Unit 5 Engine

Contents

Learning Objectives

- To learn about Internal and External combustion engines.
- To learn about the engine parts, manufacturing procedure and the material used.
- To learn about the thermal energy produced in two stroke and four stroke engines.

5.0 INTRODUCTION

Thiruvalluar quotes "When water fails, functions of nature cease". In modern world "When automobile fails, functions of world cease". The mobility of the people and world will ceases when there is no automobile. Thus Automobile plays a vital role in transportation of people and goods from one place to another, even in between the continents.

The driving force required to drive the vehicle is provided by the Engine. Engine is considered to be the heart of an automobile. Based on Law of conservation of Energy, i.e., Energy can be transformed from one form to another form, engine is used to convert heat energy obtained by burning of fuel into mechanical energy and therefore they are called as Heat Engines.

5.1 PETROL ENGINE

In petrol engines, the heat energy is obtained by burning the petrol with air and this heat energy is converted into mechanical energy. Since petrol is also called as gasoline, this engine is also called as Gasoline engines.

The liquid state of petrol fuel is converted into vapour and it is mixed with atmospheric air. This air-fuel mixture is inducted into the engine, and it is burnt with the spark introduced by the spart plug. Hence, this engine is also called as spark ignition engine. This engine was invented by Nichloas Otto, German scientist in 1876. The engine is working based on otto cycle which is constant volume cycle. To burn a fuel, four operations is required namely, intake of fuel air mixture, compression of fuel air mixture, burning of furl air mixture and sent out the burnt air fuel mixture from the engine. Each operation is completed in each stroke of the piston and four stroke is required to complete a cycle. Hence it is called as four stroke engine.

5.2 DIESEL ENGINE

In diesel engines, the heat energy is obtained by burning the diesel with air and this heat energy is converted into mechanical energy. In 1897, Rudolph diesel invented the Diesel engine and hence the engine was called by his name "Diesel engine". This engine is working based on constant pressure cycle. In diesel engine, the air alone is intaken during suction stroke and it is compressed during the compression stroke. At the end of the compression stroke, diesel fuel is injected at high pressure which automoise the diesel fuel. The temperature of the compressed air is sufficient enough to start the combustion. Since air alone is compressed at high pressure, it will liberate more energy than petrol engine. Hence this engine is used on trucks, buses and heavy vehicles.

Since the cost of the diesel fuel is less and high energy is available, this engine is widely used for transportation, though the maintenance cost is more.

5.3 PARTS OF AN IC ENGINE

1. Cylinder Block
2. Cylinder Liner
3. Cylinder Head
4. Crank Case
5. Oil Sump
6. Gasket
7. Piston
8. Connecting rod
9. Crank Shaft
10. Timing Gear, Timing Chain
11. Vibration damper
12. Cam shaft
13. Valve and Valve mechanism
14. Inlet Manifold and Outlet Manifold
15. Flywheel
16. Silencer

Other components like oil pump, fuel pump, carburetor, distributor, water pump, air filter, oil filter etc are also attached to the engine. The major components of IC Engine is shown in Fig 5.3.

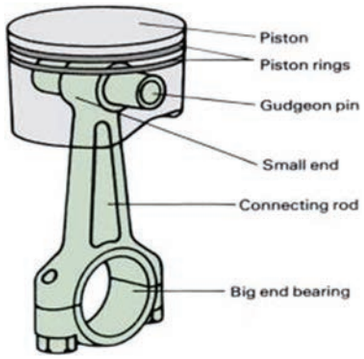
The Material of the major components are shown in Table 5.1.

Cylinder Block

Cylinder Head

Crank Case

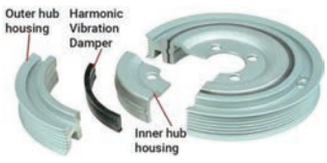
Silencer



Piston Assembly

Cam Shaft

All Types of Valves



Vibration Damper

Manifold

Flywheel

Figure 5.3 Major Components of IC Engine

Table 5.1 Major Parts of an IC Engine and Its Material

Part	Material
Cylinder Block	Grey cast iron or Aluminum alloy
Cylinder Liner	Steel alloy containing Nickel, Manganese, Chromium, Silicon
Cylinder Head	Grey cast iron or Aluminum alloy
Crank Case	Grey cast iron or Aluminum alloy
Oil Sump	Pressed steel
Gasket	Alloy Steel containing copper, asbestos
Piston	Aluminum alloy
Piston Pin	Special steel
Piston Ring	Cast iron
Connecting Rod	Forged Alloy steel
Crank Shaft	Heat treated alloy steel
Vibration Damper	Aluminum alloy or wrought iron
Timing Gear, Timing Chain	Special alloy steel
Cam Shaft	Heat treated alloy steel
Main Bearing	Steel containing phosphor cronze, lead, bronze, tin, antimony and aluminum
Valve	Alloy steel containing silicon, chromium, nickel
Manifold	Cast iron or Aluminum
Flywheel	Pressed steel / cast iron
Silencer	Cast iron or hardened steel

5.3.1 Cylinder Block

The cylinder block is the main supporting structure for the various components. Cylinder block will have one or more cylinders. For multicylinder engine, the cylinders are cast as a single unit, called cylinder block. The cylinder block inner surface is machined and finished accurately for the piston to reciprocate up and down. The cylinder head is mounted on the top of the cylinder block. Cylinder head gasket is placed between the cylinder block and cylinder head. The cylinder head and cylinder block are provided with water jackets or with cooling fins. The crankshaft is mounted on bottom of the cylinder block with the help of bearings. The bottom portion of the cylinder block is called crankcase. A sump for lubricating oil is fastened to the bottom of the crankcase.

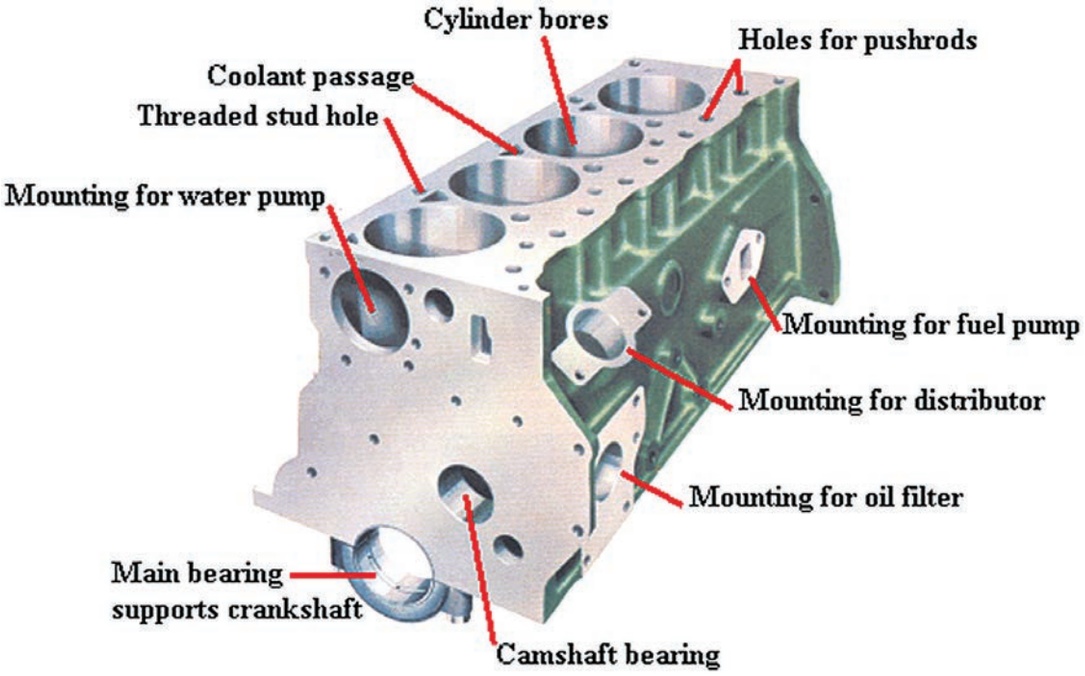
Cylinder blocks are two types

1. **Split block:** Crank case and cylinder block are manufactured as a separate unit and
2. **Mono block:** Crank case and cylinder block are manufactured as a single unit

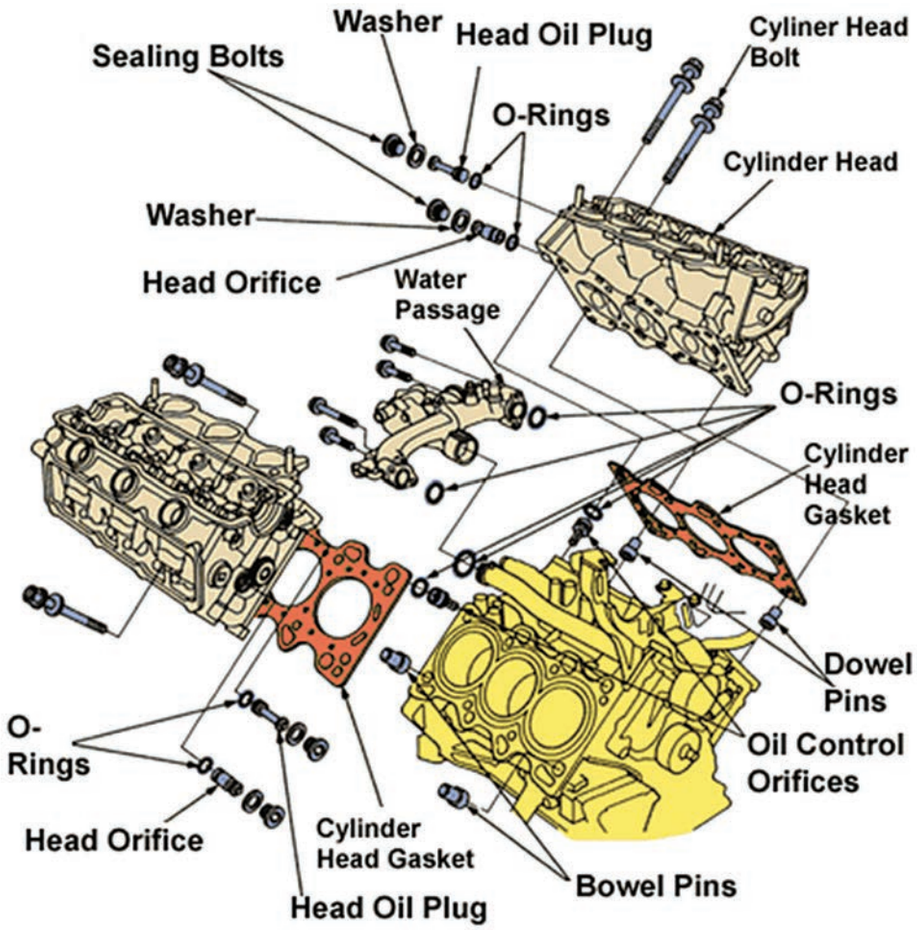
The mono block and split block are shown in Fig 5.3.1.

5.3.2 Cylinder Liner

The cylinder will wear with use, and therefore there may be reduction in



Mono Block



Split Block

Figure 5.3.1 Mono Block and Split Block

performance as well as maintenance cost is increased. In such cases, the use of a sleeve or liner can restore proper clearances to an engine. Due to prolonged use, the liner will wear and it can be replaced at lower cost. Cylinder liners are of two types namely dry liner and wet liner.

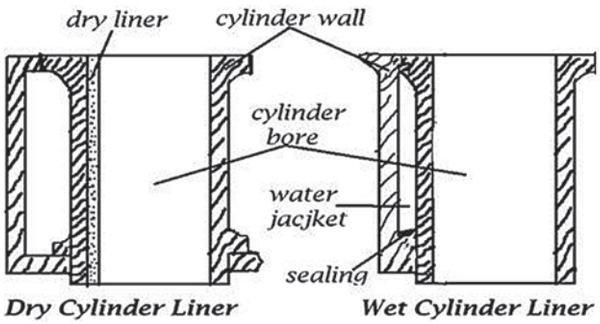


Figure 5.3.2 Dry and Wet Liner

(a) Dry liner

The outer diameter of liner and inner diameter of the cylinder wall are manufactured to fit perfectly. Liners are assembled with the help of hydraulic press or by cooling the liner. The dry type liner is not in direct contact with the coolant hence the name "Dry". The cylinder liner is surrounded by the cylinder body. The cylinder body is contacted by the cooling water so as to achieve heat dissipation. Liner thickness would be 1.5 mm to 3.0 mm. Flanges and seals are at top surface of cylinder.

Figure 5.3.2(a) Dry Liner

Wet liners may have a cooling water space between the engine block and liner, or they may have integral cooling passages. Liners with integral cooling passages are sometimes referred to as water-jacket liners.

(b) Wet liner

The inner surface of wet liner are perfectly machined and honed. The outer surface is not machined. They are referred to as "wet liners" because their outer sides come in direct contact with the engine's coolant. The thickness of the liner will be 3.0mm to 6.0 mm. It is sealed by a metallic sealing ring from top and a rubber sealing ring at the bottom. A wet liner cylinder block features cylinder walls that are entirely removable, which fit into the block by means of special gaskets.

Figure 5.3.2(b) Wet Liner

5.3.3 *Cylinder head*

In an engine, the cylinder head assembled above the cylinders on top of the cylinder block with the help of studs. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a head gasket. The head also provides passage for intake of air and fuel and exhaust of burnt gases, water cooling passage. The head can also be a place to mount the valves, spark

plugs, and fuel injectors. In case of overhead valve engine, then oil passage for pushrod and rocker arm are also available. Cylinder heads are classified as

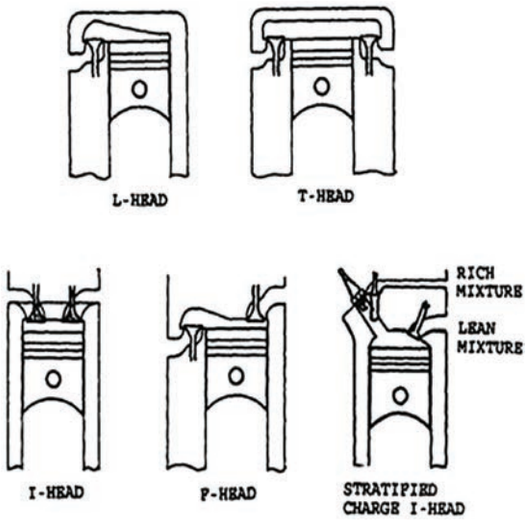


Figure 5.3.3 Types of Cylinder Head

L – Head Engine

I – Head engine

F – Head engine

T – Head engine and are shown in Fig 5.3.3.

5.3.4 Crank case

The crank shaft and cam shaft are placed on the crank case. It is formed as the portion of the cylinder block below the cylinder bore and the oil sump at the bottom. Crank case and the cylinder block are made as a single unit. The oil sump is connected with the crank case by the studs. The Crank case with Crank shaft is shown in Fig 5.3.4

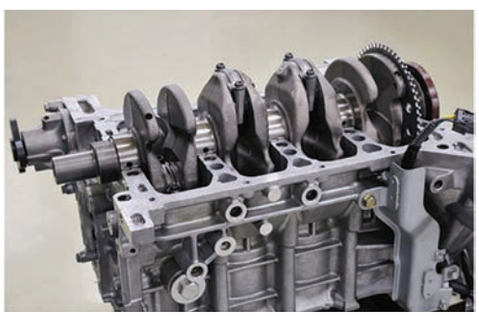


Figure 5.3.4 Crank Case with Crank Shaft

5.3.5 Oil sump

The oil sump is attached below the crank case. It is used to store the lubricating oil which is used for lubricating purpose. To drain or replace the used lubricating oil a drain arrangement is fitted.

Figure 5.3.5 Oil Sump

5.3.6 Gasket

When connecting two metal parts directly, there musty be air tight connection between the parts or otherwise if there is a gap, it allows the gas or the liquid to leak. To arrest the leakage of gas or oil, the gasket is being used. It makes the two metal components air tight and close. Gaskets are placed in the cylinder block, cylinder head crankcase and oil pump and in oil sump. For placing the inlet and outlet manifolds on the cylinder head gaskets are being used.

Figure 5.3.6 Gasket

5.3.7 Piston

The piston is the most important component of the engine. It is kept inside the

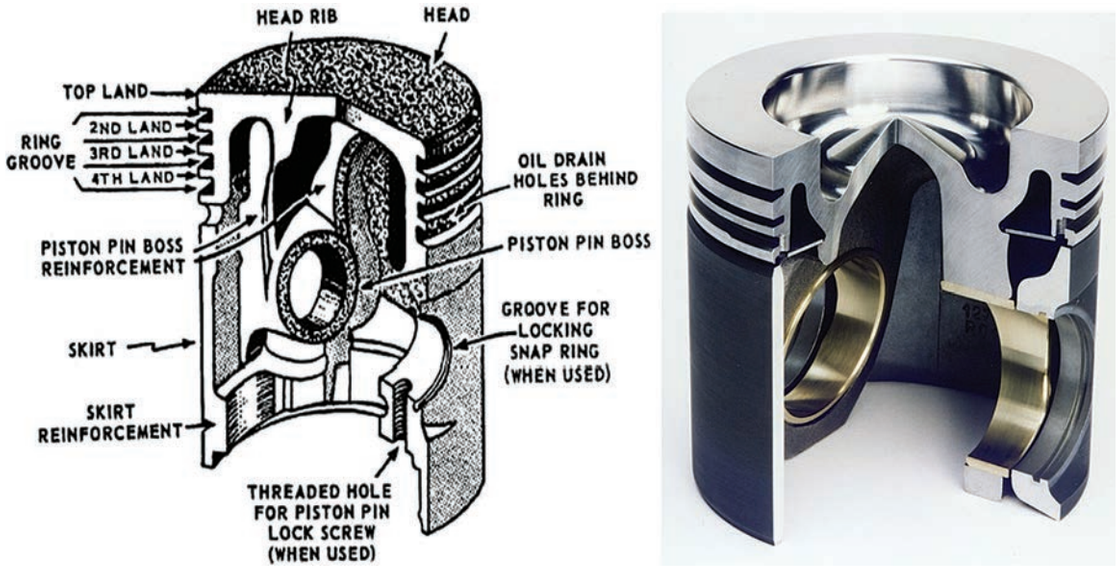


Fig 5.3.7 Parts of Piston

cylinder liner and allowed to move up and down. It is used to suck the air fuel mixture inside the cylinder and transmits the engine power to the connecting rod which is obtained during the power stroke. It is used to convert the heat energy into mechanical energy. The first piston was made of iron. As the usage of iron was heavy, it observed more energy that was produced by the engine. To avoid this power loss the less weight, easily machinable and less price metal alloys such as aluminium alloy are being used nowadays. The piston is shown in Fig 5.3.7.

To make a good piston the following qualities should be maintained while manufacturing.

1. The weight should be less
2. Cost should be low
3. The piston should be easily machinable
4. It should with stand very high temperatures
5. It should have the capacity to transfer more heat quickly.
6. It should not expand easily due to high temperature.

5.3.7.1 Methods to avoid expanding

As the engine is being operated continuously at very high temperatures the piston gets over heated than the engine cylinder. Because the engine cylinder block is continuously cooled by using the cooling water. As the Piston gets more heat than the engine cylinder the piston gets expanded. If the piston expands, the movement of the piston become difficult for it and will stop which affects the engine in producing the power. To avoid this piston expansion the following provisions are adopted on the piston

a. Horizontal slot
b. Heat Dam
c. Vertical slot
d. T slot
e. Oblique slot
f. Solid slot

a) Horizontal slot

The horizontal Slot is being made on the top of the piston, Just below the oil ring at the skirt portion of the piston so that the heat

coming from the piston head during power stroke is observed by the slot. By this way the piston is protected from expansion and allowed to operate the engine safely.

Figure 5.3.7.1(a) Horizontal Slot

b) Heat Dam:

It is like how we store water in ponds and use it when needed. Similar to that to save the heat generated inside the engine combustion chamber and use it effectively small pits in concave shape are made on the piston head which are used to save heat. Hence the heat transfered from the crown to the skirt is being reduced and the expansion of piston is being avoided

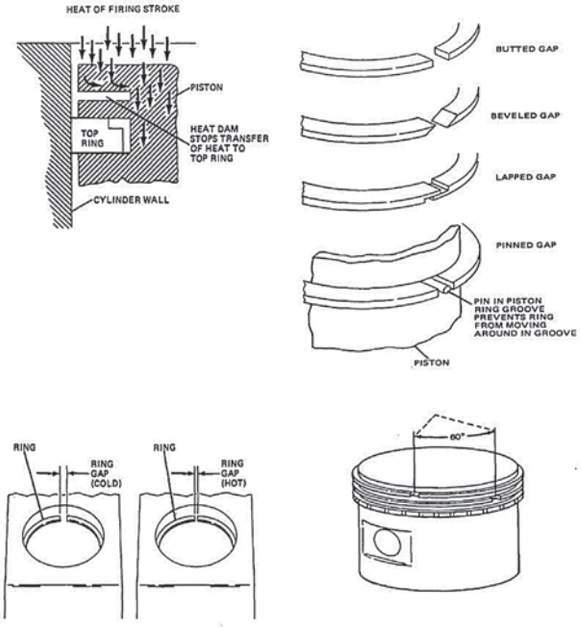


Figure 5.3.7.1(b) Heat Dam

c) Vertical Slot:

This type of slots is used in preventing the piston's expansion due to heat particularly at the outer periphery. The slots are made in selected places where the expansion is predicted to be more in such a way that it should tolerate the expansion of the piston.

Figure 5.3.7.1(c) Vertical Slot

d) T slot:

Similar to the vertical slot piston the T-slot helps the Piston to avoid expansion in the diameter wise as well as in the lengthwise and helps engine to function properly.

Figure 5.3.7.1(d) T-Slot

e) Oblique Slot:

In this type the slots are made on the piston's oil ring slots to control the temperature of the piston. The slots are made slightly in slanting manner such that it reaches the skirt. In this type the heat produced in the engine is blocked in such a way that it should not reach the skirt. The heat is transferred in sideways and also in the lengthwise so that the piston is saved from the high temperature produced inside the engine combustion chamber.

Figure 5.3.7.1(e) Oblique Slot

f) Solid Slot:

Similar to oblique slots, in solid type, small holes are made on the slots of the oil ring. These holes restrict the heat from the head to enter into the skirt. Hence the piston works safely.

Figure 5.3.7.1(f) Solid Slot

5.3.7.2 Functions of piston

In the engine at the combustion chamber the power obtained during power stroke cannot be sent directly to the crankshaft. The component used to transfer the power (gas pressure) from the combustion chamber to the crankshaft through the connecting rod is the piston.

The functions of the piston are listed below.

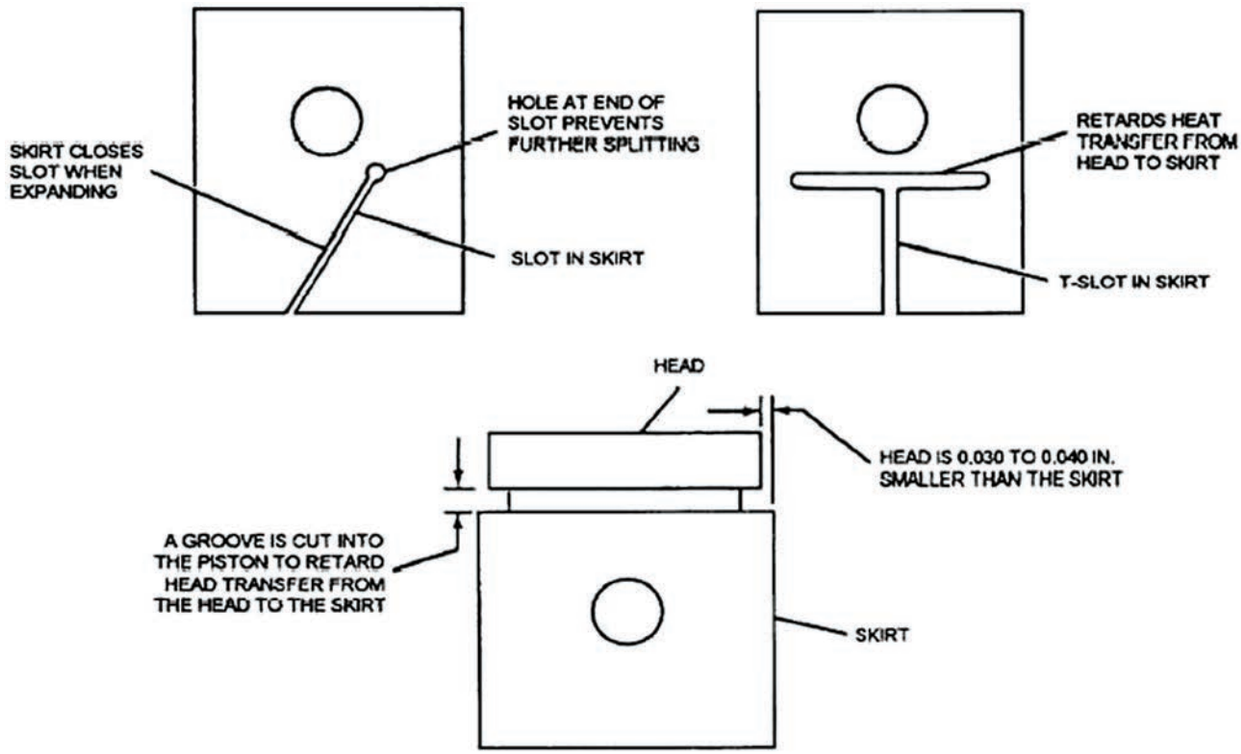


Figure 5.3.7.1 Schematic Diagrams of Various Slot

1. To transfer the power from the combustion chamber to the crank shaft through the connecting rod.
2. To transmit the heat produced from the power to the combustion chamber walls
3. To acts as seal inside the cylinder to withstand high pressure and protects the crankcase in avoiding high pressure to pass to the crank case
4. It acts as a guide to connecting rod
5. It acts as a component for supporting the piston ring
6. It is used to suck the air or air fuel mixture and also used to compress them
7. It is used to expel the hot gases to the atmosphere during the exhaust stroke.

5.3.7.3 Types of piston

Piston is used to transmit power from engine combustion chamber to the crankshaft. Pistons are classified according to their heads hased on the type of engine and its performance. They are classified as follows,

a. Flat head piston
b. Domed head piston
c. Concave (bowl) head piston

a) Flat head piston

In this type, the piston head is in flat shape. This shape helps in removing combusted products after the power stroke. The design of these pistons is very easy. However, the efficiency of the engines using this type of pistons is less.

Figure 5.3.7.3(a) Flat Piston

b) Domed head piston

In this type, the piston head is of cap like structure. ie., more volume is added to the piston head. This structure helps in smooth compression stroke and also results in proper mixing. Compression ratio is higher for using these types of piston. However the manufacturing process is difficult.

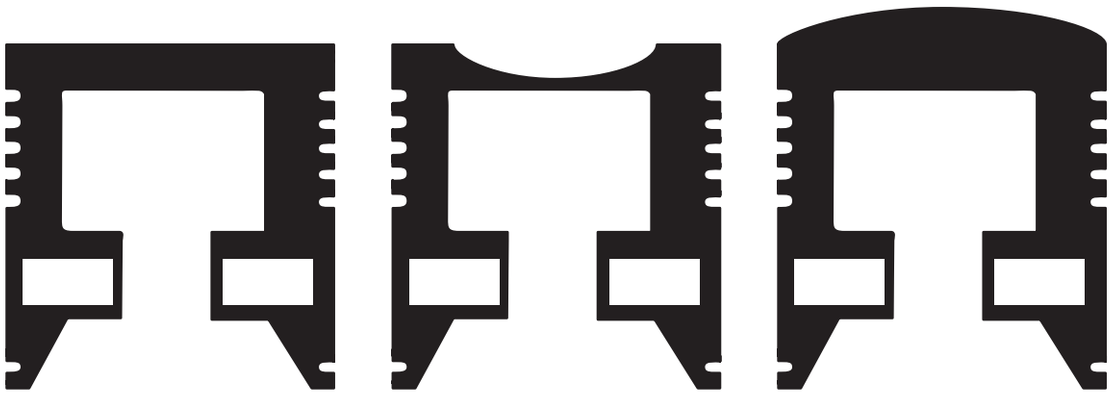


Figure 5.3.7.3 Types of Piston Head

Figure 5.3.7.3(b) Dome Piston

c) Concave head piston

In this type, the piston head is of concave in structure. Due to this, high pressure is produced inside the combustion chamber. These types of piston are used in high compression diesel engines. Concave like structure helps in increasing air turbulence which leads to proper mixing and results in good combustion.

Figure 5.3.7.3(c) Concave head Piston

5.3.7.4 Piston arrangement

The upward and downward motion of cylindrical object inside the cylinder is called piston. Piston consists of heat dam, land, skirt, piston pin boss, rings, grooves. Heat dam is a thin groove cut on the piston head between the top ring groove and the top of the piston. There are slots for compression and oil rings. Below these slots, holes are made for piston pin or piston boss. Slots are present on the

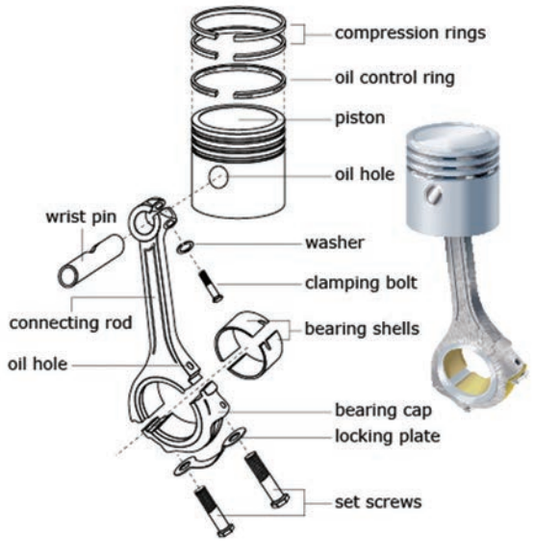


Figure 5.3.7.4 Piston Arrangement

piston skirt. Cylinder liner present inside the cylinder acts as sliding surface for piston.

a) Piston Pin

A piston pin is a hollow shaft that connects the small end of the connecting rod to the piston. It is made up of special alloy steel to prevent wear and tear.

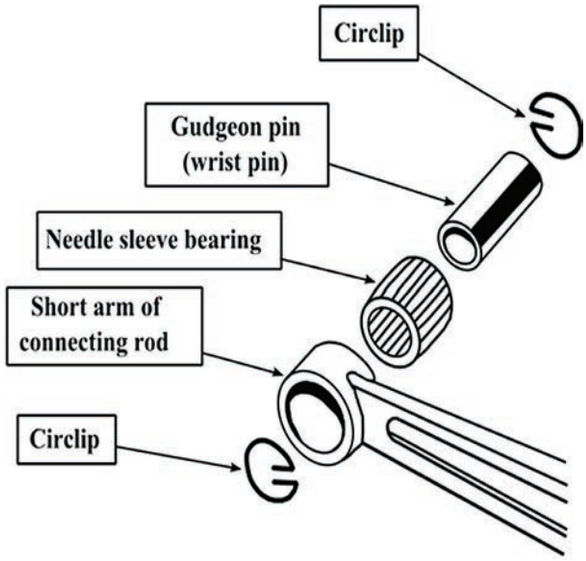


Figure 5.3.7.4(a) Piston Pin

b) Piston Rings

Depending upon the horse power of the engine, one or more piston rings is used. It provides a tight seal between the piston and the cylinder wall thus preventing leakage of combustion gases. The performance of the engine is reduced, if the piston rings are worn out and it can be replaced. Piston rings are classified as

i) Compression ring

ii) Oil scrapper ring

Compression ring

The compression ring seals the combustion chamber from any leakage during the combustion process. When the air-fuel mixture is ignited, pressure from combustion gases is applied to the piston head, forcing the piston toward the crankshaft. The pressurized gases travel through the gap between the cylinder wall and the piston and into the piston ring groove. Combustion gas pressure forces the piston ring against the cylinder wall to form a seal. It also transfers heat from the piston to the cylinder wall. No. of compression ring is depending upon the compression ratio of the engine. Higher the compression ratio more the number of piston rings. Compression rings are made up of Cast Iron.

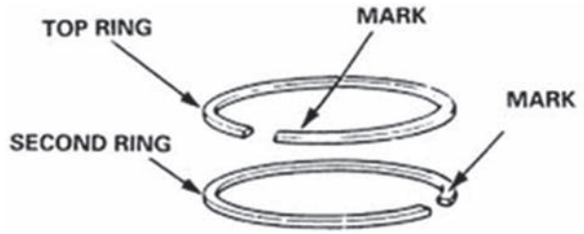


Figure 5.3.7.4(b)(i) Compression Rings

Oil scrapper ring

The bottom most ring is called as oil scrapper ring. The lubricating oils are sprinkled on the cylinder wall and inner side of the piston through the connecting rod oil passage. This ring is used to scrape excess lubricating oil from the cylinder walls, thus prevents the lubricating oil from getting into the combustion chamber of the cylinder Oil scrapper rings are made up of cast iron.

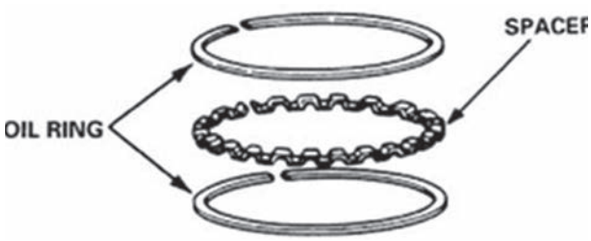
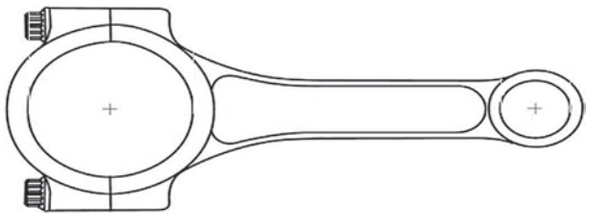


Figure 5.3.7.4(b)(ii) Oil Scrapper Ring

5.3.8 Connecting Rod

It interconnects the piston and the crankshaft and transmits the gas forces from the piston to the crankshaft. The two ends of the connecting rod are called as small end and the big end. Small end is connected to the piston by gudgeon pin and the big end is connected to the crankshaft by crank pin. Connecting rod is made up of Forged steel.



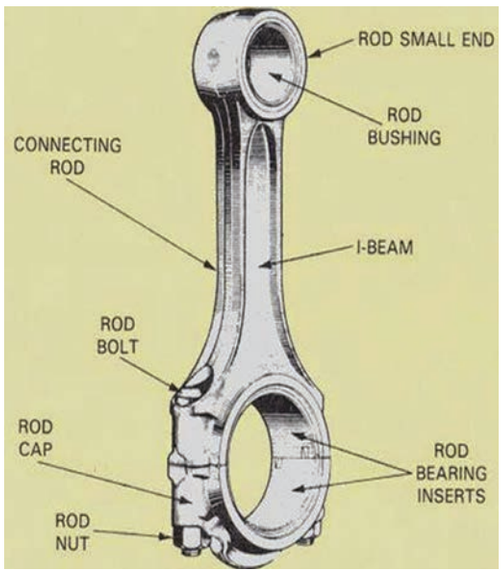


Figure 5.3.8 Connecting Rod

5.3.8.1 Piston, connecting rod and their connection procedures

The engine piston and connecting rod assembly is the most essential arrangement for operating any engine. For connecting the piston and connecting rod piston pin is used. Piston pin is connected with piston and connecting rod based on the three types as indicated below.

a. Fixed Type

B. Semi Floating Type

C. Full Floating Type

The above connecting procedures vary depends upon the torque and power produced from the engine. Piston pin connecting procedures shown in Figure 5.3.8.1.

5.3.8.1(a) *Fixed type:*

In this type the piston and connecting rod are connected with the piston pin by the fixed set of screw inside the piston pin boss for avoiding release of piston pin from its connection. For this purpose, the small end of connecting rod is positioned on centre of the piston pin for attaining the reciprocating motion.

5.3.8.1(b) Semi floating type:

In semi floating type of connection there is a split shaped arrangement in the small end of the connecting rod and it looks like a clamp. This clamp shaped portion is kept with the help of a bolt and nut to avoid removal of piston pin from it. There is a groove at the centre of the piston pin which prevents the pin to not to come out from the clamp. The two ends of the pin are connected

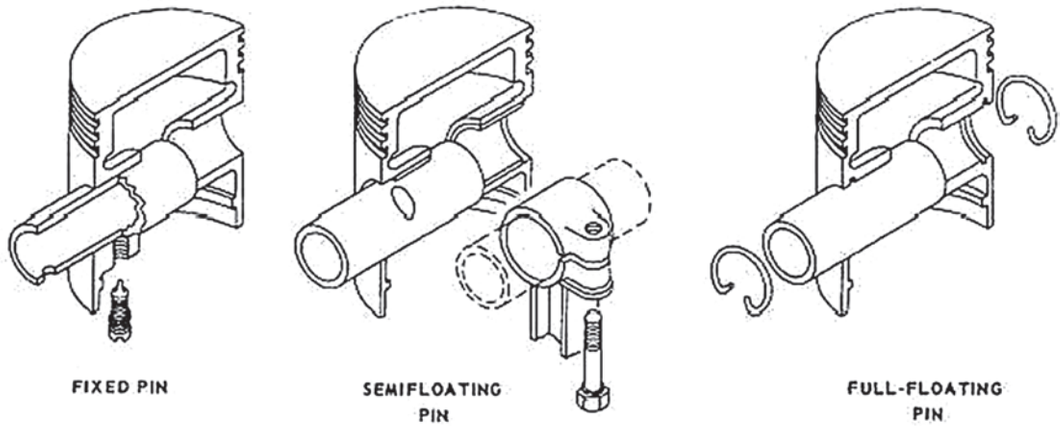


Fig 5.3.8.1 Piston Pin Fixing Method

with the help of the piston pin boss bearing and arrange to be movable within the pin.

5.3.8.1(c) Full floating type:

In this type the connection method of piston pin is designed in a simple way with no much difficulty. During the engine operation for avoiding damage on cylinder wall by the rubbing of piston pin, two circlips were attached with the piston pin boss. In this type, the piston pin is connected at the small end of the connecting rod and piston pin boss and allowed to float (move) easily with in the boss. Hence it is called as full floating type.

5.3.9 Crank Shaft

It converts the reciprocating motion of the piston into useful rotary motion of the output shaft. The crankshaft is enclosed in a crankcase and it is made up of Cast steel.

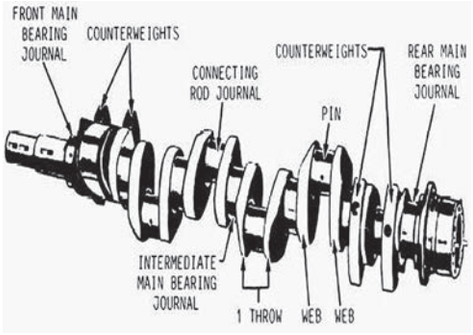


Figure 5.3.9(a) Crank Shaft

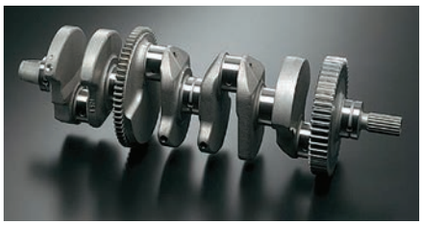


Figure 5.3.9(b) Crank Shaft

5.3.10 Vibration Damper

The power impulses of an engine result in torsional vibration in the crankshaft. If this torsional vibration were not reduced, the crankshaft might break. To avoid this, a vibration damper is mounted on the front of the crankshaft and it controls this vibration. Also a pulley is attached to the vibration damper to drive the fan.

Figure 5.3.10(a) Vibration Damper

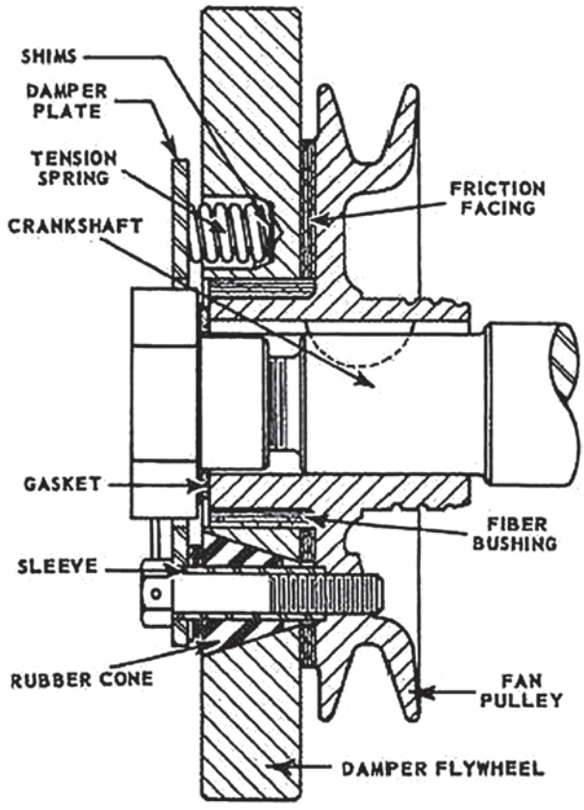
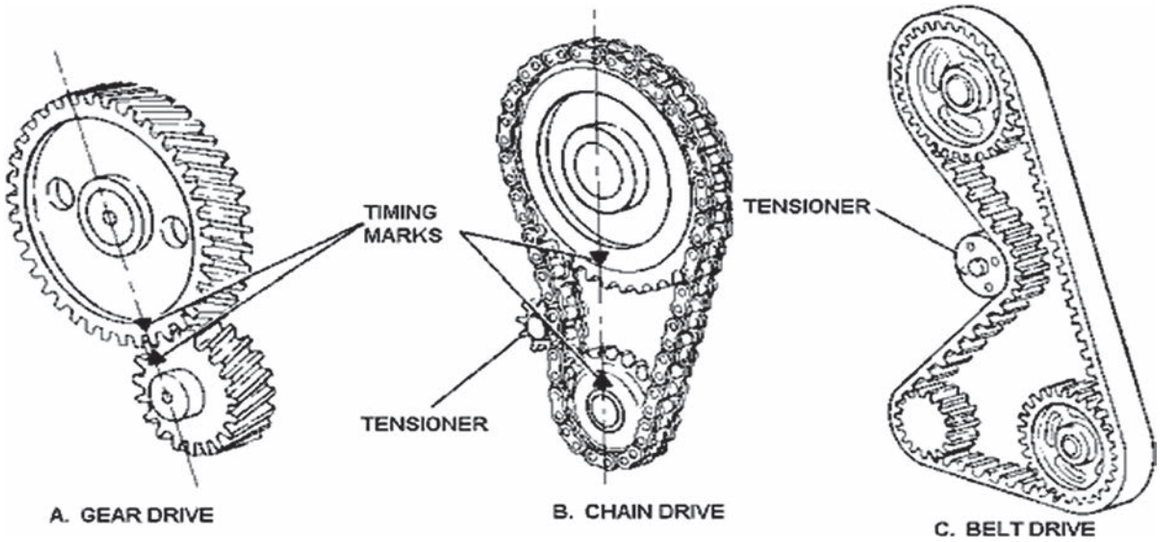
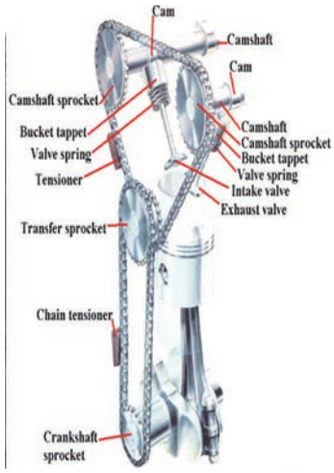


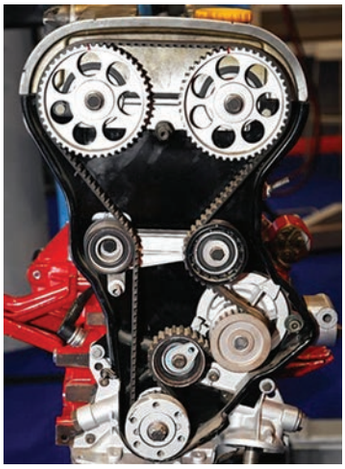
Figure 5.3.10(b) Schematic of Vibration Damper

5.3.11 Timing Gear

Timing gear is used to synchroinse the crankshaft and camshaft. The number of







A. Gear Drive **B. Chain Drive** **C. Belt Drive**

Fig 5.3.11(a, b, c) Timing Gear with Various Drive

teeth in camshaft is always twice the number of teeth in crankshaft. Hence, camshaft will always rotate at half the speed of the crankshaft. Timing mark will be marked in the timing gear. This corresponds to first cylinder TDC position. The marks are properly aligned at the time of engine assembly during manufacturing. This will operate the valve at proper time. If the distance between the crankshaft and camshaft is more, then they are connected by timing chain or by timing belt. Timing Gear with Various Drive shown in Figure 5.3.11(a, b, c)

5.3.12 Cam shaft

For obtaining power from the engine, the processes such as valve opening and closing, supplying the air fuel mixture at the appropriate timings and producing spark in the spark plug in order to ignite the air fuel mixture should be done correctly. For performing this type of operation a component called as cam shaft is used., The cams in the cam shaft are designed in such a way to rotate for opening and closing the valves by the cam shaft according to the valve timing and firing order of the engine. In addition to this, eccentric arrangement in the

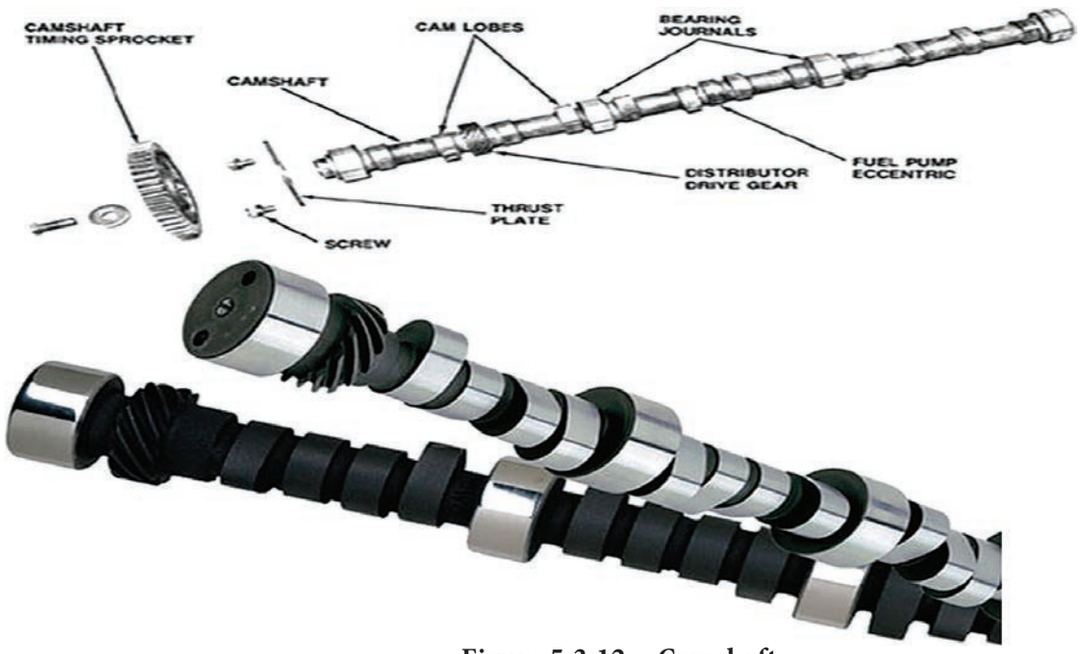


Figure 5.3.12 Camshaft

cam shaft performs the function of actuating the petrol pump and also the skew gear arrangement which is required for operating the oil pump. The timing gear is fitted at the edge of the cam shaft. This gear arrangement is placed in the cylinder block. This gear is made up of special steel for avoiding wear and tear. Cam shaft is actuated by this timing gear with the help of crank shaft. Cam shaft rotates always at half the speed of crank shaft rotation.

5.3.13 Valve

In the engines (generally in four stroke engines) valves are used for supplying enough air fuel mixture into the combustion chamber for combustion and for expelling the burned gases to the exhaust by opening and closing of ports in the engine. There are two valves namely intake and exhaust valves present in the engines. These valves are made up of nickel, chromium alloy steel or silicon chromium alloy steel. The head of the intake valve is generally larger in size than the exhaust valve. These valves are made up of the process called drop forging. In the present days, exhaust valves are produced by austenitic steel. Generally poppet valves are used in present engines.

5.3.13.1 Methods of operating the valves:

In the engine, operating mechanism of the valve varies with the position of the valve arrangements. Valves are placed on the cylinder head in such a way that the valve is moved downwards to open the ports. In another system, valve is placed at the cylinder head in such a way to move upwards to open the ports. Valve mechanisms are generally classified into,

a. Over head poppet valve mechanism
b. Straight poppet valve mechanism

a) Over head poppet valve mechanism:

Construction

This consists of two moving parts, namely push rod and rocker arm. Cam in the can shaft is always in touch with the tappet. One end of the push rod is in contact with tappet and other end with the rocker arm. The other end of

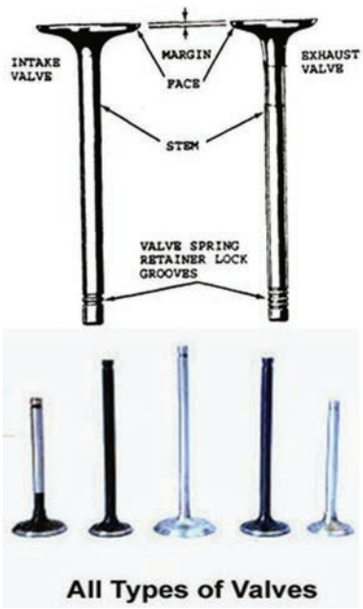


Figure 5.3.13(a) Valves

the rocker arm is made in contact with the valve stem. Rocker arm on the rocker shaft is placed in such a way that it could easily moved up and down. Valves are placed in the valve guides on the cylinder head. Valves are seated properly with the help of valve spring and spring lock.

Operation

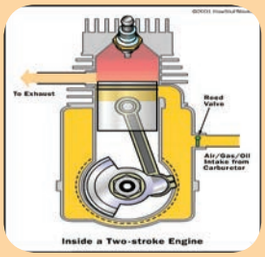
When the engine runs, the crank shaft rotates. As the crank shaft is connected with the cam shaft with the help of the timing gear and chain arrangement the cam shaft rotates now. As the cam shaft rotates, the cam present on the cam shaft also rotates. Once the cam rotates, the tappet (placed on the cam) starts to move up and down depends on the rotation of the cam. Due to this action, the push rod which is in contact with the tappet starts to move up and down. This movement of the push rod lifts one end of the rocker arm upwards. As the rocker arm is fitted with rocker shaft, the other end of the rocker arm moves down towards valve stem due to the lift of the arm end at the push rod side. Due to this valve moves downwards and opens the port. By repeating the cam shaft rotation, tappet, push rod and rocker arm, both inlet and exhaust valves open and close for inducting the charge and expelling the hot gases.

TWO STROKE ENGINE

Sir Dugald Clerk:

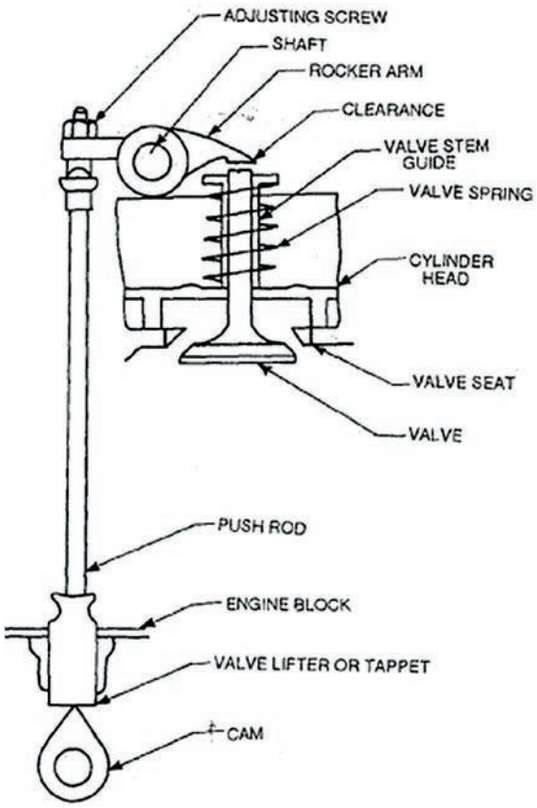
Sir Dugald C lerk (1854, Glasgow – 1932, Ewhurst, S urrey) was a Scottish engineer who designed the world' s first successful two-stroke engine in 1878 and patented it in England in 1881.

He was a graduate of Anderson's University in Glasgow (now the University of S trathclyde), and Yorkshire College, Leeds (now the University of Leeds). He formed the intellectual property firm with George Croydon Marks, called Marks & C lerk. He was knighted on 24 August 1917.

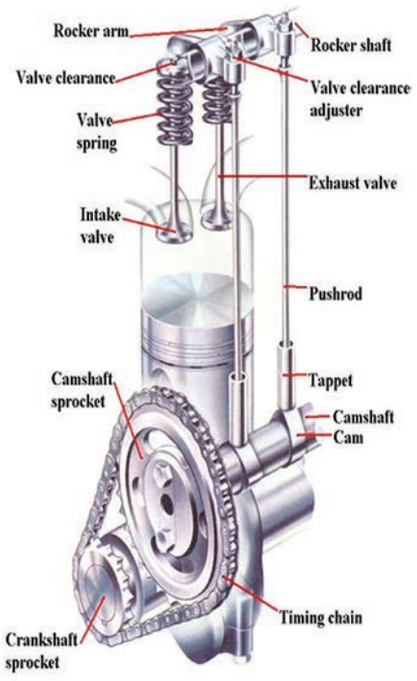


Dugald C lerk was born in Glasgow on 31 March 1854, the son of Donald Clerk a machinist and his wife, Martha Symington. He was privately tutored thenapprenticed to the firm of Messrs H O Robinson & Co in Glasgow.

From 1871 to 1876 he went to Anderson College in Glasgow studying engineering then to the Yorkshire College of Science in Leeds. In the First World War he was Director of Engineering Research for the Admiralty.



(a)



(b)

Figure 5.3.13(b) Over head Poppet Valve Mechanism

b) Straight Poppet Valve Mechanism:

Construction

In this mechanism, all the components of the over head valve except push rod, rocker arm were used. Cam on cam shaft touches tappet. Tappet directly touches valve stem. The valve is fitted with the help of valve spring and the spring lock.

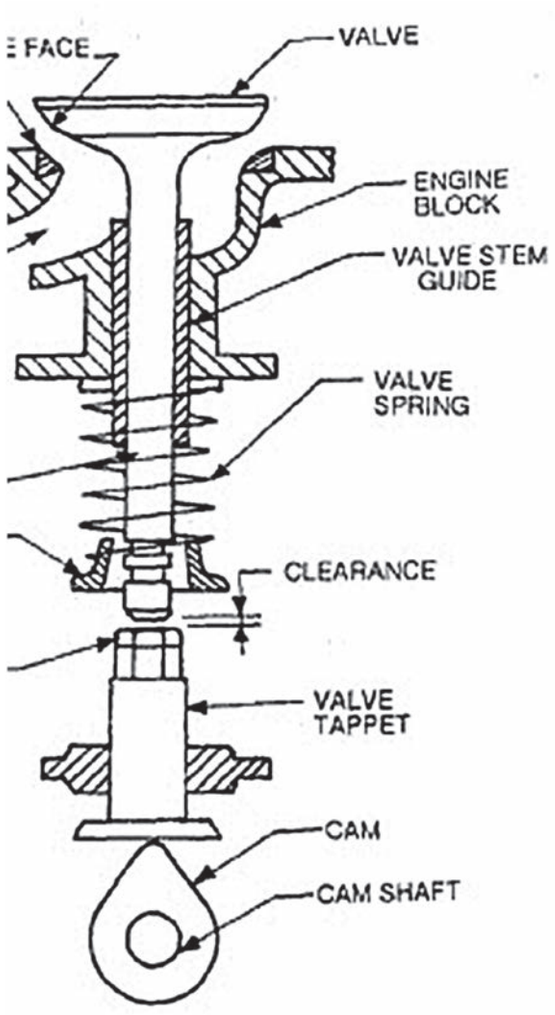


Figure 5.3.13(c) Straight Poppet Valve Mechanism

Operation

When the engine is started the flywheel rotates and the crank shaft starts to rotate. As the crank shaft and cam shaft are connected

by the timing gear and chain the cam shaft rotates. By the rotation of cam shaft the tappet started to move upwards. As the tappet is directly in contact with the valve stem when the tappet moves upwards the valve stem due to the lift of the tappet moves upwards and opens the port. By repeating the cam shaft rotation and tappet movement both inlet and exhaust valves open and close for inducting the charge and expelling the hot gases.

5.3.14 Manifold

Manifolds are the passages through which the air or air fuel mixture enters into the combustion chamber and exhaust gases from the combustion chamber are expelled out. The manifold are of two types they are,

a) Inlet Manifold

b) Exhaust Manifold

a) Inlet Manifold

Inlet manifold is used to pass the air from the filter of the diesel engine or air fuel mixture from carburetor of the petrol engine to the combustion chambers of all the cylinders. This intake manifold is generally made of cast iron. This is fitted at the top of the cylinder head.

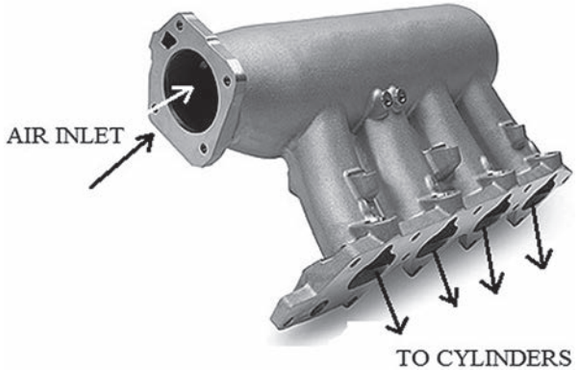


Figure 5.3.14(a) Inlet Manifold

b) Exhaust Manifold

This exhaust manifold is used to transmit the exhaust gases from the cylinder to the silencer. This is fitted between the cylinder head and silencer. This is made of cast iron.

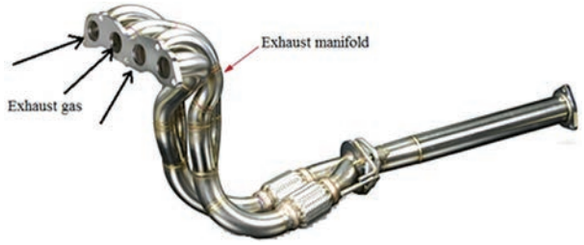
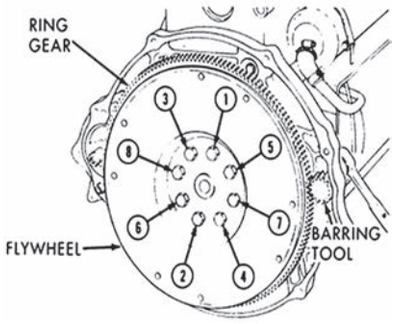


Figure 5.3.14(b) Exhaust Manifold

5.3.15 Flywheel

This is the important component of the engine. This arrangement is used for storing the energy and releasing the energy. It is used to rotate the crankshaft continuously from the initial condition due to its inertia. This is fitted at the end of the crankshaft. It



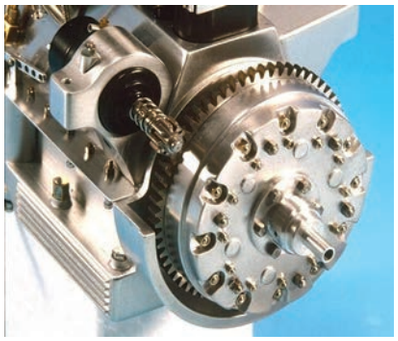


Figure 5.3.15 Flywheel

stores the power during expansion stroke and releases the energy during other strokes. It helps crank shaft to rotate continuously. The flywheel of any engine is generally made of cast iron or brass steel. Ring gear is situated at the periphery of the flywheel. This ring gear is in mesh with the pinion gear of the start motor which is used to start the engine.

5.3.16 Silencer

VBE2Z

After the power stroke of the engine the exhaust gases get expanded and expelled through the exhaust manifold. During the exhaust process when the gases are passed through exhaust manifold, due to pressure differential huge noise is produced. This leads to noise pollution. In order to reduce the noise pollution and to operate the engine in smooth condition silencer is used. Silencer acts as resistant for noise and converts the sound energy into heat. Fibre glass is generally used as the insulation material inside the silencer. Chambered, turbo, straight flow are the types of silencer used in automobile.

Figure 5.3.16 Silencer

5.4 FOUR STROKE PETROL ENGINE

Engine running with petrol as a fuel is called as petrol engine. If a power stroke is obtained once in every four stroke of piston (TDC to BDC / BDC to TDC), then the engine is said to be four stroke petrol engine.

Construction

The figure shows the construction of a single cylinder petrol engine. In this the reciprocating motion of a cylinder is converted into rotary motion of crankshaft with the help of connecting rod. One end of connecting rod is connected to piston and another end it is connected to crankshaft. In crankshaft, flywheel is attached at one end and vibration damper, fan belt pulley is attached at the other end. Intake valve, exhaust valve, spark plug is mounted above the top of the cylinder. The fresh air fuel mixture is inducted through intake valve and the burnt gases are sent out through exhaust valve. The opening and closing of valve are made by camshaft. The camshaft and crankshaft are connected by means of timing gear. The four stroke petrol engine is shown in Figure 5.4.

In any internal combustion engine, the following definite sequence of events called strokes namely

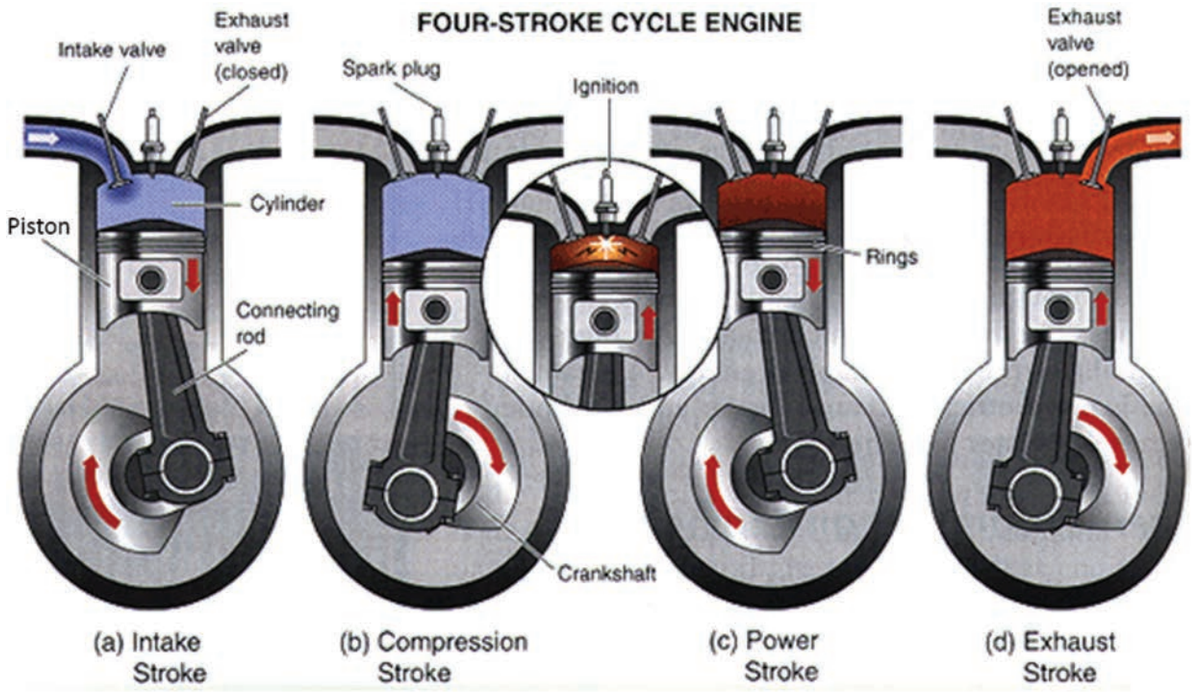


Figure 5.4 Working of Four Stroke Petrol Engine

a. Suction Stroke,

B. Compression Stroke,

C. Power Stroke And

D. Exhaust Stroke

The above four strokes will form a cycle. If the cycle of operations is completed in four strokes of the piston or two revolutions of the crankshaft or one revolution of the camshaft, then it is called as a four-stroke engine.

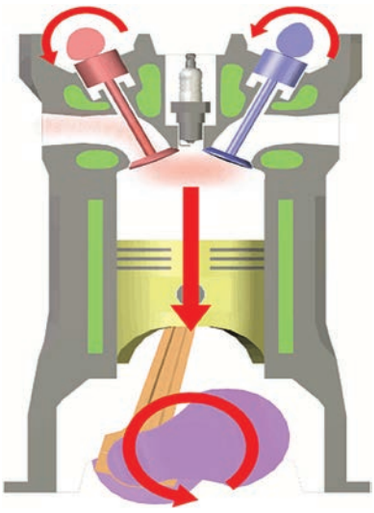


Figure 5.4(a)

a) Suction Stroke

During the suction stroke, the piston moves downward from Top Dead Centre to Bottom Dead Centre. The intake valve is open and exhaust valve is closed. This downward movement of the piston produces a partial void, or vacuum, in the cylinder, and air – fuel mixture rushes into the cylinder through the opened intake valve.

b) Compression Stroke

The charge taken into the cylinder during the suction stroke is compressed by the return stroke of the piston. The piston travels from bottom dead centre to top dead centre. During compression stroke both inlet and exhaust valves are in closed position.

The mixture which fills the entire cylinder volume is now compressed into the clearance volume. At the end of the compression stroke the mixture is ignited with the help of a spark plug located on the cylinder head.

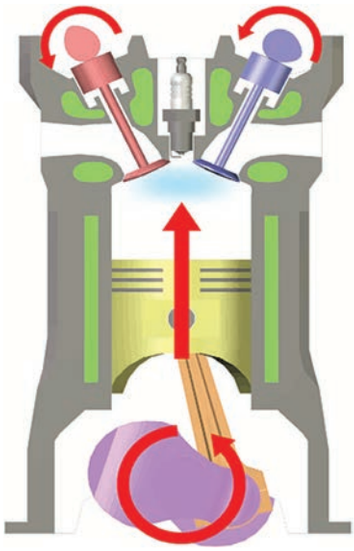


Figure 5.4(b)

c) Power Stroke

Rapid combustion of the fuel releases heat and there is an increases in the temperature inside the combustion chamber. The increased temperature of the gases also produces an increased pressure in the combustion chamber. The high pressure of the gases acting on the face of the piston causes the piston to move from TDC to BDC. This reciprocating motion is converted into the rotary motion of crankshaft through connecting rod. During power stroke, both inlet and exhaust valves are in closed condition. As the piston travels downward, there will be drop in combustion pressure and temperature as the volume increases. At the end of power stroke, exhaust stroke will be started.

d) Exhaust Stroke

At the end of power stroke, exhaust stroke will be started. During this stroke, the exhaust vavle will be open and the inlet value will be closed. When the piston from BDC to TDC, the burnt air fuel mixture is sent out through exhaust valve.

At the end of exhaust stroke, the intake stroke of the next cycle starts and this keep the engine in running condition.

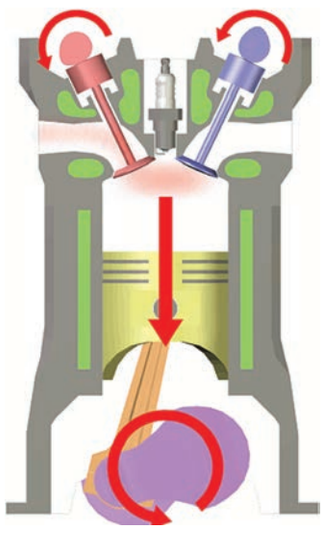


Figure 5.4(c)

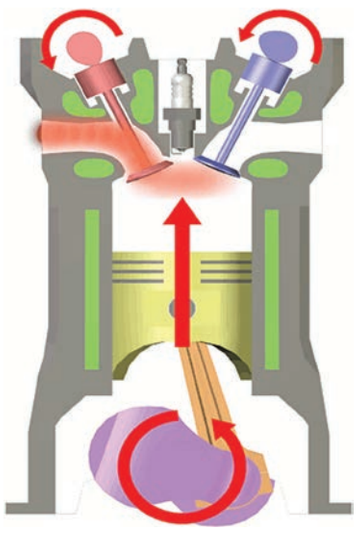


Figure 5.4(d)

Scavenging

At the end of exhaust stroke the exhaust valve is open and at the start of intake stroke, the inlet valve is kept open. At this time, fresh air – fuel mixture for the next cycle will pushes out the exhaust gases of the previous cycle. Thus, Scavenging is the process of removal of exhaust gases by blowing in fresh air.

Valve Over Lap

At the end of exhaust stroke the exhaust valve is open and at the start of intake stroke, the inlet valve is kept open. The time duration in which both the valves are kept open is called as valve overlap.

Advantages

- ❒ Fuel economy
- ❒ Lubrication oil Consumption is less
- ❒ Can be used in different vehicle
- ❒ Thermal Efficiency is high
- ❒ Volumetric Efficiency is high
- ❒ Low wear and tear

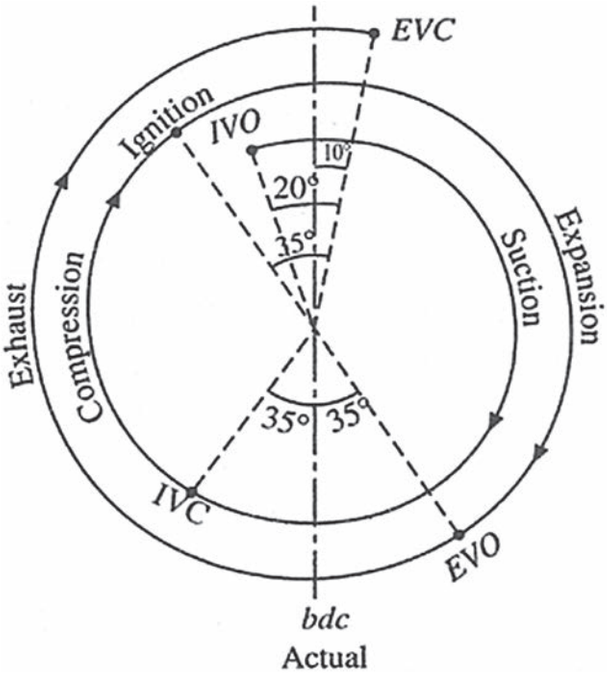
Disadvantages

- ❒ Number of parts are more
- ❒ Mechanical Efficiency is low
- ❒ Maintenance cost is more
- ❒ Complicated design
- ❒ More space is required

e) Valve Timing Diagram For A Four Stroke Petrol Engine

In a four stroke engine, an engine cycle to produce power is done on every two revolution of crankshaft. Theoretically it may be assumed that the valves open and close and the spark (or injection of fuel)occurs at the engine dead centres. However, in actual operation, the valves do not operate at dead centre positions but operate some degree on either side of the dead centres. The opening occurs earlier and the exhaust continues even at later crank angles. The ignition is also timed to occur in advance of the completion of compression stroke.

The timings of this sequence of events can be shown graphically in terms of crank angles from dead centre position. This diagram is known as valve timing diagram. It is shown in figure 5.4(e).



TDC = Top dead centre, BDC = Bottom dead centre, IVO = Inlet valve opens IVC = Inlet valve closes, EVO = Exhaust valve opens, EVC = Exhaust valve closes

Figure 5.4(e) Valve Timing Diagram For Four Stroke Petrol Engine

Intake valve timing:

The inlet valve will be open 10° to 30° before TDC (i.e during exhaust stroke), remain open during suction stroke and closes at 30° to 40° after BDC (i.e. during compression stroke). This gives the inlet valve a total opening of 220° of crankshaft rotation. This will ensure the full induction of fresh charge in cylinder during suction stroke.

After the inlet valve closed in the compression stroke, the air fuel mixture is compressed by the piston. This will increase the pressure and temperature in the cylinder.

With both intake and exhaust valve are in closed condition, the spark will be introduced by the ignition system through spark plug at 20° to 40° before TDC. These will initialise the combustion and the air fuel mixture will be burned in the combustion chamber. Thus the chemical energy of the fuel is converted into heat energy.

Exhaust valve timing:

The exhaust valve opens at 30° to 60° before the completion of power stroke. Due to this, the gases have an outlet for expansion, which removes the greater part of the burnt gases. The valves remain open during open during the exhaust stroke and it is closed at 20° after TDC, during the intake stroke of the next cycle.

Scavenaging

The inlet valve will be open 10° to 30° before TDC and at the same time the exhaust valve is already in the open condition. This will make the fresh charge to push out the burnt out gases from the cylinder. Scavenging will be made till 20°After TDC.

Valve over Lap

The portion of the operating cycle in which, when the piston is passing TDC (top dead centre) on the exhaust stroke, both the intake and exhaust valves are open. It is usually expressed in degrees of crankshaft rotation. Valve overlap is necessary for the efficient flow of gases in and out of the combustion chamber.

5.5 TWO STROKE PETROL ENGINE

The two stroke cycle engine completes one power stroke in one revolution of a crankshaft.

Construction

Inside the engine, the small end of the connecting rod is connected to the piston with the help of piston pin. The big end of the connecting rod is connected to the crankpin of the crankshaft. When the crankshaft rotates, the piston will reciprocate on the cylinder and vice versa. There is no inlet and exhaust valves as in case of four-stroke engine but consists of the inlet port (IP), an exhaust port (EP) and transfer port (TP). The fresh charge enters into the crankcase through inlet port. Transfer port is used to transfer the compressed charge from crankcase to the cylinder. Exhaust port is used to transfer the burnt gases out of the engine. The movement of the piston will open and closes the ports. A spark plug will be placed in the engine head.

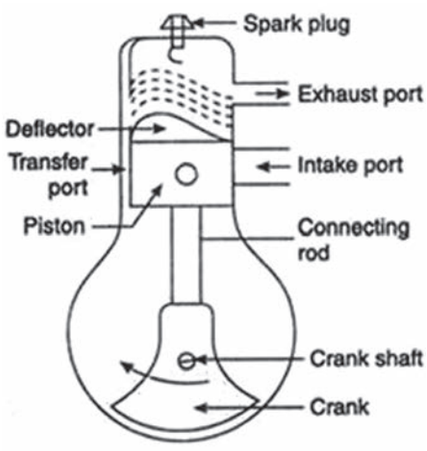


Figure 5.5(a) Two Stroke Petrol Engine

Working principle

In two stroke engine, all the four events namely suction, compression, power and exhaust cannot be distinctly identified. For each revolution of crankshaft or for every two stroke of piston, a working / power stroke is obtained. Hence the cycle of operation can be explained with two stroke of piston movement namely Upward stroke and Downward stroke.

Upward Stroke

During upward stroke, the piston moves from BDC to TDC. It expels the burnt gases to the atmosphere through the exhaust port. It closes the transfer port and then the exhaust port. Then it compresses the already inducted charge (air-fuel mixture) in the combustion chamber of the cylinder. At the end of the upward stroke, the ignition of the fresh charge is takes place by the spark plug.

Further, the upward movement of the piston a partial vacuum is created in the crankcase and this allows the entry of the fresh charge into the crankcase through uncovered inlet port. The exhaust port and the inlet port remains covered when the piston at the TDC.

Downward stroke:

As soon as the combustion of the fresh charge takes place, a large amount of the hot

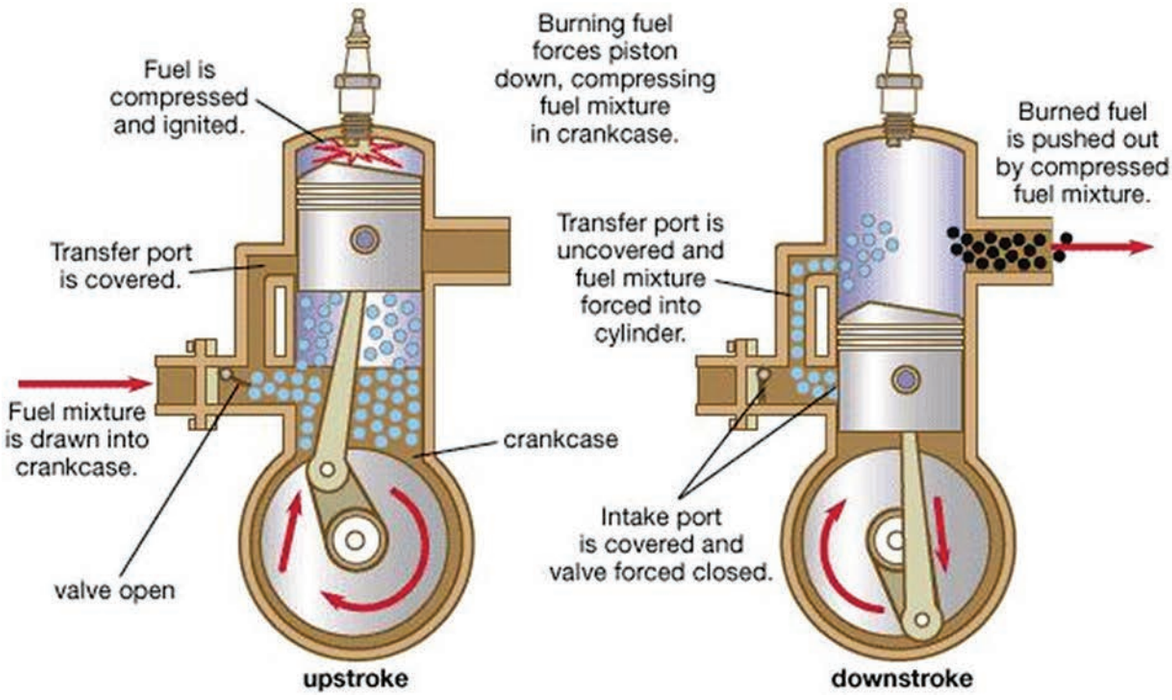


Figure 5.5(b) Upword and Downword Stroke of Two Stroke Petrol Engine

gases is produced and this exerts a very high pressure force on the top of the piston. Due to this high pressure force, the piston moves downward and rotates the crankshaft and does useful work.

During this stroke the inlet port is covered by the piston and the new charge is compressed in the crankcase due to the downward movement of piston.

Further downward movement of the piston uncovers first the exhaust and the exhaust starts through the exhaust port.

Further downward movement of the piston uncovers port the transfer port and the charge through it is forced into the cylinder.

The charge strikes the deflector on the piston crown, rises to the top of the cylinder and pushes out most of the exhaust gases.

The piston is now at BDC position. The cylinder is completely filled with the fresh charge but it is somewhat diluted with the exhaust gases.

Finally the cycle event is then repeated and the power stroke is obtained for the every single revolution of the crankshaft.

Reason for less power in two stroke engine

- The fresh air fuel charge is mixed with exhaust gas and sent out before combustion
- The charge is diluted by the burnt gases due to incomplete scavenging.
- Combustion is improper as lubrication oil is mixed with fresh charge
- Volumetric efficiency of the engine is low.

Advantages:

- Smoother in operation
- It is simpler in construction and mechanism.

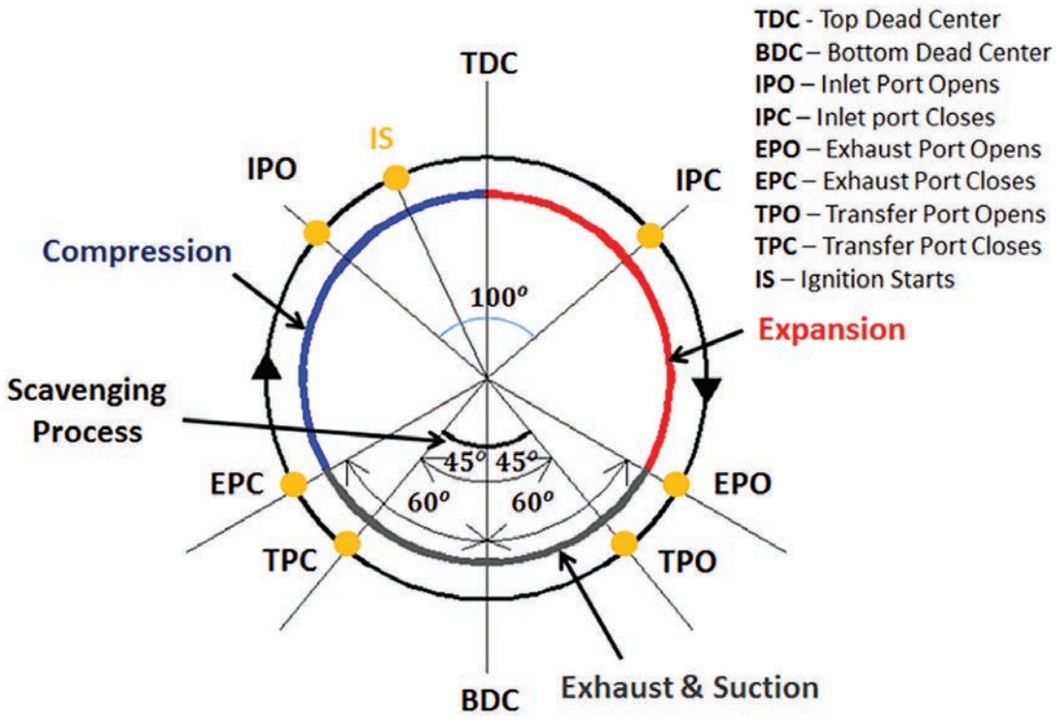


Figure 5.5(c) Port Timing diagram of Two Stroke Petrol Engine

- Power developed by the two stroke engine is twice that developed by the four stroke engine for the same engine speed and volume.
- Cost of the engine is less since less no. of parts
- Less maintenance since fewer spare parts due to its simple design
- Low manufacturing cost
- It has high mechanical efficiency.
- A two stroke engine is more compact, light and requires less space

Disadvantages:

- It has high fuel consumption
- It does more consumption of the lubricating oil.
- Not suitable for heavy vehicles
- There is a greater wear and tear of moving parts.
- Thermal efficiency is less than four stroke engine.
- The charge is diluted by the burnt gases due to incomplete scavenging.
- It produces greater noise.

5.6 COMPARISON OF TWO STROKE AND FOUR STROKE ENGINE

The two stroke and four stroke engine are compared and their differences are given below (Table 5.6).

Table 5.6 Differnce Between Two Stroke and Four Stroke Engine

S.no	Two Stroke Engine	Four Stroke Engine
1.	It has one revolution of crankshaft within one power stroke.	It has two revolution of crankshaft between one power strokes.
2.	2 strokes are required to complete a cycle.	4 strokes are required to complete a cycle.
3.	It requires lighter flywheel because it generates more balanced force due to one revolution for one power stroke.	It requires heavy flywheel because it generates unbalance force due to two revolutions for one power stroke.
4.	One non-power stroke in a cycle	Three non-power stroke in a cycle
5.	Engines are lighter	Engines are heavier
6.	Engine construction is simple.	The Engine construction is a bit complicated
7.	Ports are used for inlet and outlet of air fuel mixture	Valves are used for inlet and outlet of air fuel mixture
8.	Ports are opened and closed by piston movements	Valves are operated by separate valve operating mechanism.
9.	Less no. of moving parts	More no. of moving parts
10.	Volumetric efficiency is less	Volumetric efficiency is more
11.	Thermal efficiency is less	Thermal efficiency is more
12.	Two stroke engines are less efficient and generate more smoke.	Four stroke engines are more efficient and generate less smoke.

S.no	Two Stroke Engine	Four Stroke Engine
13.	These engines are easy to manufacture.	These engines are comparatively hard to manufacture.
14.	More wear and tear occurs	Less wear and tear occurs.
15.	A part of air fresh air fuel mixture mixes with the exhaust gas, hence less power.	Burnt out gases is not mixed with fresh charge, hence more power.
16.	Fuel consumption is more.	Fuel consumption is less
17.	High power-to-weight ratio	Less power-to-weight ratio
18.	More noise	Less noise
19.	Air cooled engine.	Air / water cooled engine.
20.	Works based on Clerk cycle.	Works based on otto / diesel cycle
21.	Easy lubrication due to lubrication oil mix with the fuel.	Complex lubrication mechanism
22.	Consumption of lubrication oil is more because some oil burns with fuel.	Consumption of lubrication oil is less
23.	Less weight	More weight
24.	Used in scooter, mopeds, auto rickwsaw.	Used in motor cycles, autoricksaw, car, bus, lorry, trucks, tractors etc.

5.7 FOUR STROKE DIESEL ENGINE

The engine which uses diesel as a fuel is called as diesel engine. The compression ratio for diesel engine is higher and it will be ranging from 16 : 1 to 20 : 1. The compression ratio for a petrol engine is 10:1. During suction stroke, the air alone is inducted. The fuel is pressured and distributed to various cylinders through the fuel injection pump. Diesel injector will be located in cylinder head for injecting the diesel fuel at high pressure. There is no spark plug. All the remaining parts are similar to petrol engine.

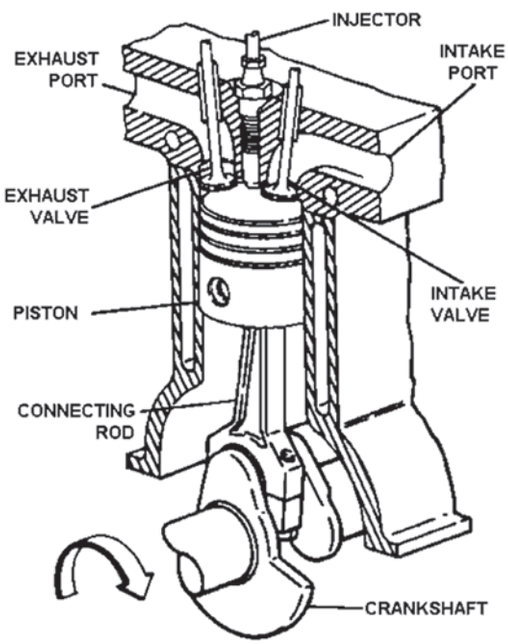


Figure 5.7(a) Four Stroke Diesel Engine

Construction

The construction of a single cylinder diesel engine is shown in above figure. The reciprocating motion of a piston is converted into rotary motion of a crankshaft through connecting rod. The piston and the crankshaft are connected by means of a connecting rod. The flywheel is attached to the one end of the

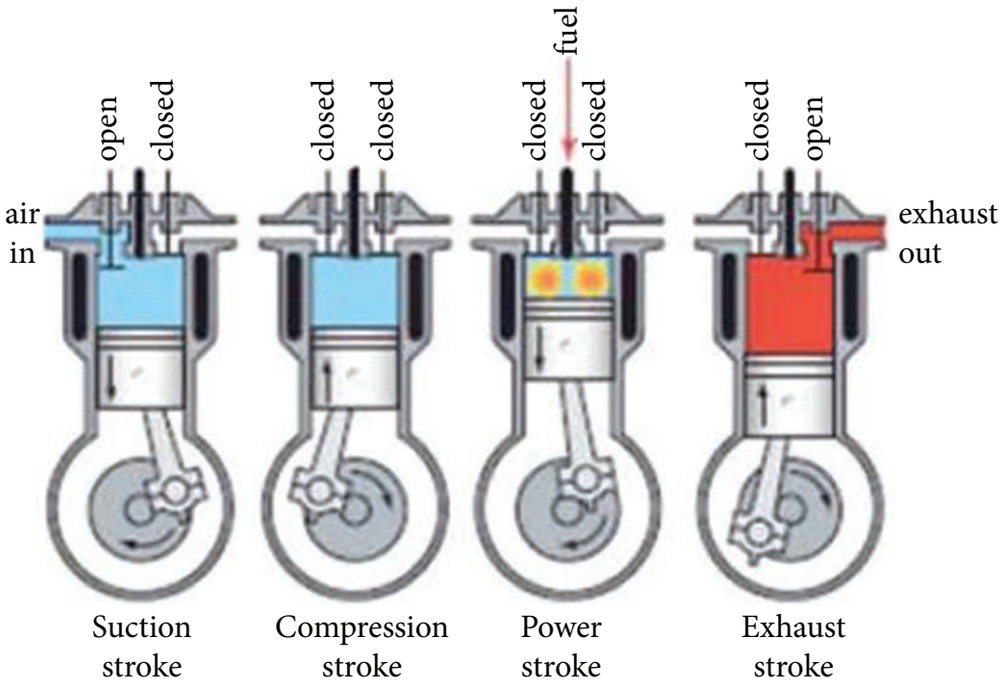


Figure 5.7(b) Working of Four Stroke Diesel Engine

crankshaft and on another side a pulley is attached to it. Inlet valve, exhaust valve and fuel injector are located on the engine head. The inlet valve will allow the air inside the cylinder, the fuel injector will inject the fuel and the exhaust valve will sent the burnt gases to the atmosphere. The valves are operated by the camshaft. The camshaft is driven by crankshaft through timing gear.

The following sequence of events will occur continuously for the engine operation. The figure shows the sequence of events

- ❒ Air alone induced inside the cylinder
- ❒ Air alone compressed
- ❒ Finely automised diesel fuel is injected onto the compressed air followed by combustion
- ❒ Burnt gases are let out from the cylinder.

The above sequence of operation forms a cycle and for each operation, a piston stroke is required. Thus for four operation, four strokes are required and hence it is called as four stroke engine. The four strokes are namely called

i. Suction Stroke
Ii. Compression Stroke
Iii. Power Stroke
Iv. Exhaust Stroke

i) Suction Stroke

In this stroke, the piston moves down from the top dead centre towards the bottom dead centre. The inlet valve opens and the air is drawn into the cylinder due to the vacuum created inside the cylinder. To fill the vacuum, the air is entered inside the cylinder. The inlet valve closes at the end of the stroke and the exhaust valve remains closed during this stroke.

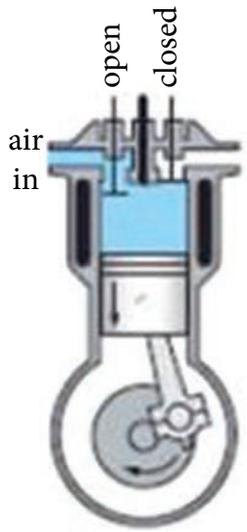


Figure 5.7.1(a) Suction Stroke

ii) Compression Stroke

In this stroke, the piston moves up from bottom dead centre to top dead centre. During this stroke, both inlet and exhaust valves are closed. The air drawn into the cylinder during suction stroke is entrapped inside the cylinder and compressed due to upward movement of the piston. The fuel is injected at the end of the compression stroke by the injector and the fuel ignites.

Figure 5.7.1(b) Compression Stroke

iii) Power Stroke

The hot gases which are produced due to ignition of fuel during compression stroke and compressed air now expand adiabatically, in the cylinder pushing the piston down towards the BDC. This downward movement of the piston is converted into rotary motion of the crankshaft and hence work is done. During expansion, the pressure and the temperature reduce. In this stroke, both inlet and exhaust valve remain closed.

Figure 5.7.1(c) Power Stroke

iv) Exhaust Stroke

At the end of the power stroke, exhaust stroke will start. In this stroke, the piston again moves upward. The exhaust valve opens, while inlet valve is closed. A greater part of the burnt fuel gases escapes due to their own expansion. The upward movement of the piston pushes the remaining gases out through the open exhaust valve. At the end of an exhaust stroke, the exhaust valve closes and the cycle is thus completed and suction stroke of next cycle is started.

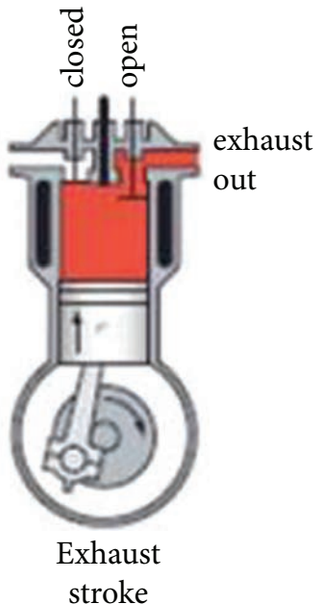


Figure 5.7.1(d) Exhaust Stroke

Scavenging

During the end of exhaust stroke and start of the suction stroke, the inlet valve and exhaust valve will be kept open condition. This will make the fresh charge to push out the burnt out gases from the cylinder and this phenomenon is called as scavenging.

Valve over Lap

The portion of the operating cycle in which both the intake and exhaust valves are kept open is called as valve overlap. It is usually expressed in degrees of crankshaft rotation. Valve overlap is necessary for the efficient flow of gases in and out of the combustion chamber.

Advantages

- ❒ Operating cost is less
- ❒ Lubrication oil consumption is less
- ❒ Can be used in all types of vehicle
- ❒ Thermal Efficiency is high
- ❒ Volumetric Efficiency is high
- ❒ Wear and tear is less

Disadvantages

- ❒ No. of moving parts is more
- ❒ Mechanical Efficiency is low
- ❒ Maintenance cost is more
- ❒ Complicated design
- ❒ More space is required

e) Valve timing diagram of four stroke diesel engine

The valve timing diagram for a four stroke cycle diesel engine is shown in Figure 5.7 (a) below:

In a four stroke diesel engine, an engine cycle to produce power is done on every two revolution of crankshaft. It may be assumed that the valves open and close and injection of fuel occurs at the engine dead centres. However, in actual operation, the valves do not operate at dead centre positions but operate some degree on either side of the dead centres. The opening occurs earlier and the exhaust continues even at later crank angles. The fuel injection is also timed to occur in advance of the completion of compression stroke. The diagram which shows the position of crank of four stroke engine at the beginning and at the end of suction, compression, expansion and exhaust of the engine are called as valve timing diagram. This diagram is known as valve timing diagram.

Inlet valve opening and closing:

In an actual engine, the inlet valve begins to open 10° to 25°before the piston reaches the TDC during the exhaust stroke. This is necessary to ensure that the valve will be fully open when the piston reaches the

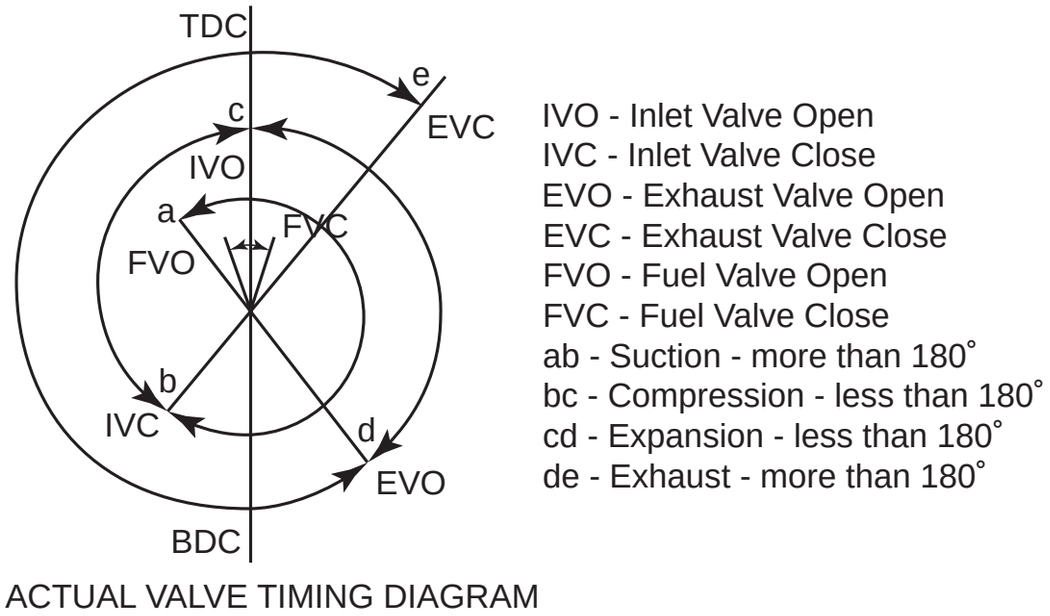


Fig 5.7(a) Valve Timing Diagram of Four Stroke Diesel Engine

TDC. If the inlet valve is allowed to close at BDC, the cylinder would receive less amount of air than its capacity. To avoid this, the inlet valve is kept open for 25°to 45°after the BDC, during the compression stroke. This will ensure the full induction of fresh charge in cylinder during suction stroke.

After the inlet valve closed in the compression stroke, the air is compressed by the upward motion of the piston. This will increase the pressure and temperature inside the cylinder.

With both intake and exhaust valve are in closed condition, the fuel injector will inject the diesel fuel at high pressure at 5° to 10° before TDC. The temperature of the compressed air at the end of compression stroke is sufficient enough to initialise the finely automised diesel fuel for combustion. The air fuel mixture will be burned in the combustion chamber. Thus the chemical energy of the fuel is converted into heat energy. Based on the speed of the engine, the fuel is injected even 25° before TDC.

Exhaust valve timing:

The exhaust valve opens at 30° to 60° before the completion of power stroke. Due to this, the gases have an outlet for expansion, which removes the greater part of the burnt gases. The valves remain open during open during the exhaust stroke and it is closed at 20° after TDC, during the intake stroke of the next cycle.

Scavenging

The inlet valve will be open 10° to 30° before TDC during exhaust stroke and at the same time the exhaust valve is already in the open condition. This will make the fresh charge to push out the burnt out gases from the cylinder. Scavenging will be made till 20° after TDC.

Valve over lap

The portion of the operating cycle in which, when the piston is passing TDC (top dead centre) on the exhaust stroke, both the intake and exhaust valves are open. It is usually expressed in degrees of crankshaft rotation. Valve overlap is necessary for the efficient flow of gases in and out of the combustion chamber. It is will vary with respect to size and configuration of engine.

5.8 TWO STROKE DIESEL ENGINE

When the cycle of operation of engine completes in one revolution of the crankshaft or two stroke of the piston and one power stroke is obtained in each revolution of a crankshaft, then the engine is called as two stroke engine.

Construction

Inside the engine, the small end of the connecting rod is connected to the piston with the help of piston pin. The big end of the connecting rod is connected to the crankpin of the crankshaft. When the crankshaft rotates, the piston will reciprocate on the cylinder and vice versa. There is no inlet and exhaust valves as in case of four-stroke engine but consists of the inlet port (IP), an exhaust port (EP) and transfer port (TP). The fresh charge enters into the crankcase through inlet port. Transfer port is used to transfer the compressed charge from crankcase to the cylinder. Exhaust port is used to transfer the burnt gases out of the engine. The movement of the piston will open and closes the ports. A fuel injector is placed in the engine head.

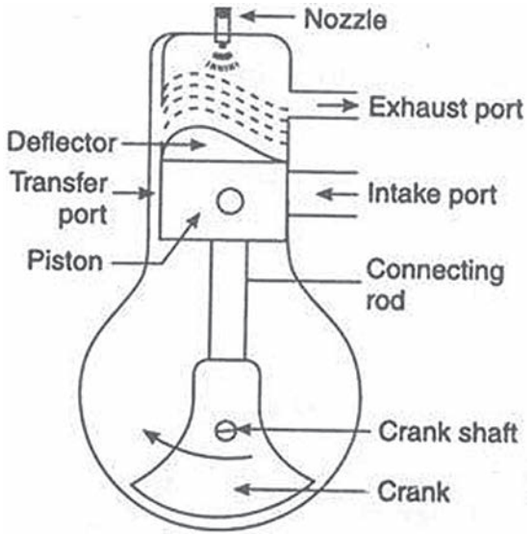


Figure 5.8(a) Two Stroke Diesel Engine

Working principle

In two stroke engine, all the four events namely suction, compression, power and exhaust cannot be distinctly identified. For each revolution of crankshaft or for every two stroke of piston, a working / power stroke is obtained. Hence the cycle of operation can be explained with two stroke of piston movement namely Upward stroke and Downward stroke.

Upward Stroke

During upward stroke, the piston moves from BDC to TDC. It expels the burnt gases to the atmosphere through the exhaust port. It closes the transfer port and then the exhaust port. Then it compresses the already inducted charge (air-fuel mixture) in the combustion chamber of the cylinder. At the end of the upward stroke, the diesel fuel is injected at high pressure through fuel injection nozzle and this will automise the fuel. The temperature of the compressed air is sufficient enough to ignite the diesel and combustion is take place.

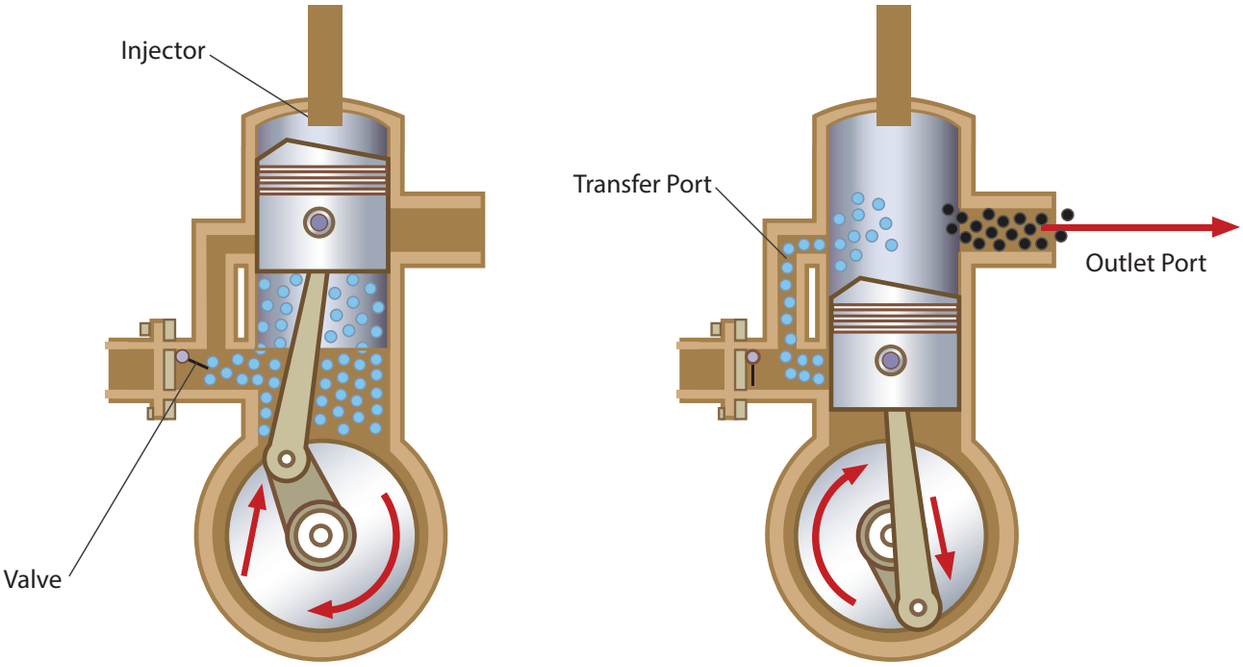


Fig 5.8(b) Upward and Downward Stroke of Two Stroke Diesel Engine

Further, the upward movement of the piston a partial vacuum is created in the crankcase and this allows the entry of the fresh charge into the crankcase through uncovered inlet port. The exhaust port and the inlet port remains covered when the piston at the TDC.

Downward stroke:

As soon as the combustion of the fresh charge takes place, a large amount of the hot gases is produced and this exerts a very high pressure force on the top of the piston. Due to this high pressure force, the piston moves downward and rotates the crankshaft and does useful work.

During this stroke the inlet port is covered by the piston and the new charge is compressed in the crankcase due to the downward movement of piston.

Further downward movement of the piston uncovers first the exhaust and the exhaust starts through the exhaust port.

Further downward movement of the piston uncovers port the transfer port and the fresh air is forced into the cylinder.

The fresh air strikes the deflector on the piston crown, rises to the top of the cylinder and pushes out most of the exhaust gases.

The piston is now at BDC position. The cylinder is completely filled with the fresh charge but it is somewhat diluted with the exhaust gases.

Finally the cycle event is then repeated and the power stroke is obtained for the every single revolution of the crankshaft.

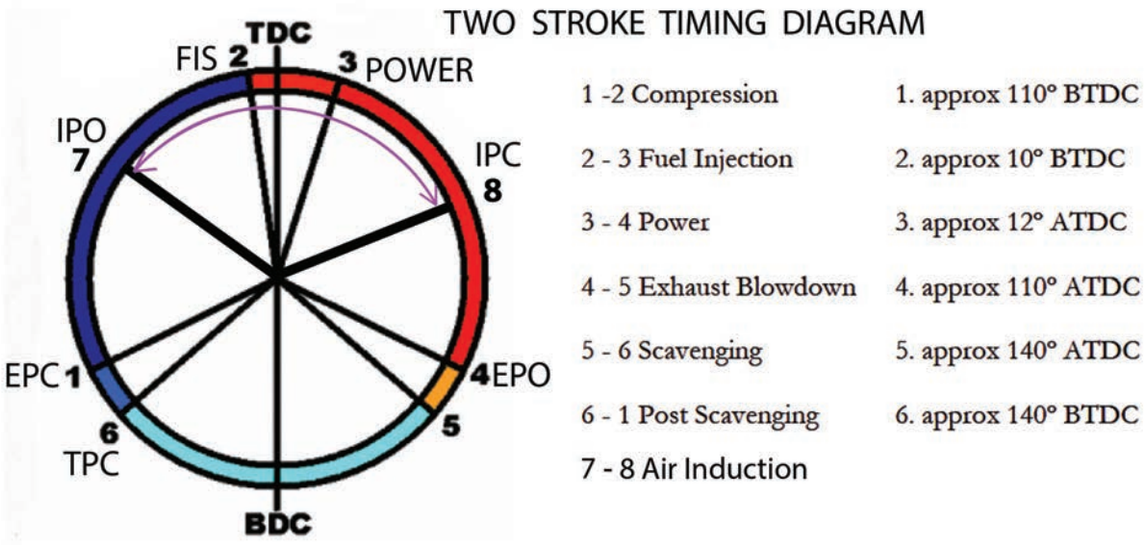


Fig 5.8(c) Port Timing Diagram of Two Stroke Diesel Engine

Student Activity

1. Students should visit the nearby workshops to study the types of petrol and diesel engines, and also to study the purpose of piston, connecting rod, crank shaft, camshaft, timing gear and flywheel.
2. Students should visit the nearby engine service centre and should prepare a sketch of engine block, crank case, cylinder head and gasket.

Glossary

Converted	-	மாற்றம்
Compressed	-	அழுத்துதல்
Combustion	-	எரியூட்டுதல்
Prolonged	-	நீடித்த
Surrounded	-	சுற்றுப்புறம்
Liner	-	உரை
Combustion Chamber	-	எரியும்அறை
Lubrication	-	உயவிடுதல்
Top Dead Centre	-	மேல்நிலை
Bottom Dead Centre	-	கீழ்நிலை

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SAMPLE QUESTIONS

Choose the correct answer:

1. Which material is used for manufacturing cylinder block?
   a) Gray cast iron or aluminum alloy
   b) Cast iron or steel
   c) Brass or steel
2. Which liner has directly contact with cooling water?
   a) Dry liner
   b) Wet liner
   c) None
3. Conecting rod is used to
   a) to connect crank shaft and cylinder head
   b) to connect crank shaft and piston
   c) to connect crank shaft and cylinder block
4. Which type of piston pin is mostly used now a days?
   a) semi floating type
   b) full floating type
   c) fixed type

5. Order of the strokes for getting power.
   a) Exhaust,suction, power, compression
   b) Suction, exhaust power, compression
   c) suction, compression power, exhaust
6. Which is used to open the valve in Engine?
   a) Crank shaft.
   b) Cam shaft
   c) Fly wheel
7. Which liner is does not contact with cooling water?
   a) Dry liner
   b) Wet liner
   c) None
8. Where is vibration Damber located?
   a) In front of the Crank shaft.
   b) Back side of the crank shaft
   c) In front of the Cam shaft.
9. Which indicates cycle of operation engine?
   a) Exhaust, suction, power, compression
   b) Suction, exhaust power, compression
   c) suction, compression power, exhaust
10. Which is used to prevent leakage between cylinder and cylinder head?
    a) Gasket
    b) Oil seal
    c) Dust cover

2MPF7

Answer the following questions:

1. Who is invented Petrol Engine?
2. Who is invented Diesel Engine?
3. Write any 10 important parts of I.C. Engine.
4. What are the two types of cylinder liners?
5. What is the purpose of Gasket?
6. State any five method to control the expansion of the piston due to over heat.
7. Name the types of Piston.
8. What is meant by Vibration Damper?
9. In how many ways Piston and connecting rod are connected? Mention the names.
10. Draw a neat sketch of Over head Puppet Valve mechanism and explain the same.
11. Draw a neat sketch of Straight Puppet mechanism and explain the same.
12. Draw a neat of Four Stroke Petrol Engine and explain the working principle.