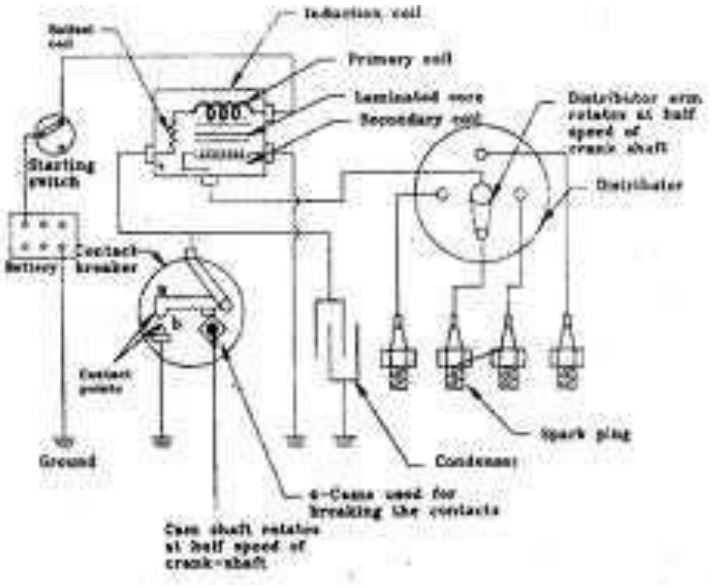
This system is too uncertain for automotive applications. One reason is that the level of oil in the crankcase will vary greatly the amount of lubrication received by the engine. A high level results in excess lubrication and oil consumption and a slightly low-level results in inadequate lubrication and failureof the engine.

Battery Coil Ignition System & Mageto ignition system 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:

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).

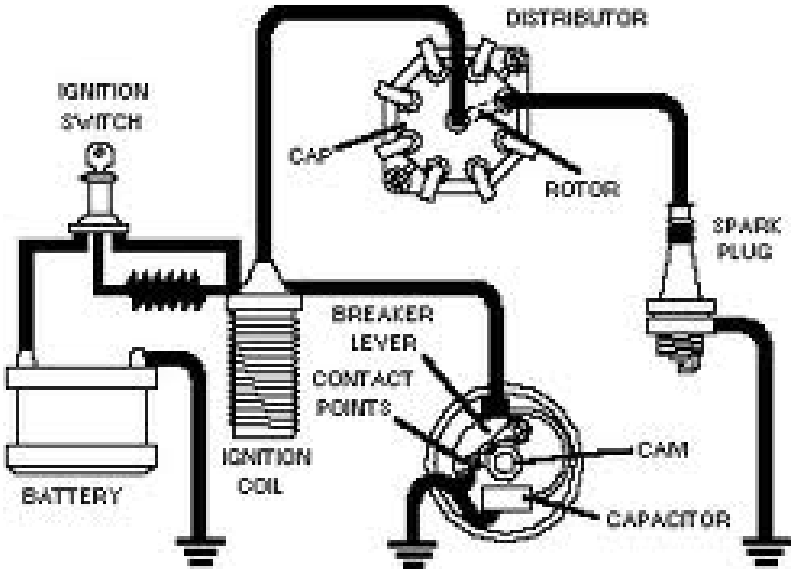


(iii) Working: When the ignition switch is closed and engine in cranked, as soonas the contact breaker closes, a low voltage current will flow through the primarywinding. It is also to be noted that the contact beaker cam opens and closes thecircuit 4-times (for 4 cylinders) in one revolution. When the contact breaker opens the contact, the magnetic 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.

The need for higher mileage, reduced emissions and greater reliability has led to the development of the electronic ignition systems. These systems generate a much stronger spark which is needed to ignite leaner fuel mixtures. Breaker point systems needed a resistor to reduce the operating voltage of the primary circuit in order to prolong the life of the points. The primary circuit of the electronic ignition systems operate on full battery voltage which helps to develop a strongerspark. Spark plug gaps have widened due to the ability of the increased voltage to jump the larger gap. Cleaner combustion and less deposits have led to longer spark plug life.

MAGNETO IGNTION 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.



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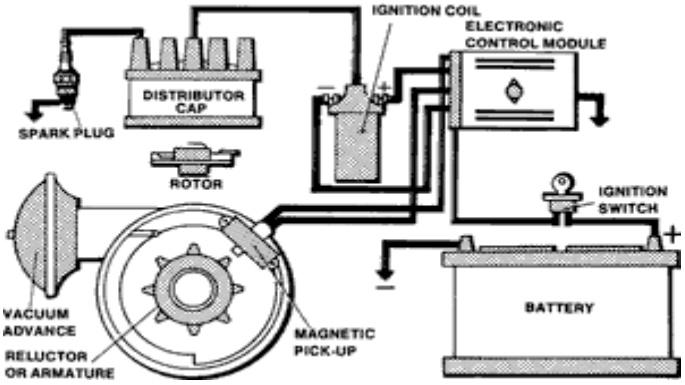
In some systems, the ignition coil has been moved inside the distributor cap. This system is said to have an internal coil as opposed to the conventional external one.



Electronic Ignition systemsare not as complicated as they may first appear. In fact, they differ only slightly from conventional point ignition systems. Like conventional ignition systems,electronic systems have two circuits: a primary circuit and a secondary circuit.The entire secondary circuit is the same as in a conventional ignition system. In addition, the section of the primary circuit from the battery to the battery terminal at the coil is the same as in a conventional ignition system

Electronic ignition systems differ from conventional ignition systems in the distributor component area. Instead of a distributor cam, breaker plate, points, and condenser, an electronic ignition system has an armature (called by various names such as a trigger wheel, reductor, etc.), a pickup coil (stator, sensor, etc.), and an electronic control module.

Essentially, all electronic ignition systems operate in the following manner: With the ignition switch turned on, primary (battery) current flows from the battery through the ignition switch to the coil primary windings. Primary current is turned on and off by the action of the armature as it revolves past the pickup coil or sensor. As each tooth of the armature nears the pickup coil, it creates a voltage that signals the electronic module to turn off the coil primary current. A timing circuit in the module will turn the current on again after the coil field has collapsed. When the current is off, however, the magnetic field built up in the coil is allowed to collapse, which causes a high voltage in the secondary windings of the coil. It is now operating on the secondary ignition circuit, which is the sameas in a conventional ignition system.

Question Bank (B.Voc. Automobile Servicing First Year)

Subject Name:- Two and Three Wheeler

Unit-I The Power Unit

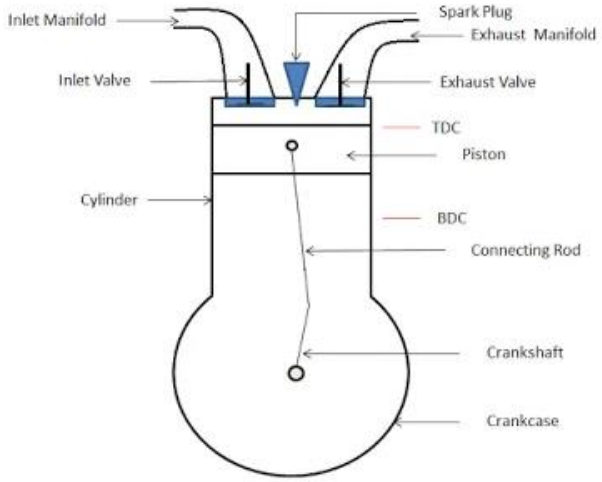
1. State difference between two and four stroke engines

Two-Stroke Engine	Four-Stroke Engine
It can generate one revolution of the crankshaft within one power stroke, i.e., one power stroke per 360 degrees rotation of the crankshaft.	It can generate two revolutions of the crankshaft between one power stroke i.e., one power stroke in every 720 degrees rotation of the crankshaft.
Uses a port for inlet and outlet of fuel.	Uses valve for inlet and outlet.
It requires a lighter flywheel to cause a more balanced force due to one revolution for one power stroke.	It requires a heavy flywheel because it gives rise to unbalanced forces due to two revolutions for one power stroke.
Cheaper in price as they require less effort in manufacturing and are light by weight.	Hard to manufacture due to the heavy flywheel and valve mechanism and are expensive due to the valve and lubrication mechanism.
Generates more torque at a higher rpm.	Generates a higher torque at a lower rpm.

2. Write a note on SI engines.

A spark-ignition engine (SI engine) is an internal combustion engine, generally a petrol engine, where the combustion process of the air-fuel mixture is ignited by a spark from a spark plug. This is in contrast to compression-ignition engines, typically diesel engines, where the heat generated from compression together with the injection of fuel is enough to initiate the combustion process, without needing any external spark.

The working cycle of both spark-ignition and compression-ignition engines may be either two-stroke or four-stroke. A four-stroke spark-ignition engine is an Otto cycle engine. It consists of following four strokes: suction or intake stroke, compression stroke, expansion or power stroke, exhaust stroke. Each stroke consists of 180 degree rotation of crankshaft rotation and hence a four-stroke cycle is completed through 720 degree of crank rotation. Thus for one complete cycle there is only one power stroke while the crankshaft turns by two OR MORE revolutions



3. State Advantages and Disadvantages of four stroke engines.

ADVANTAGES OF 4 STROKE ENGINE :-

More torque :- In general, 4 stroke engines always make extra torque than 2 stroke engine at low RPM. Although 2 stroked ones give higher torque at higher RPM but it has a lot to do with fuel efficiency.

More fuel efficiency :- 4 stroke engines have greater fuel efficiency than 2 stroke ones because fuel is consumed once every 4 strokes.

Less pollution :- As power is generated once every 4 strokes & also as no oil or lubricant is added to the fuel; 4 stroke engine produces less pollution.

More durability :- We all know that more the engine runs, quicker it wears out. 2 stroke engines are designed for high RPM. If an engine can go for 10000 rpm's before it wears out; a 4 stroke engine with 100 rpm will run for 100 minutes than the other 2 stroke engine which has a higher rpm of 500 & will run for only 20 minutes.

No extra addition of oil :- Only the moving parts need lubrication intermediately. No extra oil or lubricant is added to fuel.

DISADVANTAGES OF 4 STROKE ENGINE :-

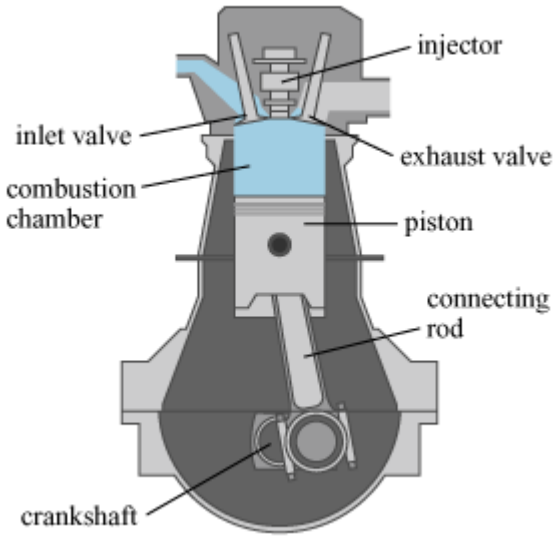
Complicated design :- A 4 stroke engine has complex valve mechanisms operated & controlled by gears & chain. Also there are many parts to worry about which makes it harder to troubleshoot.

Less powerful :- As power gets delivered once every 2 rotations of crankshaft(4 strokes), hence 4 stroke is less powerful.

Expensive :- A four stroke engine has much more parts than 2 stroke engine. So they often require repairs which leads to greater expense.

4. Write a note on CI engines

Compression ignition engine or CI engine is an internal combustion engine in which ignition of the fuel takes place with the help of hot compressed air. As the air is compressed, it gets hot and its heat is used for the ignition and burning of the fuel. In this engine the air is sucked during suction stroke and then this air is compressed while compression stroke. At the end of the compression stroke, fuel is injected into the cylinder and it gets ignited from the heat of compressed air and burning process begins. Diesel is used as fuel for the working of this engine. It works on the principle of Diesel Cycle. The compression ratio of this type of engine is usually ranges from 14:1 to 22:1. It is used in heavy duty vehicles like buses, trucks, ships, etc.



5. What is scavenging process ?

In an engine, scavenging refers to the process of ejecting the exhaust gas and replenishing it with fresh air or air/fuel mixture for the next cycle. When done correctly, scavenging is massively effective to maximize efficiency and reduce the loss of fresh air through the exhaust valve. It plays a crucial role for not only efficient combustions inside the engine, but also to assist the cooling of piston, valves and cylinder. Therefore, it is important for two- stroke as well as four- stroke engines alike.

Advantages–

- It takes very low cost to manufacture.
- Low engine volume when used in multi cylinder arrangement.
- Provides with good scavenging at low speeds (part throttle).

Disadvantages–

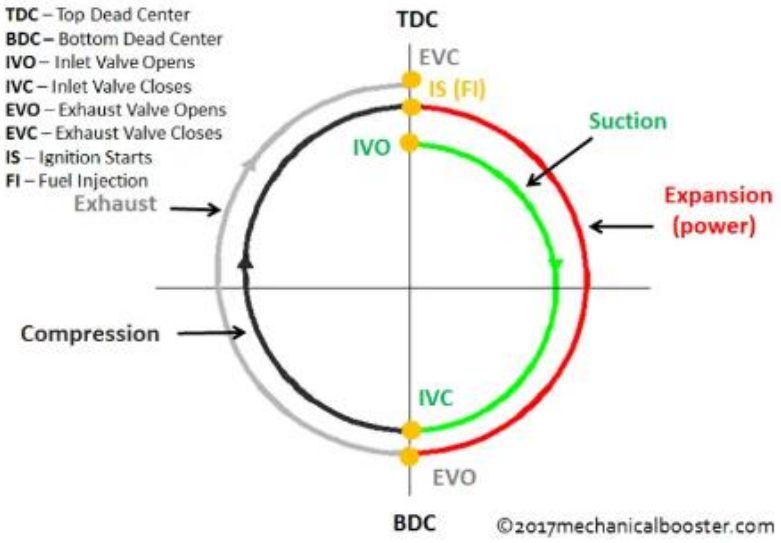
- Poor scavenging at high speeds (full throttle).
- Has a heavy piston, resulting in high heat absorption.
- Requires a water-cooling system.
- High probability to get knocked.

6. Explain valve timing diagrams.

The valve timing diagram comprises of a 360 degree figure which represents the movement of the piston from TDC to BDC in all the strokes of the engine cycle, Which is measured in degrees and the opening and closing of the valves is controlled according to these degrees.

Valve Timing Diagram for 4-Stroke Engine (petrol and diesel)

As we all know in 4-stroke engine the cycle completes in 4-strokes that are suction, compression, expansion and exhaust , The relation between the valves (inlet and outlet) and piston movement from TDC to BDC is represented by the graph known as valve timing diagram.



Theoretical Valve Timing Diagram of 4 Stroke Engine

7.

Unit-II Fuel and Ignition Systems

1. **Write a note on fuel systems used in automobiles.**

FUEL SUPPLY SYSTEM IN SPARK IGNITION ENGINE The fuel supply system of spark ignition engine consists of:

(i) Fuel tank

(ii) Fuel filter

(iii) Sediment bowl

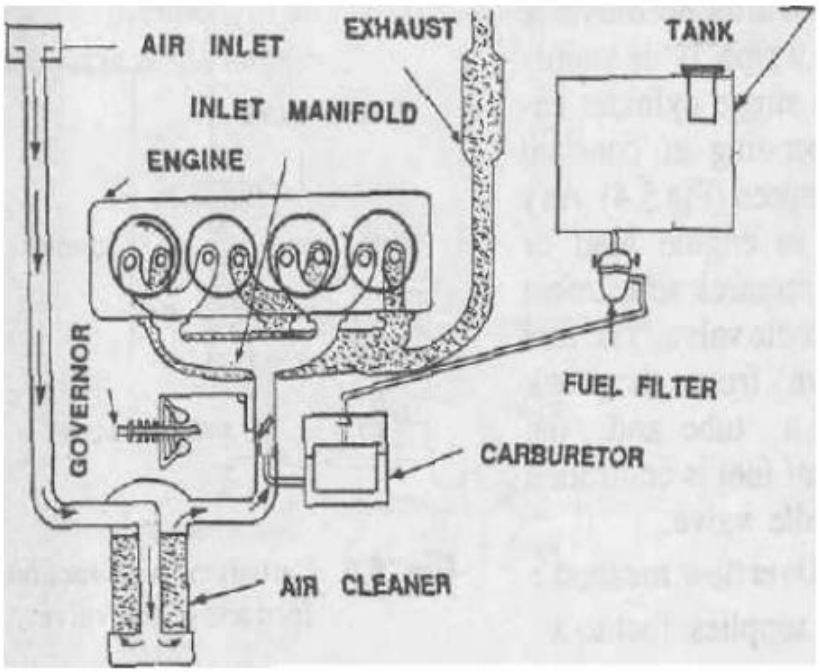
(iv) Fuel lift pump

(v) Carburetor

(vi) Fuel pipes

(vii) Inlet manifold

In some spark ignition engine, the fuel tank is placed above the level of the carburetor. The fuel flows from the fuel tank to the carburetor under the action of gravity. There are one or two filters between the fuel tank and the carburetor. 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 carburetor, a lift pump is provided in between the tank and the carburetor for forcing fuel from the tank to the carburetor of the engine. The fuel comes from the fuel tank to the sediment bowl and then to the lift pump. From there the fuel goes to the carburetor through suitable pipe. From the carburetor, the fuel goes to the engine cylinder, through the inlet manifold of the engine



Fuel system of spark ignition engine.

2. Explain fuel injection system in automobiles.

A fuel injection system is a mechatronic circuit that is the combination of mechanical and electronic circuits to supply fuel of ideal volume into the engine. Since the fuel injection system is such a vital component, engineers around the globe have evolved it to its most efficient and effective version

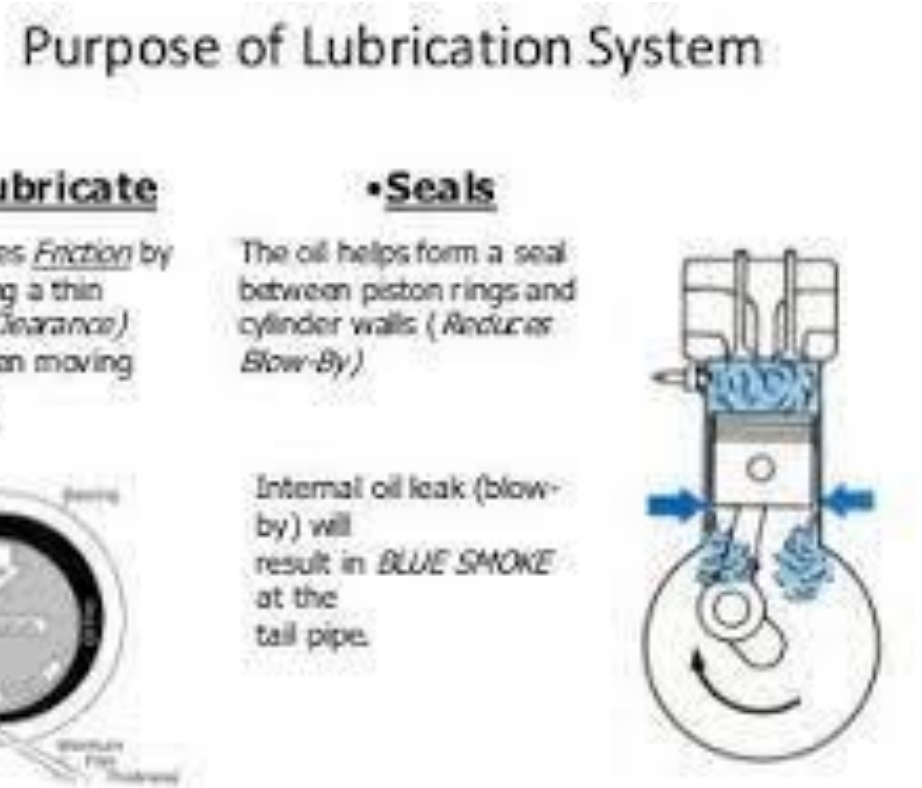
The fuel injection types used in newer cars include four basic types:

- Single-point or throttle body injection.
- Port or multipoint fuel injection.

- Sequential fuel injection.
- Direct injection.

3. Write a note on Lubrication system

- Lubrication system is used to distribute oil to the moving parts to reduce friction between surfaces in an engine. The lubrication system has a basic function to lubricate the compressor's moving components. Lubrication system is used to cool the system by removing heat from the compressor's moving parts
- Lubrication plays a key role in the life expectancy of an engine. Without oil, an engine would succumb to overheating and seizing very quickly. Lubricants help mitigate this problem, and if properly monitored and maintained, can extend the life of your motor.
- Its basic functions within an engine include reducing friction, cooling, sealing, cleaning, and serving as protection for moving parts



4. Explain Magneto coil spark ignition system

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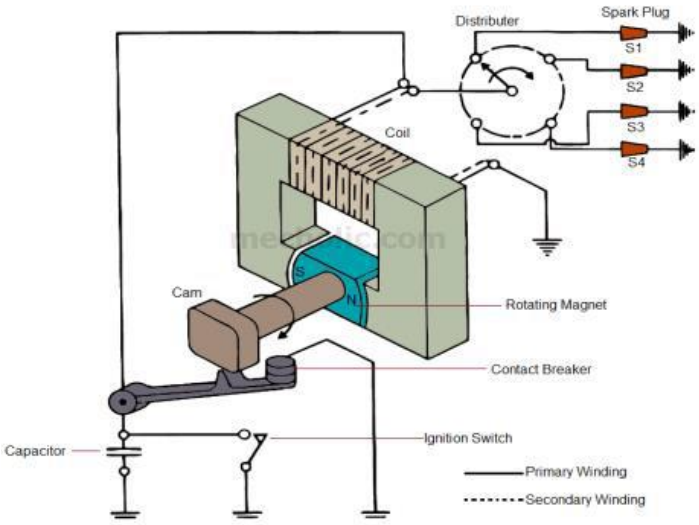

Schematic Diagram of Magneto Ignition System

5. Write short note battery coil spark ignition system.

A battery Ignition System is used in an automobile to produce a spark in the spark plug with the help of a Battery. It is generally used in the 4-wheeler vehicle but nowadays it is also used in two-wheeler vehicles where a 6-volt or 12-volt battery supplies the current to the ignition coil.

Parts of Battery Ignition System:

The main components of Battery Ignition system are listed below:

1. Ignition switch
2. Battery

3. Ignition coil
4. Ballast resistor
5. Contact breaker
6. Distributor
7. Capacitor
8. Spark Plug

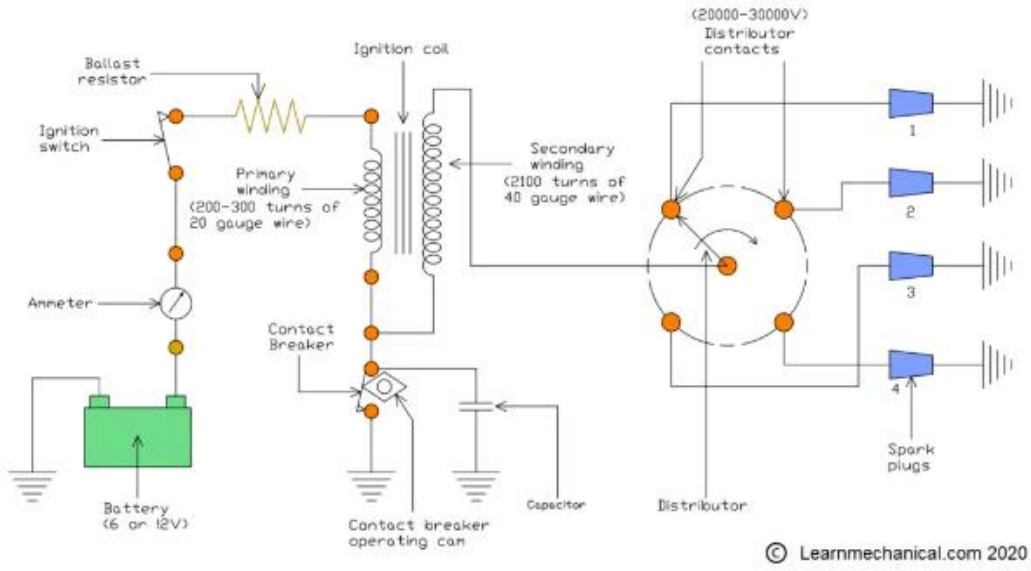

Diagram of Battery Ignition System, *Learn Mechanical*

6. Write a note on Starting system of automobiles

- The starting system includes the battery, starter motor, solenoid, ignition switch and in some cases, a starter relay.
- An inhibitor or a neutral safety switch is included in the starting system circuit to prevent the vehicle from being started while in gear.
- When the ignition key is turned to the **start** position, current flows and energizes the starter's solenoid coil.
- The energized coil becomes an electromagnet which pulls the plunger into the coil. The plunger closes a set of contacts which allow high current to reach the starter motor.