

## **EXPERIMENT-1**

**AIM:** To study and sketch about the Locomotive Boiler.

### **APPARATUS USED:**

The model of Locomotive Boiler

### **INTRODUCTION:**

The Locomotive Boiler is horizontal, multi-tubular, natural circulation, internally fired, fire tube boiler. The maximum pressure range 21bar and streaming rate is as high as 55 to 70 Kg per square meter of heating surface per hour.

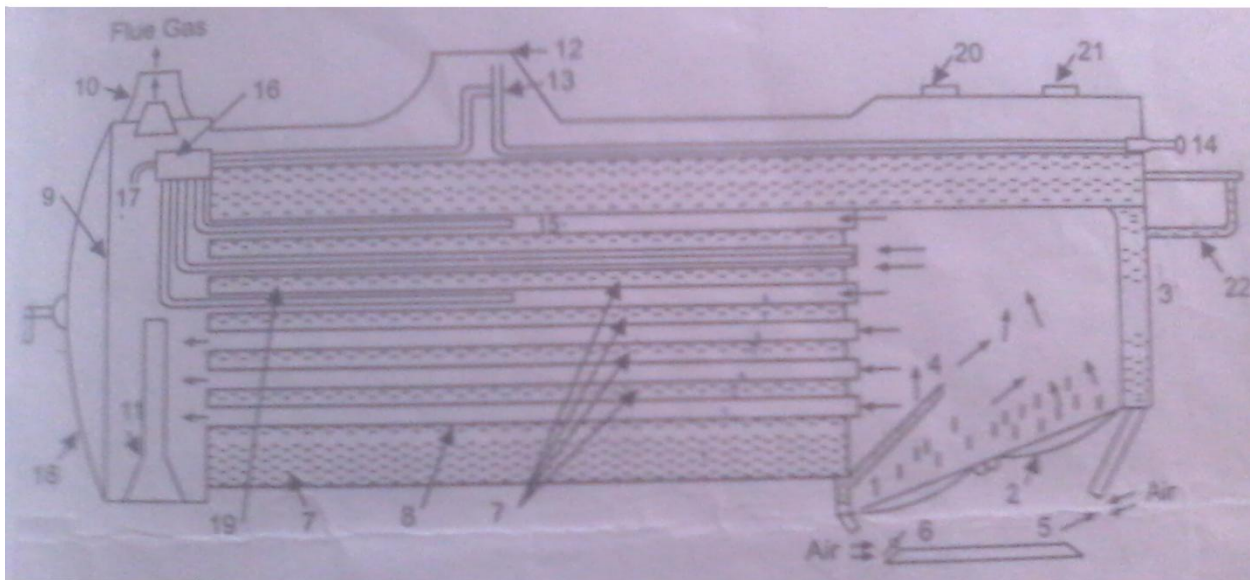
### **CONSTRUCTION DETAILS:**

It consists of cylindrical steel shell. There is a rectangular fire box at the back end of the shell which forms a combined grate and combustion chamber. The main parts of the locomotive boiler are given below:

1. Fire Box
2. Grate
3. Fire Hole
4. Fire Bridge Arch
5. Damper
6. Ash Pit
7. Fire Tube
8. Cylindrical Barrel or Shell
9. Smoke Box
10. Chimney
11. Exhaust Steam Pipe
12. Steam Dome
13. Regulator
14. Super Heater Tubes
15. Super Heater Header
16. Super Heater Exit Tube
17. Smoke Box Door
18. Feed Check Valve
19. Safety Valve
20. Water Gauge

## WORKING PROCESS

The coal is burnt in the fire box and produces the hot flue gases. These flue gases rising from the grate are deflected upwards by a fire bridge and so that its come into contact with the walls and roof of the fire box. Due to the motion of the locomotive a strong draught is created and the atmospheric air rushes into the fire box through the dampers. The function of the dampers is to control the quantity of air entering in the fire box. The ash of the coal burnt on the grate falls into the ash pit. The hot flue gases pass from the furnace box to the smoke box through horizontal smoke tubes. A large door in the front of the smoke box gives access to it and the tubes for examination and cleaning purposes. The hot gases from the smoke box are discharged to the atmosphere through a short chimney.



1. Fire box	2. Grate
3. Fire hole	4. Fire bridge arch
5. Ash pit	6. Damper
7. Fire tubes	8. Barrel or shell
9. Smoke box	10. Chimney (short)
11. Exhaust steam pipe	12. Steam dome
13. Regulator	14. Lever
15. Superheater tubes	16. Superheater header
17. Superheater exit pipe	18. Smoke box door
19. Feed check valve	20. Safety valve
21. Whistle	22. Water gauge

During the travel of hot gases from the grate to the chimney, they give heat to the water and generate steam. The generated steam is collected in the steam dome to increase the steam release capacity and to increase the distance of steam from water line which reduces priming. The driver operates the regulator by turning a lever which leads the dry steam is diverted to superheated header with the help of a regulator and lever arrangement and then to superheater tubes. They start from the superheater header and are laid inside the large diameter fire tubes supply heat to the superheater tube that heat the steam inside superheater tubes which get superheater steam.

## EXPERIMENT-2

**AIM-** To study and sketch about Lancashire Boilers

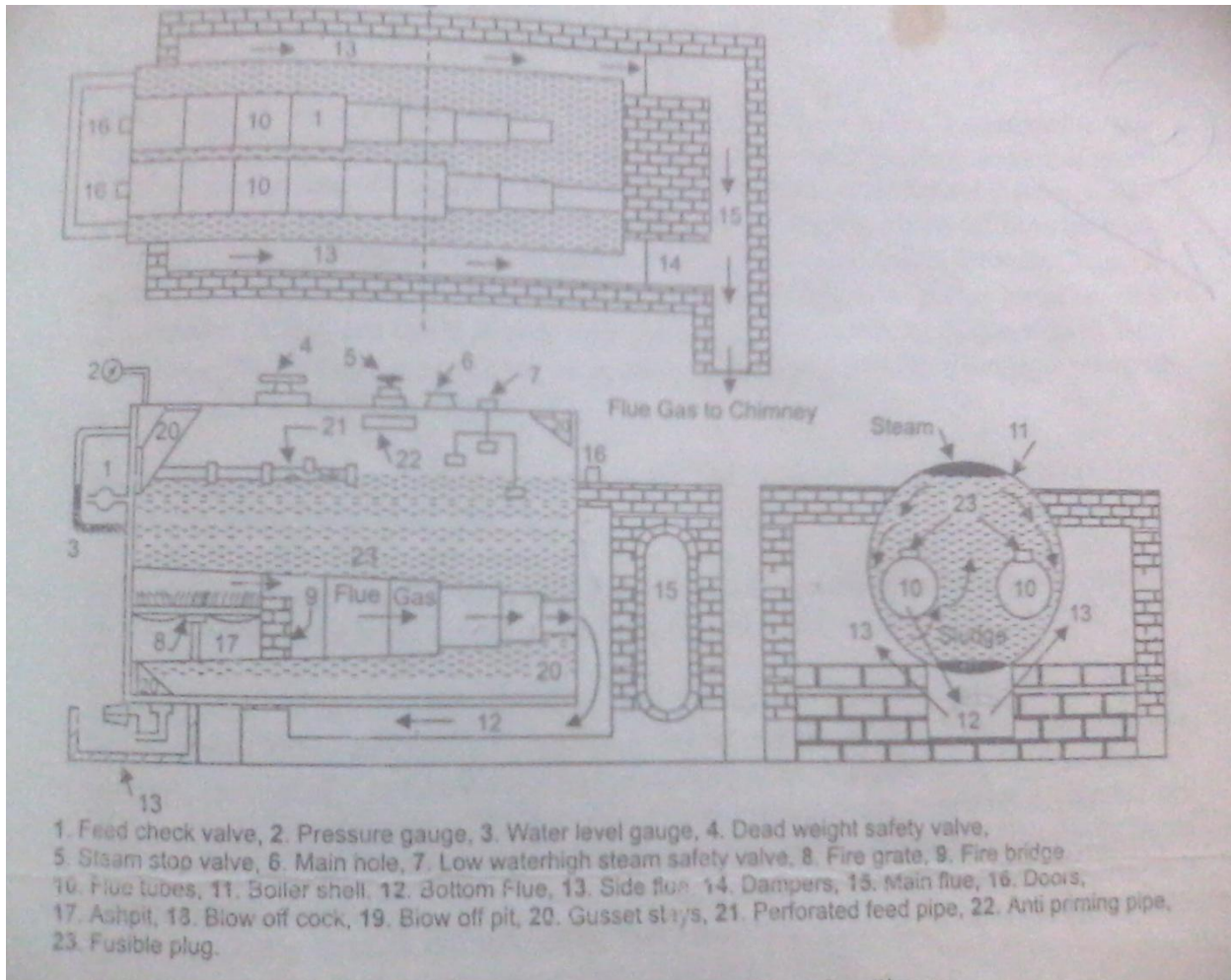
### APPARATUS USED:

Model of Lancashire Boilers

### INTRODUCTION:

A Lancashire Boiler is fire tube boiler. Its normal working pressure range is 15 bar and steaming capacity is about 8000 Kg/h. Its size varies from about 8 meters to 9 meters in length and from 2 to 3.5 meters in diameter.

### CONSTRUCTION DETAILS:



It consists the following parts:

1. **Feed Check Valve:** Feed water is supplied to the boiler under pressure, feed check valve stops it escaping back.
2. **Pressure Gauge:** It is used for measuring the pressure of steam.
3. **Water level Gauge:** It indicates the level of water in the boiler.
4. **Dead weight safety valve:** It is for safety against pressure in excess of the rated pressure.
5. **Steam stop valve:** It opens and closes the supply of steam for using.
6. **Man Hole:** It is for cleaning and inspecting the drum.
7. **Fire Grate:** The grate in which the solid fuel is burnt.
8. **Fire Bridge:** This is used for deflecting the gases of combustion upwards.
9. **Flue Tubes:** These are for the first pass of the flow of the flue gases. The flue tubes are tapered being larger in diameter at the front and smaller at the back.
10. **Boiler Shell:** It is used for containing water and steam. It is made of several welded and riveted rings of Simens-martin open hearth steel plates.
11. **Dampers:** It is used for controlling the flow of flue gases. These are iron doors which slide up and down in the grooves by rope and pulley.
12. **Blow off cock:** Blow off cock is provided at the bottom of the shell by a bent pipe to blow off sludge at intervals. Since the water shell is not perfectly horizontal, a few degrees tilting towards the front enables all the sediments to accumulate in front near the blow off cock.

## **EXPERIMENT-3**

**AIM-** To study and sketch about the model of Babcock Wilcox Boiler

### **APPARATUS USED:**

Model of Babcock Wilcox Boiler

### **INTRODUCTION:**

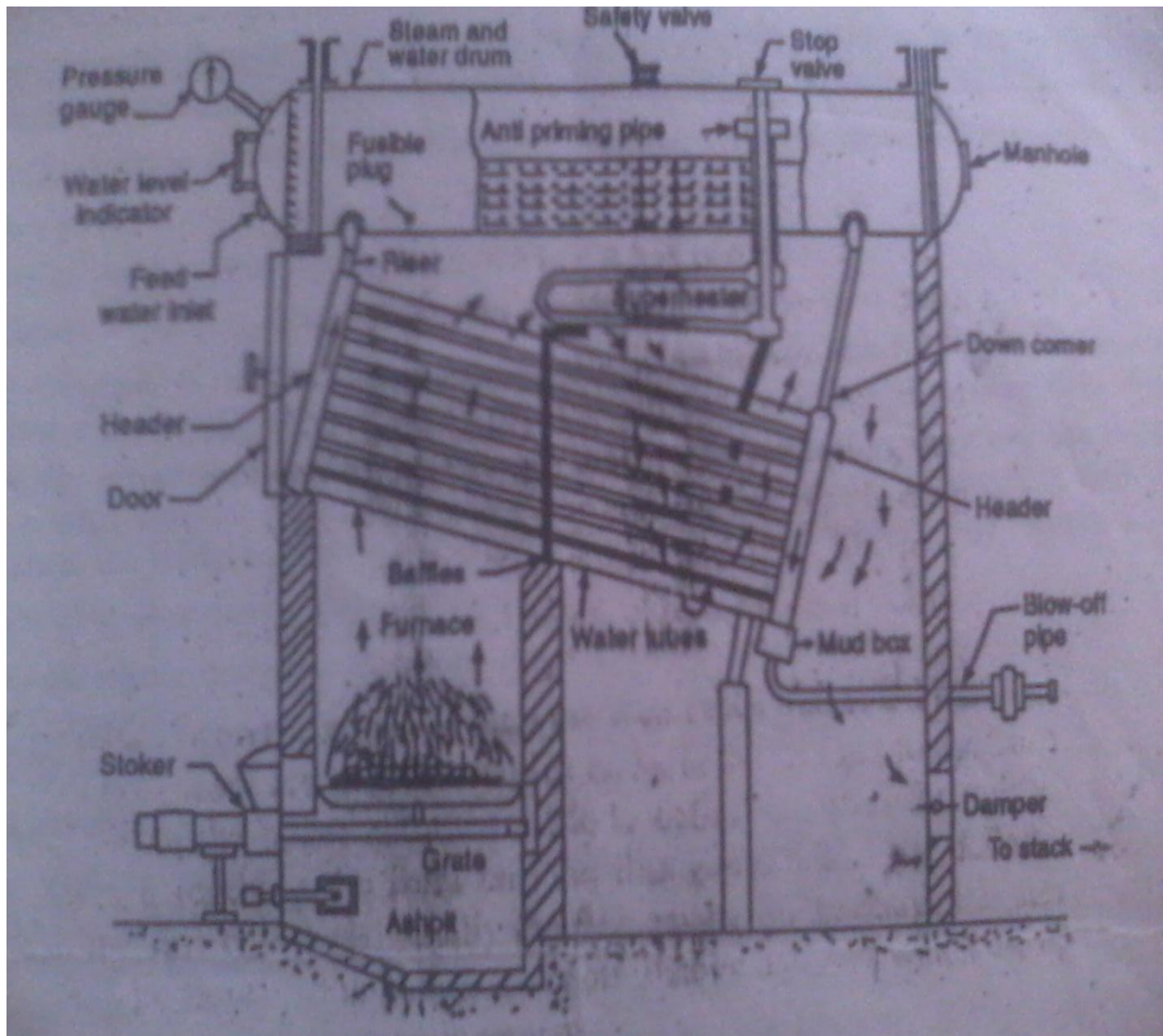
Babcock Wilcox Boiler is a water tube boiler. Evaporative capacity of such boilers ranges from 20,000 to 40,000 kg/hr of steam and operating pressure is about 40 bar.

### **CONSTRUCTION:**

It consists of high pressure drum mounted at the top. From each end of the drum connections are made with the upper header and down tube header. A large number of water tubes connects the uptake and down take header. The water tubes are inclined 25 to 35 degree to promote water circulation. The heating surface of the unit is the outer surface of the tubes and half of the cylindrical surface of water drum which is exposed to flue gases. A mud box is attached to the bottom of the down take header.

The whole of the assembly of water tubes is hung along with the drum from steel girder frame by steel rods called slings in a room made of masonry work, lined with fire bricks. Below the uptake header the furnace of boiler is arranged. The coal is fed to chain grate stoker. There is a bridge wall deflector which deflects the combustion gases upwards. Two baffles are also arranged which provide three passes of the flue gases. A damper is placed at the inlet of the chimney to regulate the draught. Different other mountings and accessories are given below:

Pressure Gauge, Water gauge, safety valve, feed water inlet, Headers, Non return valve, Anti priming pipe, Super heater, Baffles, Fire Grate, Ash Pot, Clean out doors, Riser, Blow off pipe, Damper etc.



## WORKING PROCESS:

The hot combustion gases caused by burning of fuel on the grate rise upwards and are deflected by the bridge wall deflection and pass over to the front portion of the water tubes and drum. In this way they complete the pass, with provision of baffles they deflect downwards and complete second pass. Again with the provisions of baffles they rise upwards and complete the third pass and finally come out through the chimney. During their travel they give heat to water and steam is formed. The circulation of water in boiler is natural circulation set up by convective currents.

Feed water supplied by a feed water inlet pipe. The hottest water and steam rises from the tubes to the uptake header and then through the riser enters the boiler drum. The steam vapours escape through the water to upper half of the drum. The cold water flows from the drum to the down take header and thus the cycle is completed. The flue gases passing over the flue tubes produce superheated steam. The steam thus superheated is finally supplied to be used through a steam stop valve. The super heaters remains flooded until the steam reaches the working pressure. The superheater is then drained and steam is allowed to enter in it for superheating purposes.

### **USES:**

The Babcock Wilcox Boiler is used in electric power plants for running steam turbines.



## EXPERIMENT-4

**AIM-** To study and sketch Simple Steam Engine Model

### APPARATUS USED:

Steam Engine Model

### INTRODUCTION:

The steam engine is a reciprocating type prime mover which utilizes steam as the working medium to convert heat energy into mechanical energy. It is also known as external combustion engine.

### MAIN PARTS OF SIMPLE STEAM ENGINE

**Cylinder:** This is the chamber in which the piston moves to and fro due to the action of steam.

**Steam Chest:** This is generally cast integral with the cylinder. There are two ports called inlet port and outlet port made in the casting for connecting the steam chest to the cylinder.

**Piston:** This is made of cast iron and moves to & fro in the cylinder by the action of steam.

**Piston Rings:** The function of piston rings is to prevent the leakage of steam and any wear and tear taking place in the cylinder.

**Piston Rod:** The piston rod connects the piston and cross head and is made of mild steel.

**Cross head:** It connects the piston rod and connecting rod and moves between guides.

**Connecting rod:** It is made of forged steel. One end of connecting rod is connected to the cross head by gudgeon pin and other end is connected to the crank.

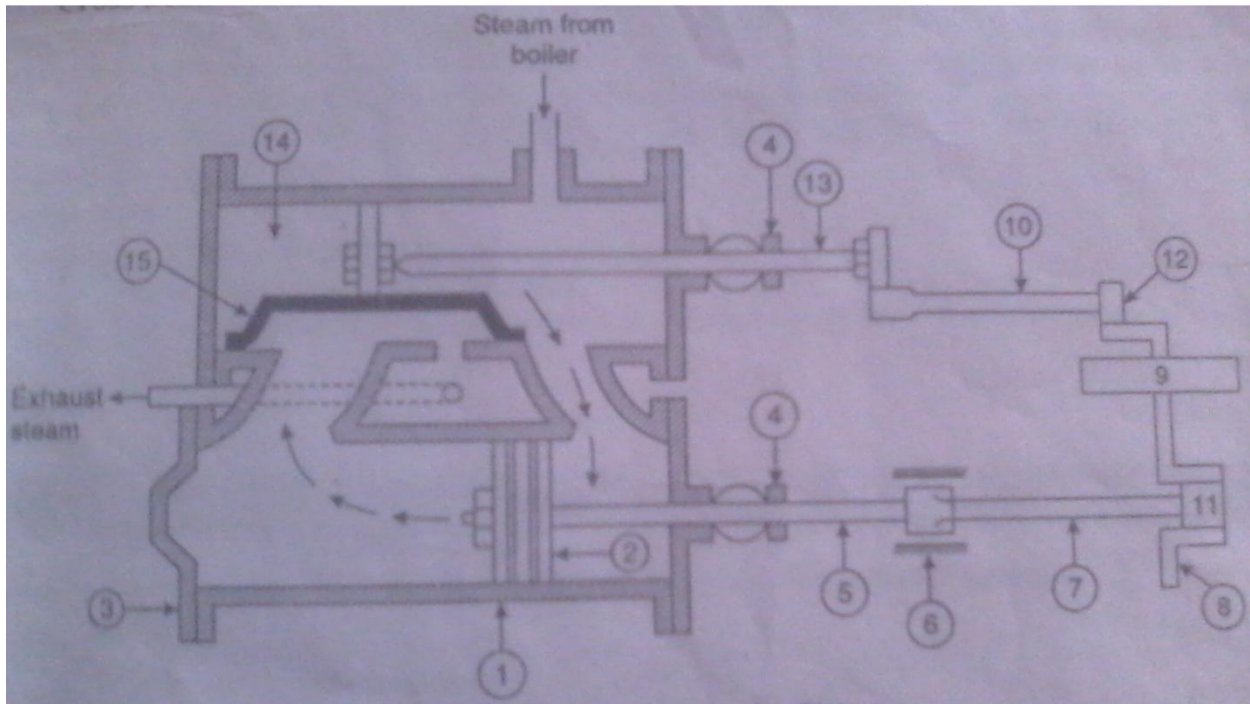
**Crank shaft:** It is made of alloy steel. The crank shaft is main part of steam engine which serves the purpose of converting the force applied by the connecting rod into a rotational force.

**Valve:** It reciprocates over the valve seat in the steam chest by the eccentric so located on the crank shaft relative to crank so as to admit or exhaust steam to & from the cylinder at the proper time through the port.

**Valve rod & Eccentric rod:** The valve rod connects the valve and the eccentric rod through a valve rod guide which prevents the bending of the valve rod while the eccentric rod connects the valve rod and eccentric.

**Governor:** The function of governor is to maintain the speed of engine fairly constant irrespective of the load.

**Main Bearings:** Generally two main bearings are provided at each end of the crank shaft to support it, the bearings are attached to the frame.



- |                     |                     |
|---------------------|---------------------|
| 1. Cylinder         | 2. Piston           |
| 3. Cylinder cover   | 4. Stuffing box     |
| 5. Piston rod       | 6. Cross head guide |
| 7. Connecting rod   | 8. Crank shaft      |
| 9. Fly wheel        | 10. Eccentric rod   |
| 11. Crank pin       | 12. Eccentric       |
| 13. Slide valve rod | 14. Steam chest     |
| 15. D. Slide valve  |                     |

## **WORKING PROCESS OF STEAM ENGINE:**

Consider a simple, double acting non condensing, D-slide valve type engine. Let the piston is at the cover end position of the cylinder and ready for the forward stroke. Now the valve opened the inlet port. The high pressure steam from the boiler enters the cylinder through the steam chest. The pressure of steam pushes the piston, thus performing the forward stroke. The motion of piston moves the crank, shaft and eccentric. The delivery valve just uncovered and the used steam from the previous stroke becomes free and escapes to the exhaust pipe.

Admission of steam continues to occur till the eccentric has moved the valve to close the inlet port, thus cutting off the steam, the steam now expands and the volume of steam increases so that the pressure falls. This fall in pressure makes the steam performs the work. Before the end of forward stroke, the valve opens the same inlet port to the exhaust side and steam is released. After releasing the steam, the piston reverses its motion performing the return stroke. Now delivery port opens and fresh steam enters the cylinder which pushes the piston inward to complete the inward stroke. When the piston nearly reaches its end of the return stroke the valve closes the inlet port to exhaust the steam. The steam entrapped between the piston & cylinder head is compressed till the piston reaches to the corner end. Now the cycle is completed and the piston is ready for the next cycle.

### **Applications:**

Steam engines are used in the following:

1. For driving pumps & Compressors
2. In locomotive & hoisting where reverse operation and wide flexibility in speed control are required.

## EXPERIMENT-5

**AIM:** To study and sketch about vapour compression refrigeration system.

### APPARATUS USED:

Model of vapour compression refrigerator

### INTRODUCTION:

The principle of Vapour Compression Refrigeration Cycle involves the condensing and evaporating of the refrigerant (liquid gas) again and again. The liquid gases CO, NH, Freon-12, Freon-22 etc. are used as refrigerant for the above cycle. During evaporation, the refrigerant absorbs a large amount of heat from the brine circulating around evaporating unit. During condensation, the refrigerant gives out latent heat to water circulating in the condenser.

### MAIN PARTS OF VAPOUR COMPRESSION REFRIGERATOR:

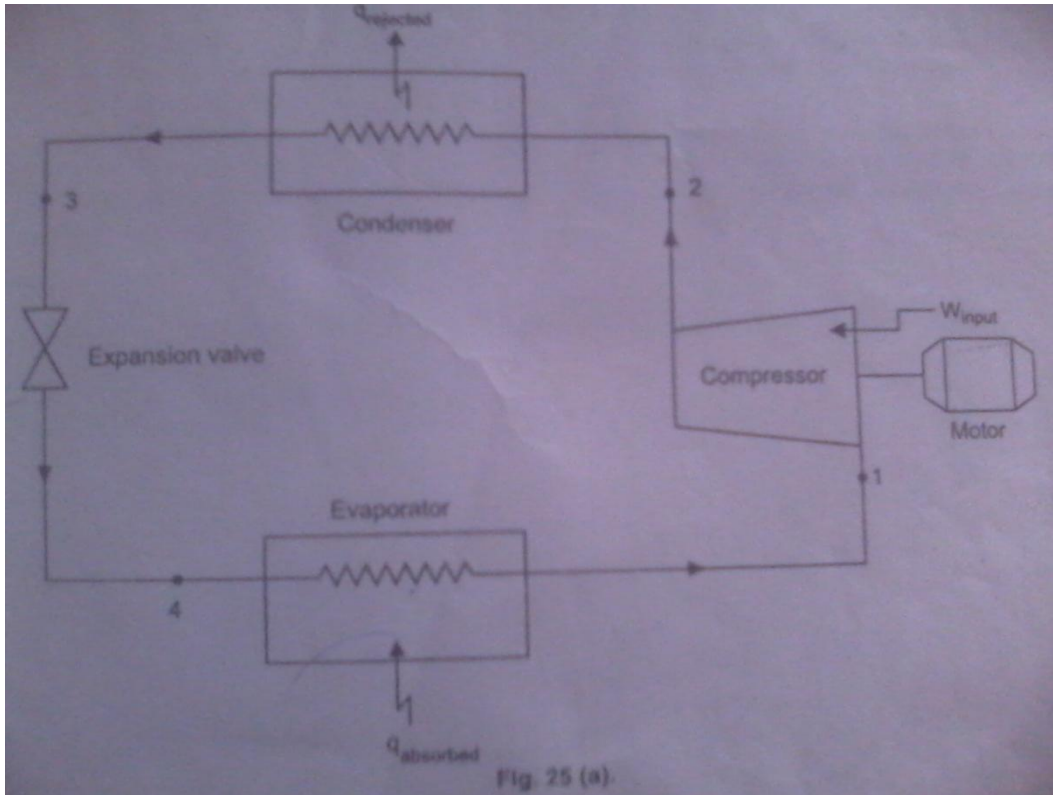
A simple vapour compression system of refrigeration consists of four main parts:

- (i) Compressor
- (ii) Condenser
- (iii) Expansion valve
- (iv) Evaporator

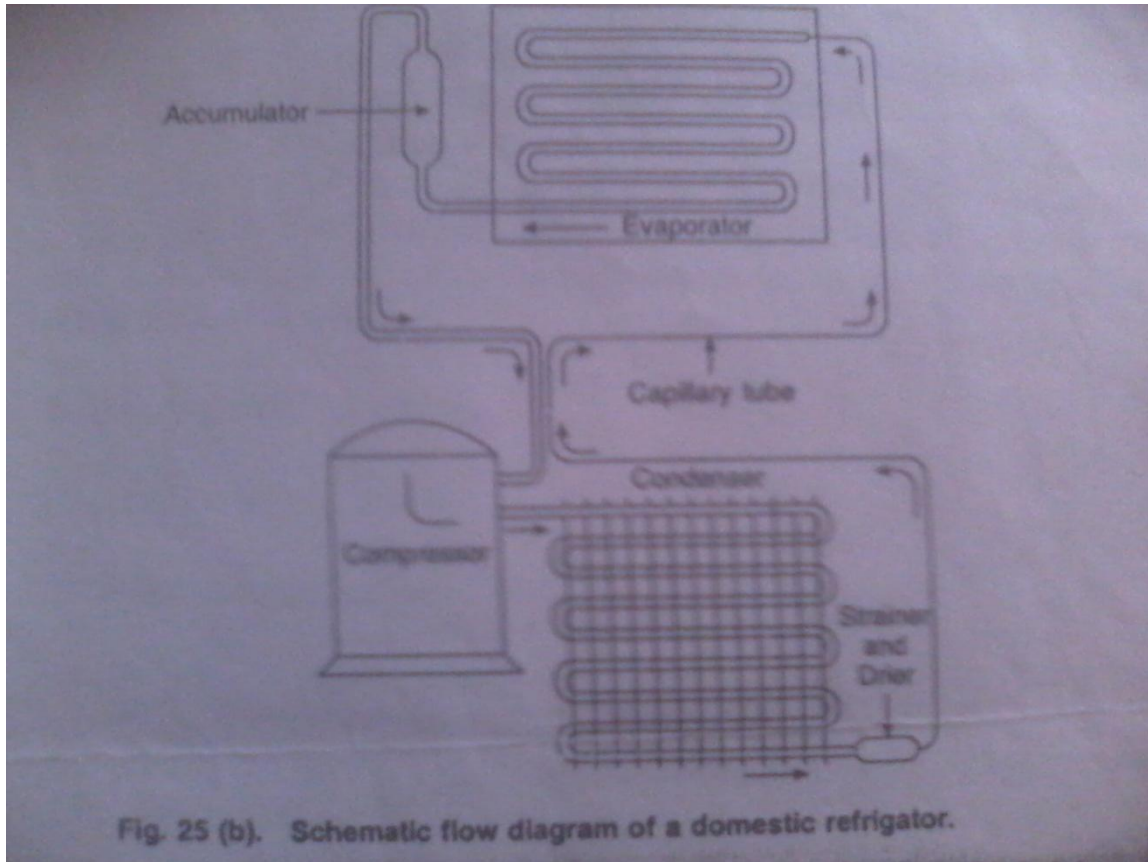
### WORKING PROCESS:

The working process of vapour compression refrigerating system is followed in these sequences:

- (i) **Compression process:** The compression of vapour takes place from low pressure and low temperature to high pressure and high temperature. If initial state of the vapour is saturated or superheated, the compression is called Dry Compression. If the initial state of the vapour is wet, the compression is called Wet Compression. The reciprocating compressor is generally used in the refrigerators.



- (ii) **Condensation Process:** Vapour under high pressure and high temperature is delivered to the condenser where its heat is rejected to the condenser at constant pressure. This is carried out in two stages. The first stage where the condenser absorbs the heat from the high pressure vapour and temperature of the vapour falls to saturation temperature. The second stage where the vapour finally condensed to a liquid by rejecting latent heat at constant temperature.



- (iii) **Throttling Process:** The high pressure liquid refrigerant is expanded irreversibly through an expansion valve to a lower pressure. During throttling the enthalpy remains constant. Due to drop in pressure the liquid starts boiling and the latent heat for this provided by the fluid itself. Thus there is a fall in temperature of refrigerant.
- (iv) **Evaporation Process:** The extremely wet vapour from the expansion valve passes through evaporator coil immersed in brine where the latent heat of brine is absorbed by the wet vapour and consequently gets evaporated. The final stage of the refrigerant depends upon the quantity of heat absorbed.

## APPLICATIONS:

The application of vapour compression refrigerating system is in the following fields:

- (i) For making ice
- (ii) For preservation of photographic films
- (iii) In processing of tobacco, petroleum and other chemical products.

## **EXPERIMENT-6**

**AIM-** To study the model of gas turbine

### **INTRODUCTION & THEORY:**

Gas turbine is a rotary type internal combustion thermal prime mover. The gas turbine plant works on a gas power cycle. It obtains its power by utilizing the energy of a jet of burnt gases and air, the velocity of jet being absorbed as it flows over several rings of moving blades, which are fixed to a common shaft. It thus resembles a steam turbine, but it is a step forward in eliminating water-to-water step (the process of converting water into steam in a boiler) and using hot gases directly to drive the turbine.

The main operations of a gas turbine plant consist:

- (i) The compression of cool air in a rotary compressor
- (ii) The heating of this air by the combustion of fuel in the combustion chamber
- (iii) The expansion of this hot high pressure gas in a turbine

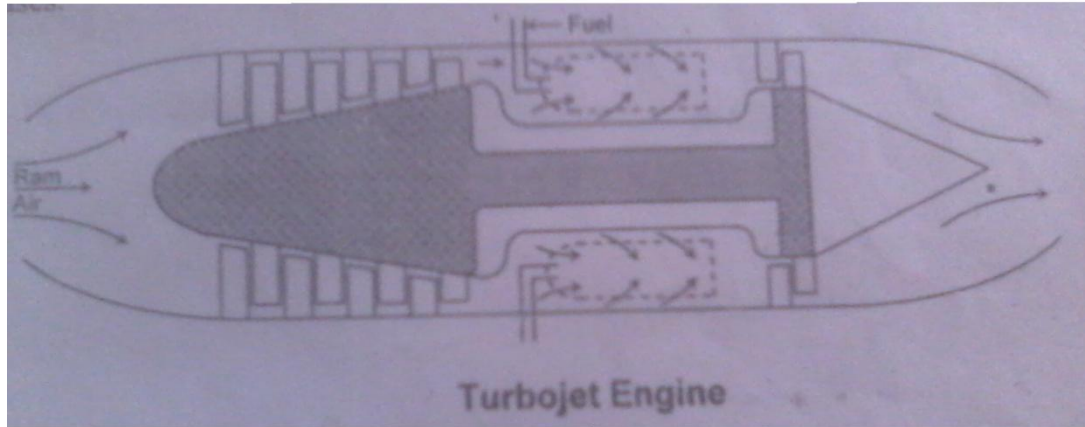
The compressor is usually coupled to the turbine and directly driven by the turbine and lowers the overall efficiency of the gas turbine power plant. The turbine output should therefore be sufficient to produce a useful output in addition to the power required to drive the compressor. Another drawback of a gas turbine plant is that it is not self-starting. Against these drawbacks, the outstanding advantage of the gas turbine lies in the successful use of pulverized coal as fuel.

The Gas turbine plant finds its applications in

- a) Stationary power plant
- b) Locomotive propulsion
- c) Ship propulsion
- d) Aviation
- e) Automotive
- f) Combination with steam power plant

### **TURBOJET ENGINES**

The Turbojet engine is similar to the similar constant pressure gas turbine plant, except that the exhaust gases are first partially expanded in the turbine to produce just sufficient power to drive the compressor. The exhaust gases leaving the turbine are then expanded to atmospheric pressure in a propelling (discharge) nozzle. The remaining energy of gases after leaving the turbine is used as a high-speed jet, which the thrust is obtained. In turbojet engine, the thrust is completely due to jet of exhaust gases.



Thus, the essential components of a turbojet engine are:

- (i) An entrance air diffuser in front of the compressor, which causes rise in pressure in the entering air by slowing it down in the diffuser. This is known as **ram**.
- (ii) A rotary compressor, which raises the pressure of air further, required value and delivers it to the combustion chamber. The compressor is driven by the turbine.
- (iii) The combustion chamber, in which paraffin (kerosene) is sprayed, as a result of this, combustion takes place at constant pressure.
- (iv) The gas turbine into which products of combustion pass on leaving the combustion chamber. The products of combustion are partially expanded in the turbine to provide necessary power to drive the compressor.
- (v) The discharge nozzle in which expansion of gases is completed, thus developing the forward thrust.



## **WORKING CYCLE**

Air from surrounding atmosphere is drawn in through the diffuser, in which air is compressed partially by ram effects. Then air enters the rotary compressor and major part of the pressure rise is accomplished here. The air is compressed to a pressure of about 4 atmospheres. From the compressor the air passes into the annular combustion chamber. The fuel is compressed to a high pressure in the oil pump and is forced through the fuel nozzle into the combustion chamber. Here, the fuel is burnt at constant pressure. This raises the temperature and volume of the mixture of air and products of combustion. The weight of air supplied is about 60 times the weight of fuel burnt. This excess air produces sufficient mass for the propulsion jet, and at the same time prevents gas temperature from reaching values, which are too high for the metal of the rotor blades.

The hot gases from the combustion chamber then pass through the turbine nozzle ring. The hot gases, which partially expand in the turbine, are then exhausted through the discharge (propelling) nozzle, by which the remaining pressure energy is converted into kinetic energy. Thus, a high velocity propulsion jet is produced.

The oil pump and compressor are mounted on the same shaft as the turbine rotor. The power developed by the turbine is spent in driving the compressor and the oil pump. Some starting device such as compressed air motor or electric motor must be included in the turbojet plant. Speeds up to 800 kilometers per hour are obtained from this type of unit.

## **RESULT:**

Model of Turbojet Engine has been visualized and studied.

## **EXPERIMENT-7**

**AIM-** To Study and sketch about the principle and working of two stroke Diesel Engine

### **INTRODUCTION:**

The fuel is supplied with the help of fuel injection pump and the injection to the cylinder. The working of diesel engine is similar to two stroke S.I Engine except that only air is induced into the crank case in case of C.I Engine in place of mixture of fuel and air.

### **MAIN PARTS OF THE C.I ENGINE:**

#### **1) Cylinder-**

It is hollow cylinder, one side of which is closed by cylinder head and is made of cast iron. Cylinder head usually contains both the valves and fuel injector or Spark Plug. The internal diameter of cylinder is called Bore.

#### **2) Piston-**

The Piston is made of cylindrical casting of iron or aluminium alloy. The main function of the piston is to transmit the force created by combustion products to the connecting rod.

#### **3) Piston Rings-**

It is made of grey cast iron.

#### **4) Connecting Rod-**

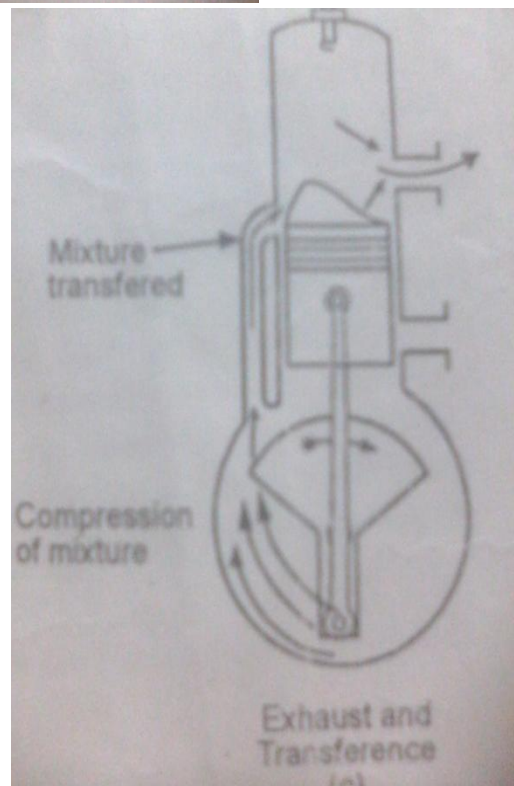
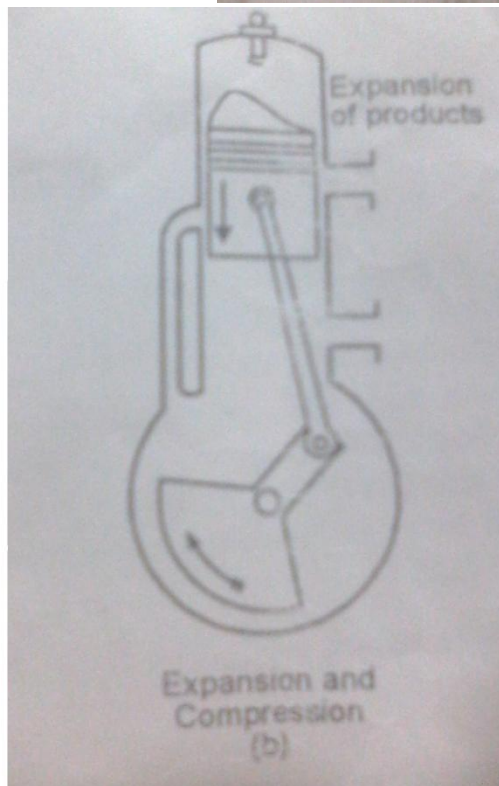
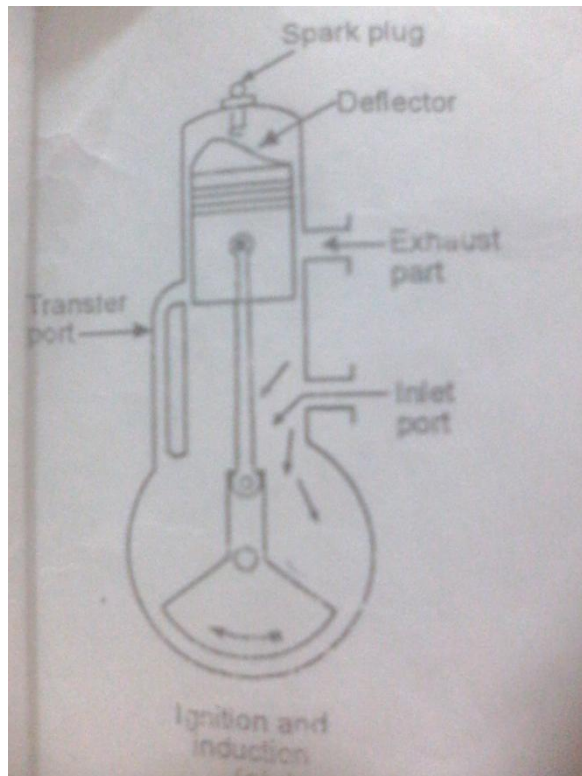
The function of connecting rod is to convert the reciprocating motion of the piston into rotary motion of crankshaft. It is made of forged steel.

#### **5) Crank shaft-**

It controls the motion of piston and is made of forged alloy steel or carbon's steel.

### **WORKING OF THE C.I ENGINE:**

The fuel is supplied with the help of fuel injection pump and the injector to the cylinder. The working of diesel engine is similar to two stroke S.I Engine except that only air is induced into the crank case in case of C.I Engine in place of mixture of fuel and air. Consider the piston at T.D.C when piston moves down, the hot gases expand. During its downward motion, the piston firstly uncovers the exhaust port and a little later it uncovers the transfer port.



- The air compressed during the previous stroke in the crankcase is transferred into the cylinder via the transfer port. This incoming air pushes out the burnt gases while passing over the deflection. This process of sweeping out the burnt gases is called Scavenging
- The piston moves upwards i.e. from B.D.C to T.D.C. It first closes the transfer port and a little later the exhaust port.
- The air transfer earlier into the cylinder is now compressed with further movement of piston upwards.
- Before the end of compression stroke, the fuel is injected and the atomized fuel burns due to high temperature of air called Auto-ignition.
- The resultant hot gases will again expand, thus completing a cycle.

### **APPLICATIONS:**

1. I.C Engines are used in all road vehicles
2. I.C Engines are widely used in rail road, aviation, marine etc.
3. I.C Engines are extensively used in lawn movers, motor boats, concrete mixing equipment etc.

## **EXPERIMENT-8**

**AIM-** To Study and sketch about the principle and working of two stroke I.C. Engine or Petrol Engine

### **INTRODUCTION:**

The internal combustion engine is a heat engine in which the energy of fuel air mixture is released by combustion in the engine cylinder itself. The heat energy increases the pressure and temperature of the cylinder gas and subsequent expansion of the gas converts the heat energy into mechanical work.

### **MAIN PARTS OF THE I.C ENGINE OR PETROL ENGINE**

**1) Cylinder:**

It is hollow cylinder, one side of which is closed by cylinder head and is made of cast iron. The fuel is burnt inside of the cylinder and power is developed due to reciprocating motion of the piston.

**2) Piston:**

The piston is made of cylindrical casting of iron or aluminium alloy. The piston is accurately machined to running fit in the cylinder bore and is provided with several grooves into which piston rings are fitted.

**3) Piston Rings:**

The piston is made of cylindrical casting of iron or aluminium alloy. The function of the piston rings is to prevent any leakage of gas past the piston and to prevent the wear of the piston.

**4) Connecting Rod:**

The Connecting Rod connects the piston and crank pin. The function of connecting rod is to convert the reciprocating motion off the piston into rotary motion of crankshaft.

**5) Crank Shaft:**

The crankshaft is the principle rotating part of the engine. It serves to convert the forces applied by the connecting rod into rotational force.

### **WORKING OF TWO STROKE PETROL ENGINE:**

In this type of engine the valves of the four stroke engine are replaced by ports which are three in number namely, transfer port, inlet or induction port and exhaust port.

When the piston moves from TDC to BDC, the burnt gases expand and develop the motive power. When the piston moves downwards during its expansion stroke, the piston first covers the inlet port and compresses the fresh charge held in the crank case. After

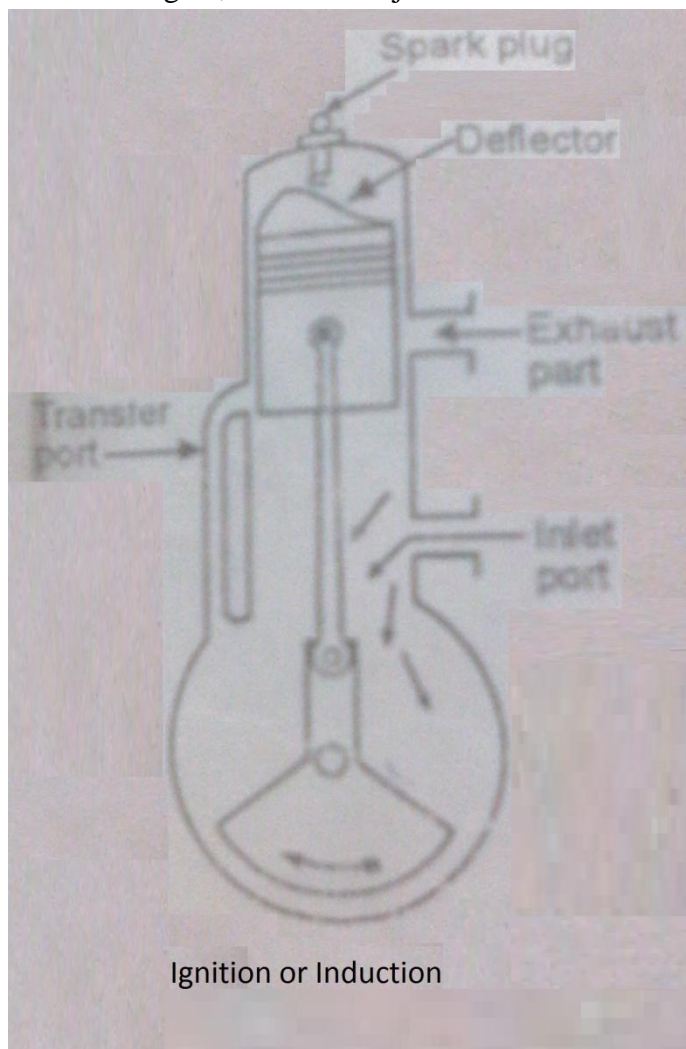
the completion of about 80% expansion stroke, the piston uncovers the exhaust port and some of the products of combustion escape to atmosphere.

On further motion of the piston, the piston uncovers the transfer port and allows the slightly compressed charge from the crank case to be admitted into the cylinder via the transfer port.

The top of the piston usually has a deflector. The fresh charge sweeps out the remainder of the burnt gases while passing over the deflector. During the upward motion of the piston from BDC to TDC, the piston first uncovers the inlet port allowing the fresh charge to be admitted into the crank case due to the partial vacuum created in the crank case & then it uncovers the transfer and exhaust ports. The cycle is now again repeated.

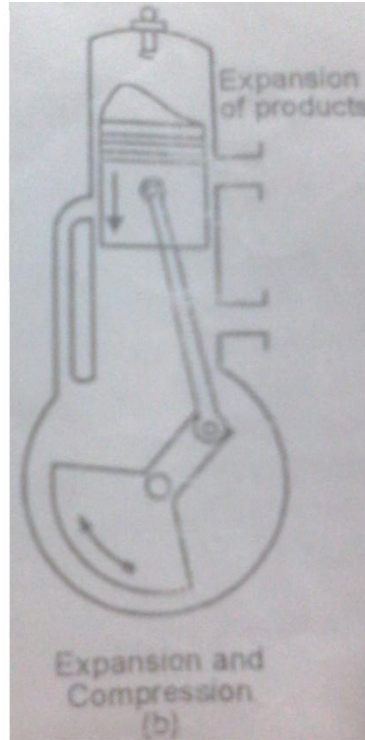
#### I. **IGNITION OR INDUCTION:**

The piston is almost at the T.D.C position when the air or mixture of air and fuel is in compressed form. In Petrol Engine Spark occurs and ignition takes place. But in case of Diesel Engine, the fuel is injected and combustion takes place automatically.



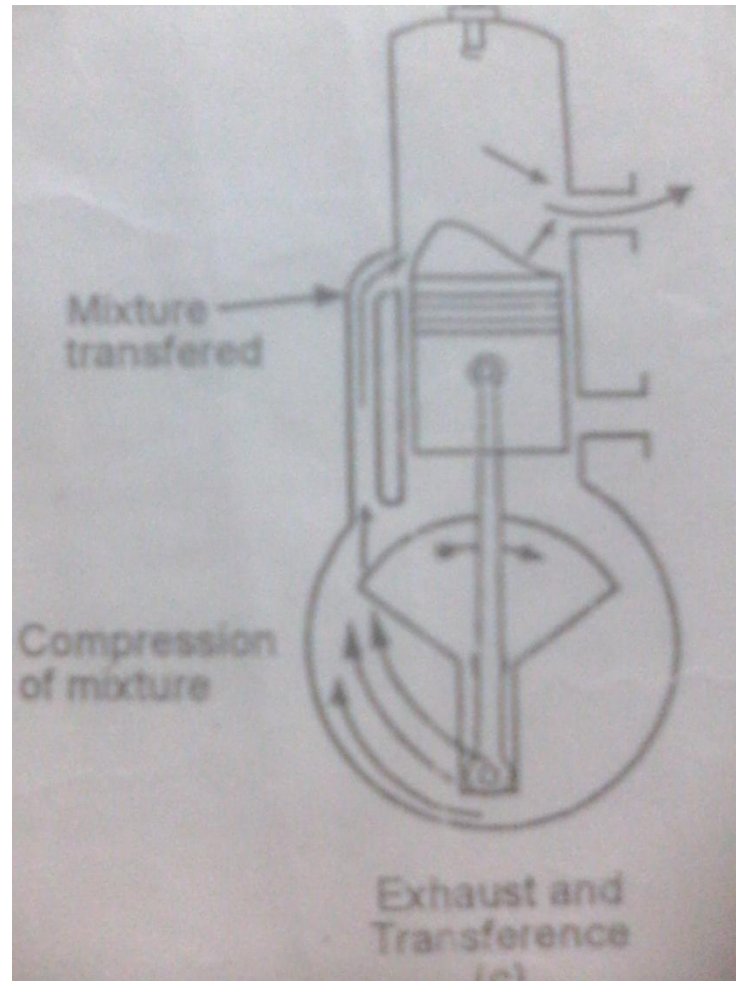
## II. EXPANSION AND PARTIAL COMPRESSION:

Due to combustion of the charge, the pressure increases which pushes the piston down, the expansion of gas takes place and work is done.



## III. EXHAUST AND TRANSFERENCE:

After completing of about  $4/5^{\text{th}}$  of the power, the exhaust port is uncovered by the piston and the products of combustion starts leaving the cylinder through the exhaust port. When the piston is approaching at the B.D.C position, the exhaust port is still open and transfer port is uncovered by the piston. As soon as the piston reaches B.D.C, it moves upward. In this position both inlet port and exhaust port are closed and the compression of the charge begins in the cylinder till the piston reaches at T.D.C. Thus during the two stroke of the piston, there is one power stroke.



➤ **APPLICATIONS:**

4. I.C Engines are used in all road vehicles
5. I.C Engines are widely used in rail road, aviation, marine etc.
6. I.C Engines are extensively used in lawn movers, motor boats, concrete mixing equipment etc.



## **EXPERIMENT-9**

**AIM-** To Study and sketch about the principle of working of four stroke I.C. Engine or Petrol Engine and Diesel Engine

### **INTRODUCTION:**

The internal combustion engine is a heat engine in which the energy of fuel air mixture is released by combustion in the engine cylinder itself. The heat energy increases the pressure and temperature of the cylinder gas and subsequent expansion of the gas converts the heat energy into mechanical work.

### **MAIN PARTS OF THE I.C ENGINE OR PETROL ENGINE**

#### **1) Cylinder:**

It is hollow cylinder, one side of which is closed by cylinder head and is made of cast iron. The fuel is burnt inside of the cylinder and power is developed due to reciprocating motion of the piston. Cylinder head usually contains both the valves and fuel injector or spark plug. The internal diameter of cylinder is called Bore.

#### **2) Piston:**

The piston is made of cylindrical casting of iron or aluminium alloy. The piston is accurately machined to running fit in the cylinder bore and is provided with several grooves into which piston rings are fitted. The main function of piston is to transmit the force created by combustion products to the connecting rod.

#### **3) Piston Rings:**

The piston is made of cylindrical casting of iron or aluminium alloy. The function of the piston rings is to prevent any leakage of gas past the piston and to prevent the wear of the piston.

#### **4) Connecting Rod:**

The Connecting Rod connects the piston and crank pin. The function of connecting rod is to convert the reciprocating motion of the piston into rotary motion of crankshaft. It is made up of forged steel.

#### **5) Crank Shaft:**

The crankshaft is the principle rotating part of the engine. It serves to convert the forces applied by the connecting rod into rotational force. It controls the motion of piston and is made of forged alloy steel or carbon steel.

#### **6) Valves:**

There are two valves for every cylinder. One is the inlet valve which admits air or mixture of air and fuel in the suction stroke. The other is the exhaust valve through which the product of combustion after doing work on the piston escapes to the atmosphere.

#### **7) Cams and Camshaft:**

Each valve requires a cam to open and close it, at the proper point in engine cycle. The cams are mounted on a shaft known as camshaft, which is driven by crank shaft through gears.

#### **8) Crankcase:**

The crankcase holds together the cylinder, piston and crankshaft.

#### **9) Carburetor:**

It is used in petrol engines to atomize, vaporize and mixing the fuel with air in required proportion at all loads and speed before entering to the engine cylinder.

#### **10) Fuel Pump and Injector Unit:**

It is used in diesel engine to supply the fuel under high pressure to atomizer or injector which consists of one or more orifices through which the fuel is sprayed into cylinder.

#### **11) Spark Plug:**

In petrol engine a spark plug is located at the top of cylinder and initiates combustion.

#### **12) Flywheel:**

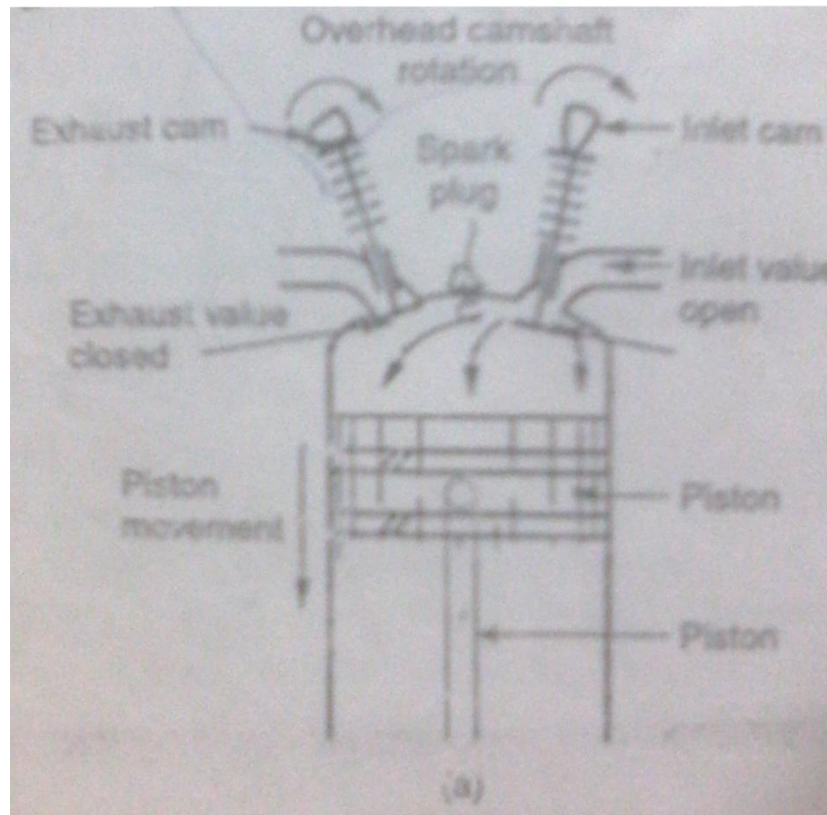
It is heavy wheel mounted on the crankshaft to minimize the cyclic variations in speed the turning moment becomes uniform at the crankshaft.

## WORKING OF FOUR STROKE PETROL ENGINE:

Petrol Engine operates on a four stroke cycle.

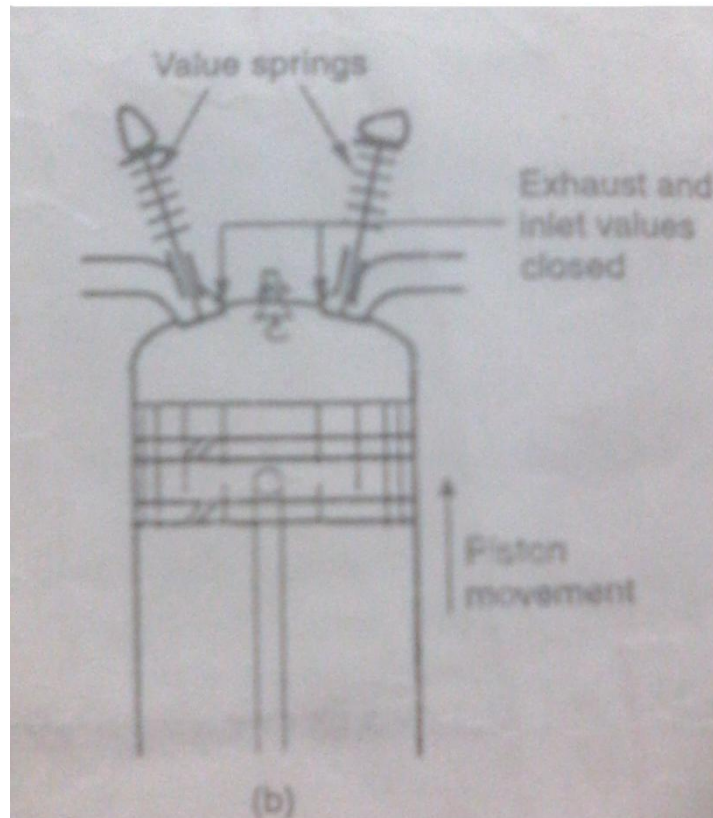
### I. INTAKE OR SUCTION STROKE:

During suction stroke intake valve is opened and the exhaust valve is closed and the piston moves down, due to rotation of crankshaft either getting energy from the flywheel or from a motor starter. As the piston moves the pressure in the cylinder drops below atmospheric pressure. The high pressure on carburetor or air filter side thrust the air to rush towards cylinder. The suction process continues till the piston moves from the top dead centre position to the bottom dead centre.



## II. COMPRESSION STROKE:

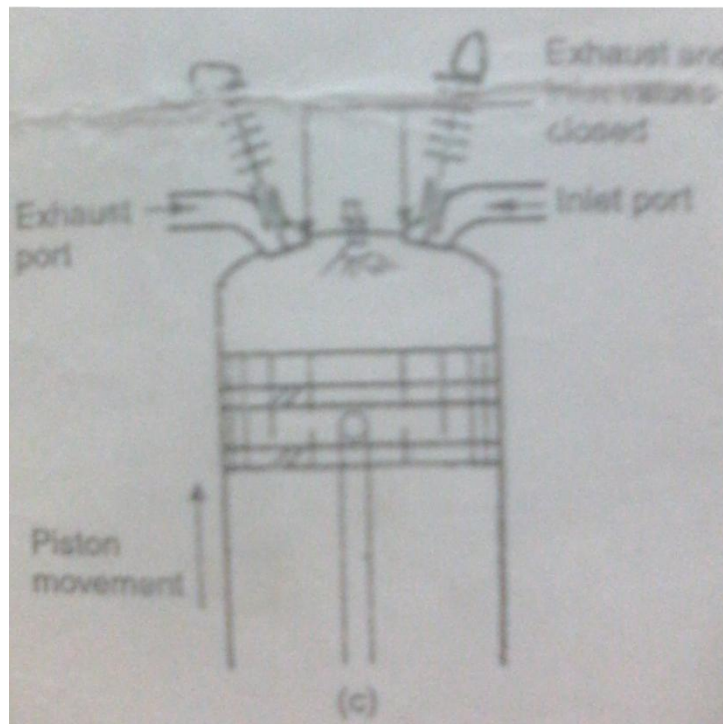
During this stroke both the valve are closed and piston moves from B.D.C to T.D.C. The air is compressed upto a compression ratio. There is reduction of volume of air or charge which results in an increase of pressure and the temperature of the cylinder contents. In petrol engines the compression ratio varies from 5 to 10.5 and pressure and temperature at the end of compression are 7 to 14 bars and 250°C to 500°C respectively. For Diesel engines the compression ratio is 12 to 20 and the pressure and temperature at the end of compression are 28 to 59 bars and 600°C to 700°C respectively.



### III. EXPANSION OR POWER STROKE:

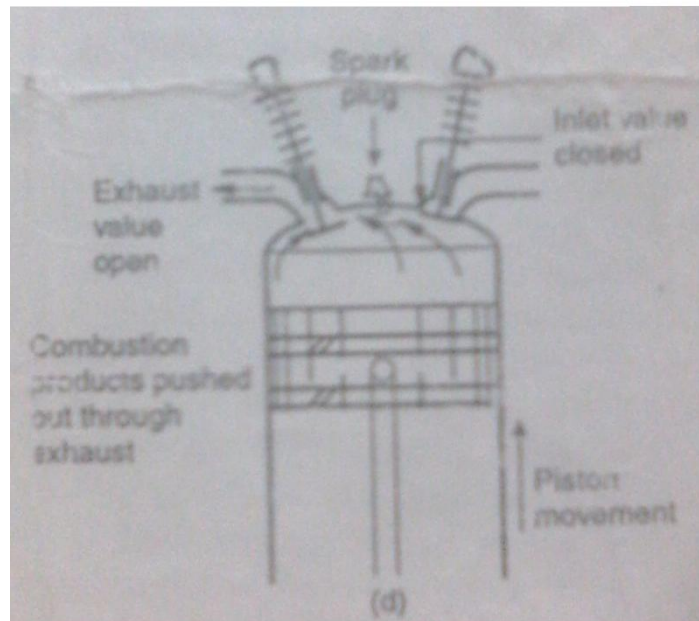
During this stroke both valves are closed. The power stroke includes combustion of fuel and expansion of the products of the combustion. The combustion starts at the end of the compression stroke when piston is approaching to T.D.C. In petrol engine, a spark plug initiates the combustion. During combustion temperature and pressure of the gas is increased. The volume of gas however remains constant during combustion.

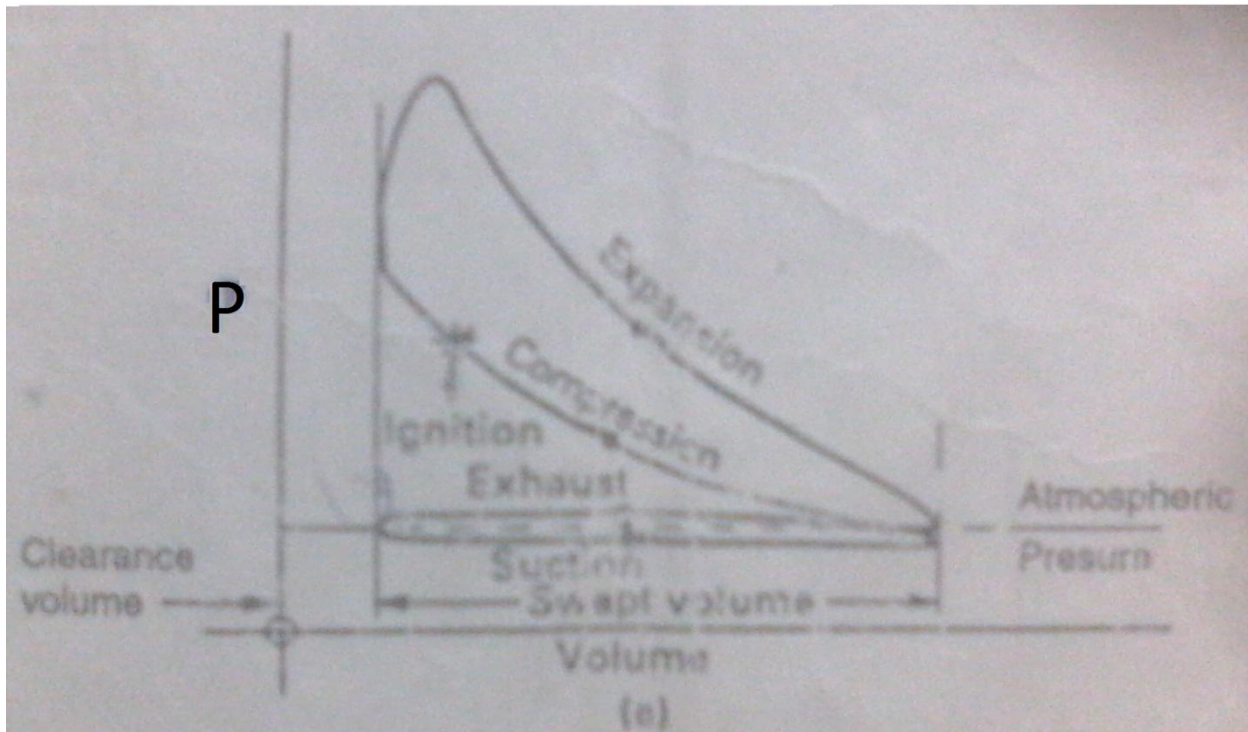
In Diesel Engines, one or more jets of fuel, compressed to a pressure of 105 to 210 bar by an injector pump are injected into the combustion chamber by a fuel nozzle at the end of compression stroke. The injected fuel is vaporized and is raised to self ignition temperature. The combustion then starts automatically and there is sudden rise of temperature at constant pressure. The high pressure and the high temperature of the product of combustion, thus obtained push the piston outward from T.D.C TO B.D.C position. This reciprocating motion of the piston is converted into the rotary motion by crankshaft, connecting rod and crank mechanism.



#### IV. EXHAUST STROKE

When about  $7/8^{\text{th}}$  of the power stroke has been completed, the exhaust valve begins to open and the inlet valve remains closed. The products of combustion are exhausted into atmosphere when the piston moves from B.D.C to T.D.C position. During this process the pressure is slightly more than atmospheric pressure when the piston is approaching T.D.C, the exhaust valve closes and some of the rest burnt gases are left in clearance space. At the end of exhaust stroke, the inlet valve opens and the cylinder is ready to receive the fresh charge to begin a new cycle.





### APPLICATIONS:

7. I.C Engines are used in all road vehicles
8. I.C Engines are widely used in rail road, aviation, marine etc.
9. I.C Engines are extensively used in lawn movers, motor boats, concrete mixing equipment etc.







