# EXPERIMENT NO: 01

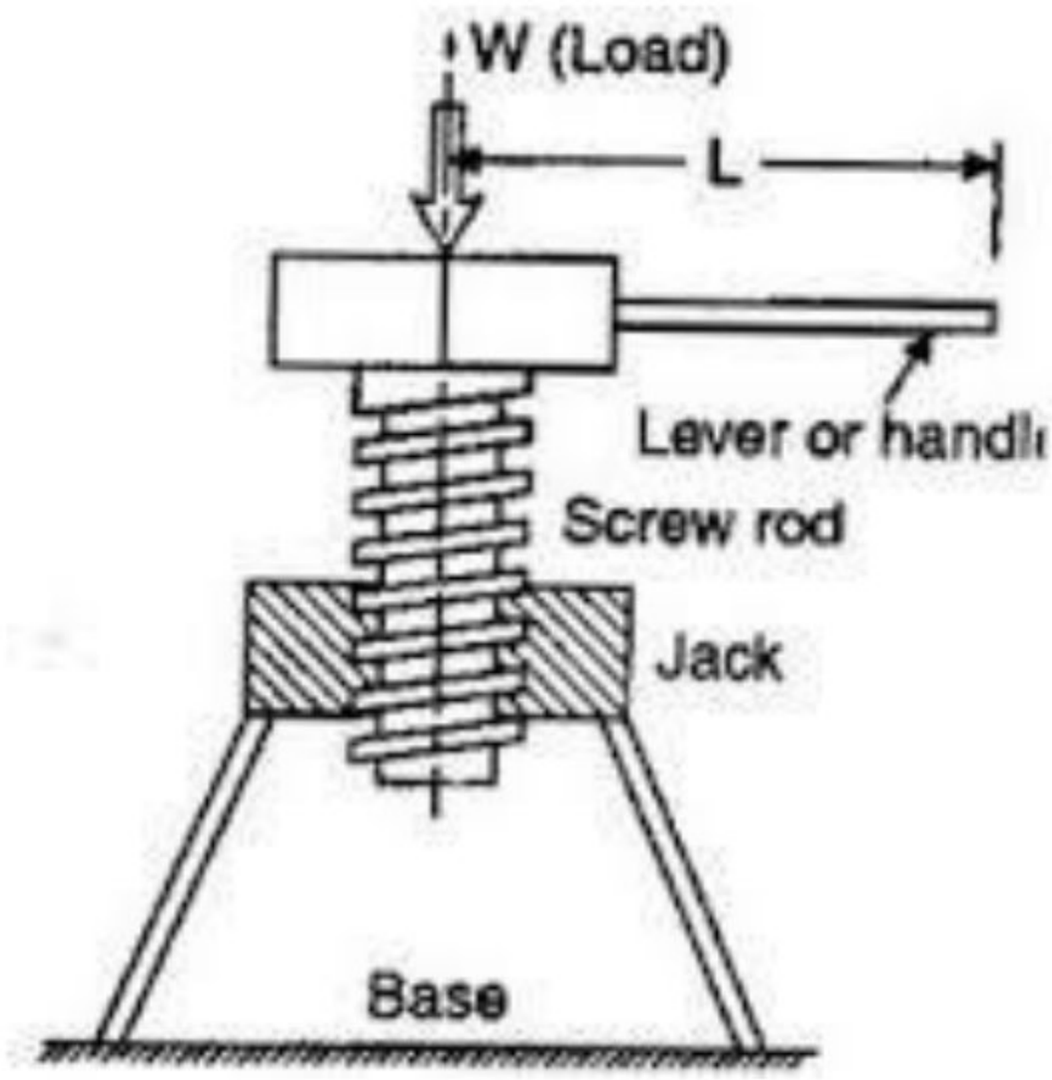
**AIM OF THE EXPERIMENT:-**

To find out V.R, M.A and Efficiency of simple Screw Jack.

**APPARATUS REQUIRED:-**

| Sl.No. | Name of the apparatus | Specification | Quantity |
|---|---|---|---|
| 1 | Screw Jack with its handle | 2 ton | 1 Set |
| 2 | Different slotted and conical weights | 50-100 gms | 8 set |
| 3. | Nylon string | 2 m | 2 nos |
| 4 | Meter rod & pan | | 1 set |

**Screw jack**




**THEORY:**

- Screw jack is a device for lifting heavy loads by applying a comparatively smaller effort at its handle.
- A screw jack consists of a threaded rod called screw rod or simply called screw.
- The screw has square thread, on its outer surface which fit into the inner threads of the jack .
- The load to be raised or lowered is placed on the head of the screw which is rotated by the application of an effort at the end of the lever for raising or lowering the load.

## MATHEMATICAL FORMULA USED

Let L = Length of the effort arm, in m

p'= Pitch of the screw, mm

W = Load liftedby the screw jack, kg

P = Effort applied to lift the load at the end of the lever,

We know that,

- The distance moved by the effort in one revolution of the screw = $2\pi L$
- The distance moved by the load = p'

- Velocity Ratio (V.R) $= \frac{\text{Distance moved by the effort}}{\text{Distance moved by the load}} = \frac{2\pi L}{p'}$

- Mechanical Advantage (M.A) $= \frac{\text{Load lifted}}{\text{Effort } applied \text{ to lift the load}} = \frac{W}{P}$
- Efficiency $(\eta) = \frac{M.A}{V.R}$

## PROCEDURE

- Wrap one string round the circumference of the screw head and take it over a small pulley. Effort '$\mathbf{P_1}$' is tied to the free end of this string.
- Wrap another string round the circumference of the screw head in the same direction in which above string is wounded and take it over the another small pulley.
- Place a load **'W'** on the screw head.
- Suspend $P_1$& $P_2$ to the free ends of both the strings coming over the two small pulleys. Then, P1 & $P_2$ should be increased gradually.
- Note down "W ' & 'P' very carefully to determine mechanical advantages (M.A) M.A.= $\frac{W}{P}$, in this case $P_1 + P_2$ will be the value of " P"
- Repeat step 3 to 5 with increasing W & P i.e. P= $P_1 + P_2$ and take at least 3 readings and put the values in observation table.
- Find the distance moved by the effort in one revolution of screw = $2\pi L$
- Measure the pitch i.e. the distance between two consecutives threads.
- Find out the V.R. by putting the formula of $\frac{2\pi L}{p'}$

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- At last find out the efficiency of screw jack by putting formula $(\eta) = (\frac{M.A}{V.R})$

**OBSERVATION TABLE:**

| Sl no | Load lifted (w) | Effort applied (P) | Distance moved by the effort(p') | Distance moved by the load | V.R | M.A | Efficiency (η) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
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**CONCLUSION:**

From this the above experiment, we successfully found the value of V.R, M.A and efficiency of simple screw jack.

## VIVA QUESTION:

# EXPERIMENT NO: 03

**AIM OF THE EXPERIMENT:-**

Study of Universal Testing Machine(UTM) and determination of tensile stress and young's modulus of M.S specification.

**APPARATUS REQUIRED:-**

| Sl.no | Name of the apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Universal testing machine | 200KN | 01 |
| 02 | Mild steel specimen | L=..... D=..... | 01 |
| 03 | Vernier calliper | Least count=0.02mm | 01 |
| 04 | Steel rule | L=300mm | 01 |

**THEORY:-**

- The result obtained by the tensile test are widely used in design of material for structures and others purposes.
- In this test the specimen pulled out at a constant rate by gradually increasing the axial pull till the rupture takes place.
- The tensile test for a ductile material is generally carried out with the help of UTM.
- The machine has two units ,one is control unit and another is release valve.
- Control unit is used for controlling the load applied and release valve is used for releasing the hydraulic pressure.
- The tensile test of a material is generally performed to determine:-Proportional limit,Elastic limit,Yield point,Ultimate point,Fracture point or breaking point

- **Proportional Limit**

  We see from the above diagram that from point 'o' to 'A' is a straight line which represents that the stress is proportional to strain. Beyond point 'A', The curve is slightly deviated from the straight line. It is then obeys the hook's law hold up to 'A' and is known as proportional limit.

- **Elastic Limit**

  It may noted that even if the load is increased beyond point 'A' up to point 'B' the material will regain its shape and size .The point 'B' is known as elastic limit.

- **Yield Point**

  If the material is stretched beyond point 'B' the elastic stress will be reached i.e on the removal of the load ,the material will not be able recover its original shape and size .The point 'C' and 'D' are called upper yield and lower yield point respectively .The stress corresponding to yield point is known as yield stress.

- **Ultimate Point**

  At 'E' the specimen undergoes the regain if some strain and higher values stress are required for higher stress and then those between 'A' and 'E'. The stress goes on increasing till point 'F' is reached. At 'E' the stress which attains maximum values is known as ultimate tensile stress.

- **Breaking Point**

  After the specimen has reached to the ultimate stress the neck is formed which decreases the cross sectional area of the specimen. The stress is therefore reduced until the specimen breaks itself at point 'F'. The stress corresponding to point 'G' is known as breaking stress.

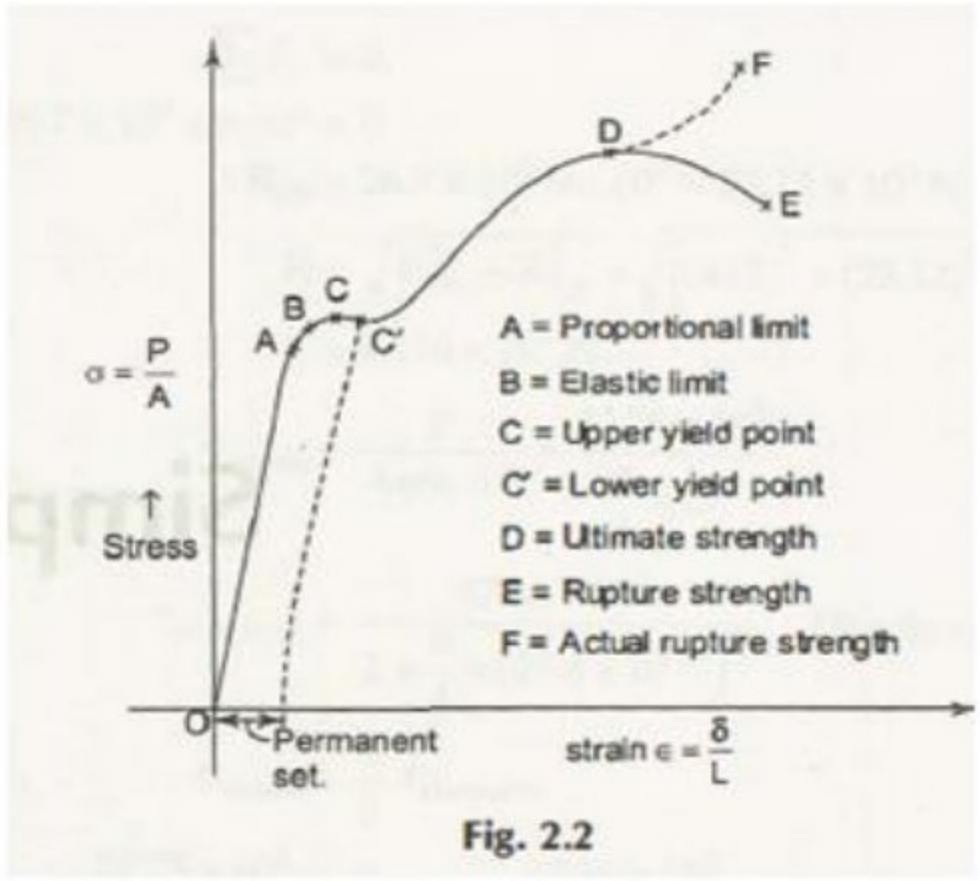


Fig. 2.2

Conditions f-or $\epsilon = \frac{\delta}{L}$, to be constant.

## PROCEDURE

- **Mathematical Formula Used**

Stress (σ) =load/cross sectional area =P/a ,$N/m^2$

a=area of the specimen=(π/4) xd2,m2

d=diameter of the specimen, m'

Strain(e) =change in length/original length= δL/L, It is unit less.

Young's modulus(E)=stress/strain= σ/e , $N/m^2$

## TECHNICAL SPECIFICATION

Diameter of the Specimen(d) = m.

Area of specimen (a)=$\pi.d^2/4$ =.....$m^2$

Original Length of the Specimen(L)= m.

## OBSERVATION & CALCULATION TABLE

| Sl no. | Load applied(P) | Change in length(δl) | Stress(σ)=P/a | Strain(e)=δl/L | Young's Modulus E=σ/e |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
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**CONCLUSION:-**

From the above experiment we have successfully determine the young's modulus of mild steel specimen by using Universal Testing Machine (UTM).

## VIVA QUESTION:

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# EXPERIMENT NO-04

## AIM OF THE EXPERIMENT:-

Study of pressure measuring devices such as piezometer & simple manometer.

## APPARATUS REQUIRED:-

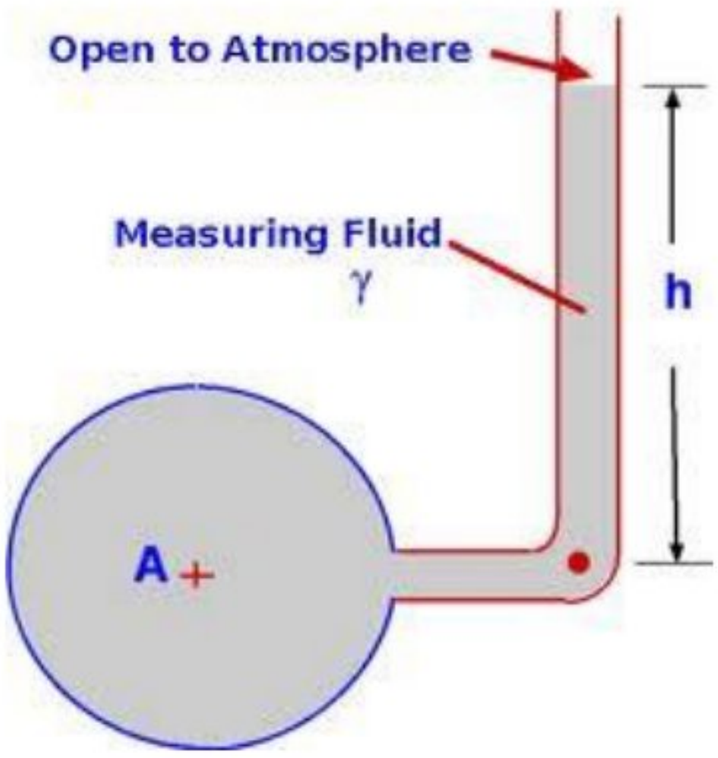
| Sl.no | Name of the apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Piezometer | Simple | 01 |
| 02 | Manometer | U-tube | 01 |

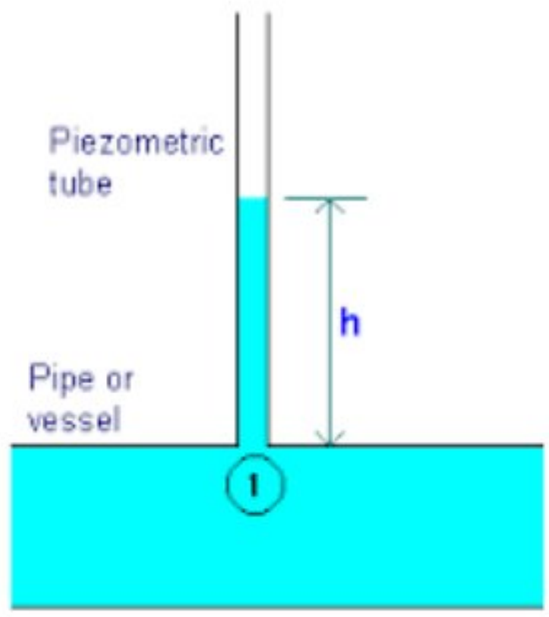
## THEORY:-

### 1-Study of Piezometer

- A piezometer is either a device used to measure liquid in a system by measuring the height to which a column of the liquid rises against gravity.
- Piezometer tube is the simple form of pressure measuring instrument by which pressure head of a liquid contained in a vessel can be directly measured.
- Intensity of pressure of the liquid in the vessel can then be calculated from the pressure head(h).
- Piezometer consists of a glass tube which is open at both ends.
- One end is connected to the vessel containing a liquid whose pressure head is required to be found out.
- The other end of the glass tube is exposed to the atmosphere.

Let h=vertical height through which the liquid rises in the piezometer tube .
Then the pressure P=ρgh

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## 2-Study Of Manometer

- A Manometer is slightly improved form of a piezometer tube for measuring high as well as negative pressure.
- A simple manometer, in its simplest form, consists of a tube bent in U-shape, one end of which is connected to the vessel containing the liquid whose intensity of pressure is to be measured and other end is open to the atmosphere.
- The liquid used in the bent tube is generally Mercury (Hg) which is 13.6 times heavier than water.
- The pressure of the liquid containing in the vessel will force the manometric liquid in the left hand vertical limb of the U-tube downward and will force the manometric liquid to rise up in the right hand vertical limb of the U-tube through equal distance (fig-1). This will happen when the pressure in the vessel is greater than atmospheric pressure.
- If pressure of liquid in the vessel is less than atmospheric pressure ,the deflection of manometric liquid will be observed in the left hand limb of the u-tube(fig-2)

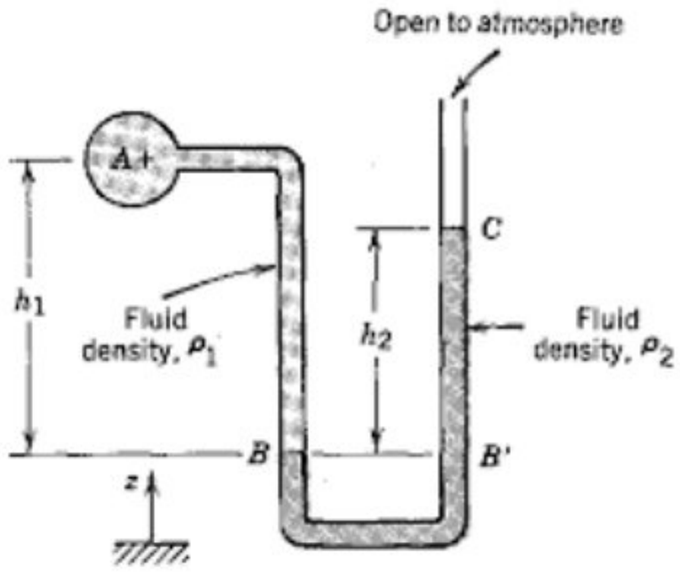


Fig-1

Gauge Pressure Measurement Vacuum using U tube manometer

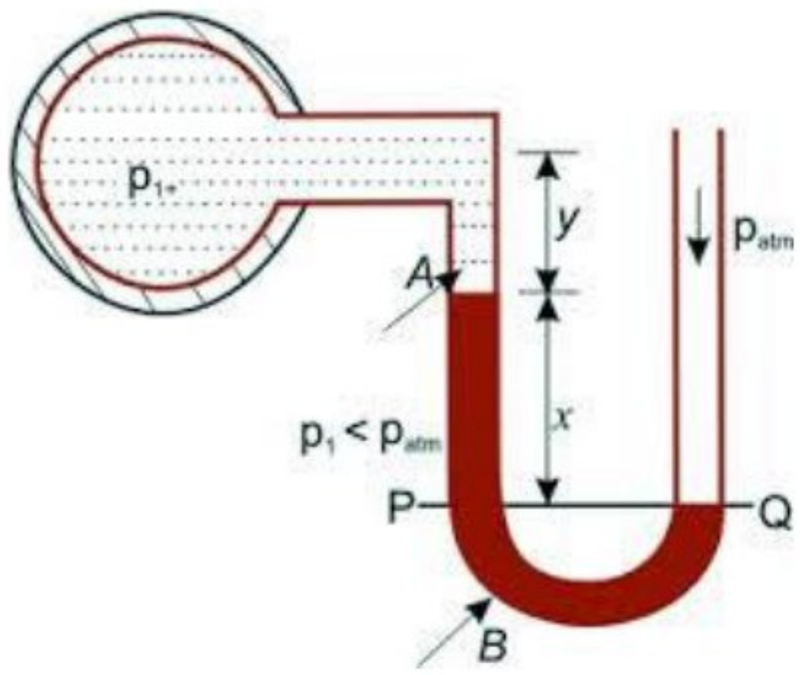


fig-2

Pressure Measurement using U-tube manometer

**CONCLUSION:-**

From the above experiment we have successfully studied about piezometer & simple manometer.

**VIVA QUESTION:**

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# EXPERIMENT NO-05

## AIM OF THE EXPERIMENT:-

Study of Bernoulli's Theorem.

## APPARATUS REQUIRED:-

| Sl.no | Name of the apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Bernoulli's Apparatus with venturimeter | Test Rig | 01 |
| 02 | Steel rule | L=30cm | 01 |

## THEORY:-

- Bernoulli's theorem states that "For a steady, continuous, incompressible, & non-viscous fluid flow, the total energy or total head remains constant at all the sections along the fluid flow provided there is no loss or addition of energy".

  i.e. $P/\rho g + V^2/2g + Z$= Total head (H) = constant

  Where, P/g = Pressure head in m
  $V^2/2g$ = Velocity or kinetic head in m (where Velocity of water = Q/A, m/s)
  Z = Potential head (Height above some assumed datum level I.e. Z=0)
- Bernoulli's equation is based on Euler's equation of motion. It is applicable to flow of fluid through pipe and channel. It is required to be modified if the flow is compressible & unsteady.

Concept Structure:-




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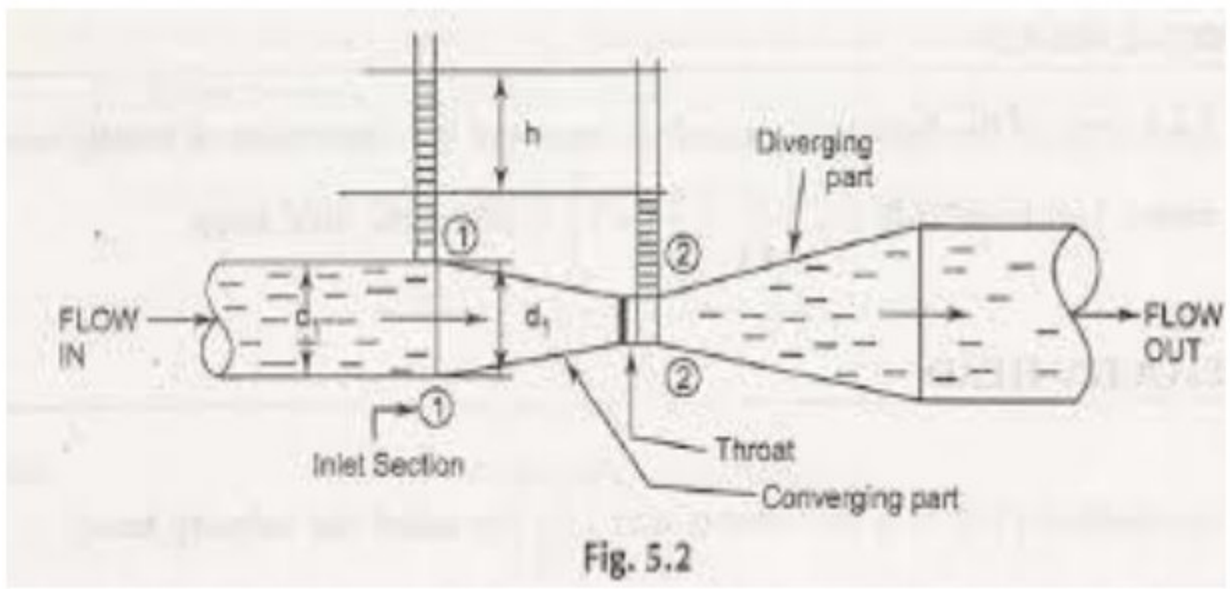


Fig. 5.2

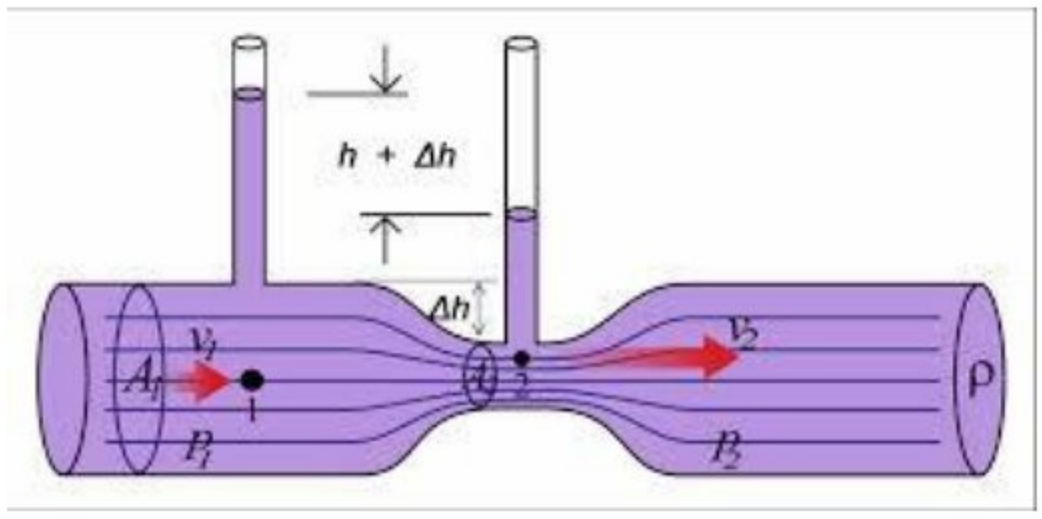


Fig:-Venturimeters used in Bernoulli's Theorem

**CONCLUSION:-**

Hence we have successfully studied about Bernoulli's theorem.

**VIVA QUESTION:**

# EXPERIMENT NO-07

## AIM OF THE EXPERIMENT:-

Model study of,Francis Turbine,Kaplan Turbine,Pelton wheel Turbineand Centrifugal Pump.

## APPARATUS REQUIRED:-

| Sl.No | Name of the Apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Centrifugal pump | Model | 01 |
| 02 | Francis turbine | Model | 01 |
| 03 | Kaplan Turbine | Model | 01 |
| 04 | Pelton Turbine | Model | 01 |

## THEORY:-

### STUDY OF TURBINES:-

The hydraulic machine which converts the hydraulic energy into mechanical energy is called Turbines. Turbines are 3-types:-PeltonWheel Turbine, Francis Turbine & Kaplan Turbine.

### 1. Pelton Turbine:-

- It is a tangential flow impulse Turbine which is used for high head and low discharge.
- Main parts of this turbine are:-Nozzle with and guide mechanism, Runner with buckets, casing .
- Working principle:-The jet of water from the nozzle strikes at the center of the buckets with a very high velocity and leaves the buckets with a low velocity and produces impacts on buckets. Due to the impacts, turning moment acts on the runner which now rotates at high speed.

### 2. Francis Turbine:-

- Francis turbine is an inward flow reaction turbine, in which water flows radially from outwards towards the axis of rotation of the turbine shaft.
- Main parts of this turbine are:-casing, guide mechanism, runners, draft tube.
- Working principle:- water from the reservoir is led to the turbine through the penstock then enters into the Casing with guide vanes and runner. Flowing through the guide vanes, water radially strikes the runner blades and causes the runner to rotate. Then the water flows to the tailrace through draft tube.

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**3. Kaplan Turbine:-**

- Kaplan turbine is a vertical axial flow reaction turbine .
- Here water flows into the "scroll casing" from "pen stock" and from their water flows over the guide blades into the runner blades.
- Water exerts force to the runner blades due to pressure difference between inlet and outlet side of the runner.
- This force causes the turbine to rotate about a vertical axis.
- Ultimately water leaves the runner through a draft tube into the tail race.

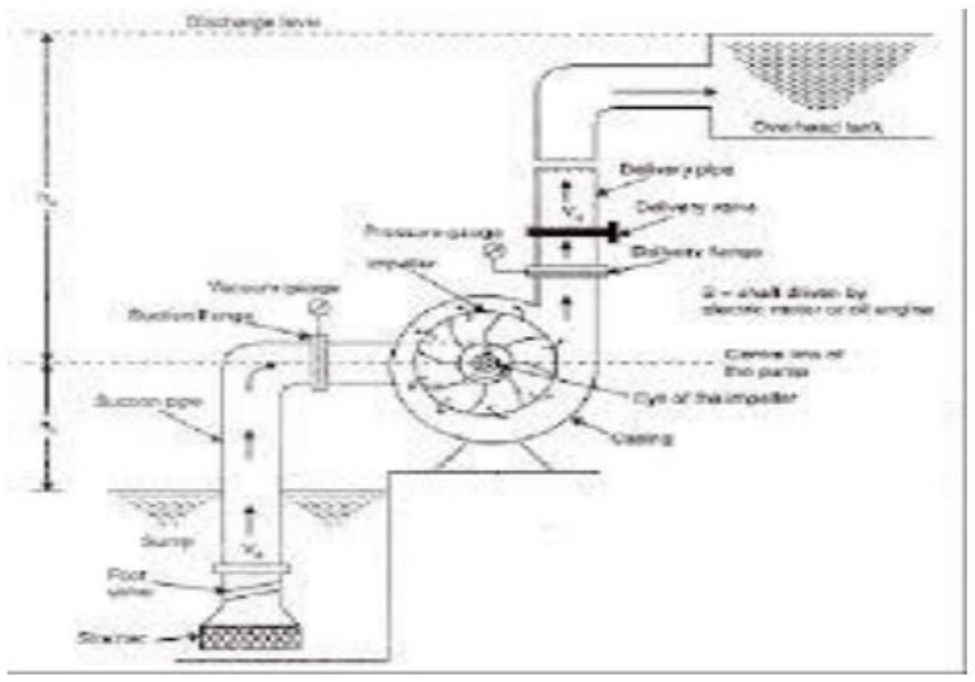
**STUDY OF PUMPS:-**

The hydraulic machine which converts the mechanical energy into hydraulic energy is called pumps. Pumps are 2-types:-Centrifugal pump &Reciprocating pump.

**Centrifugal Pump:-**

- If the mechanical energy is converted into pressure energy by means of centrifugal force acting on the fluid, the hydraulic machine is called centrifugal pump.
- The centrifugal pump works on the principle of vertex flow which means that when a certain mass of liquid is rotated by an external torque, the rise in pressure head of the rotating liquid takes place.
- Main parts of this turbine are:-Impeller, casing & suction pipe with foot valve and a strainer.
  - **Impeller:**-It is the rotating part of the centrifugal pump, consists of a series of backward curved vanes. It is mounted on a shaft which is connected to the shaft of an electric motor.
  - **Casing**:-It is an airtight passage surrounding the impeller and is designed in such a way that the K.E of the water discharge at the outlet of the impeller is converted into pressure energy before the water leaves the casing.

- **<u>Suctionpipe with foot valve</u>**:- A pipe whose one end is connected to the inlet of the pump and other end dips into water in a sump is known as suction pipe. A foot valve which is a non-returning valve is fitted at the lower end of the suction pipe. The foot valve opens only in the upward direction. A strainer is also fitted at the lower end of the suction pipe.



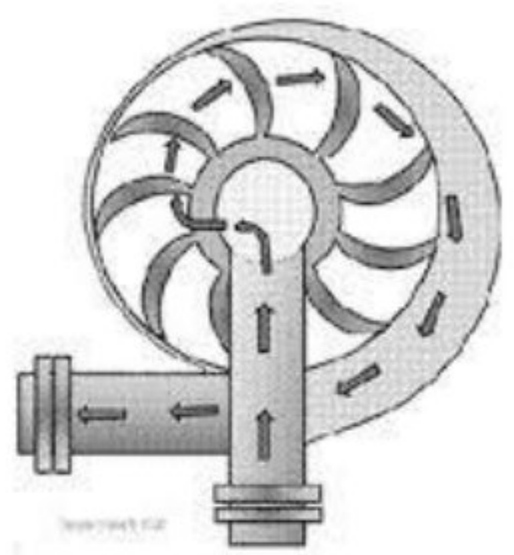
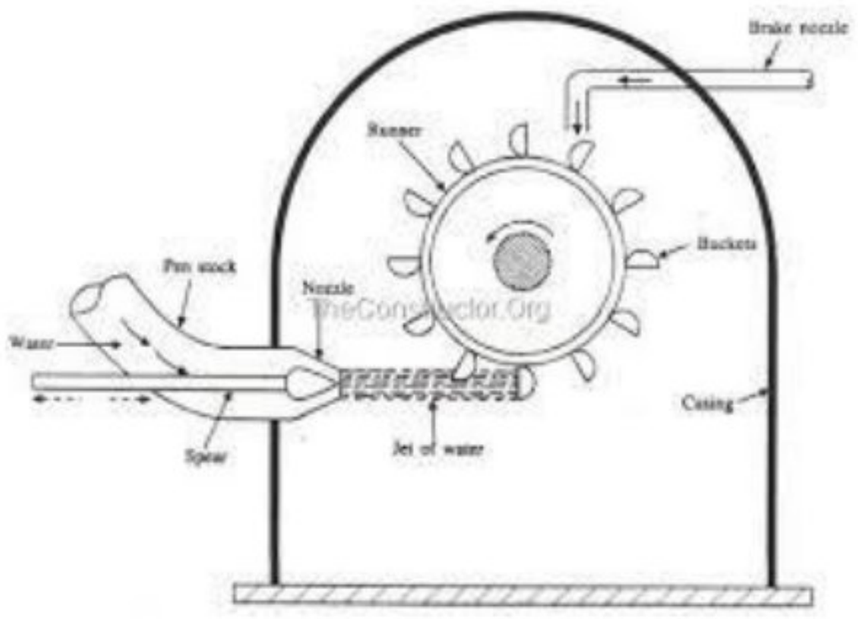



Fig:-Centrifugal pump



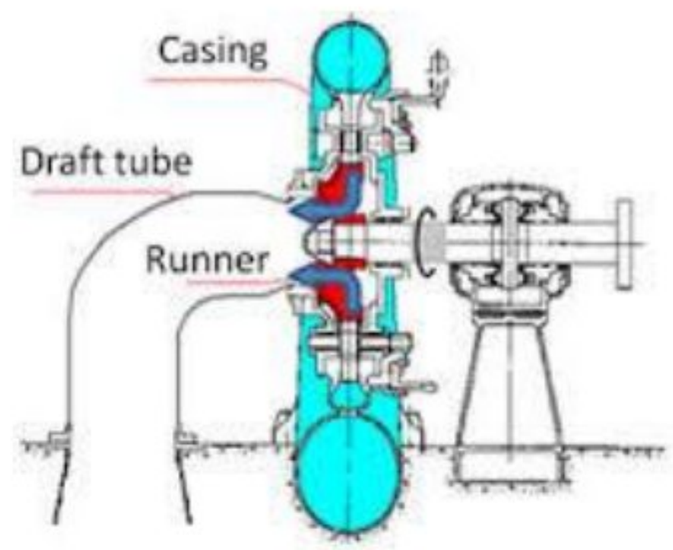
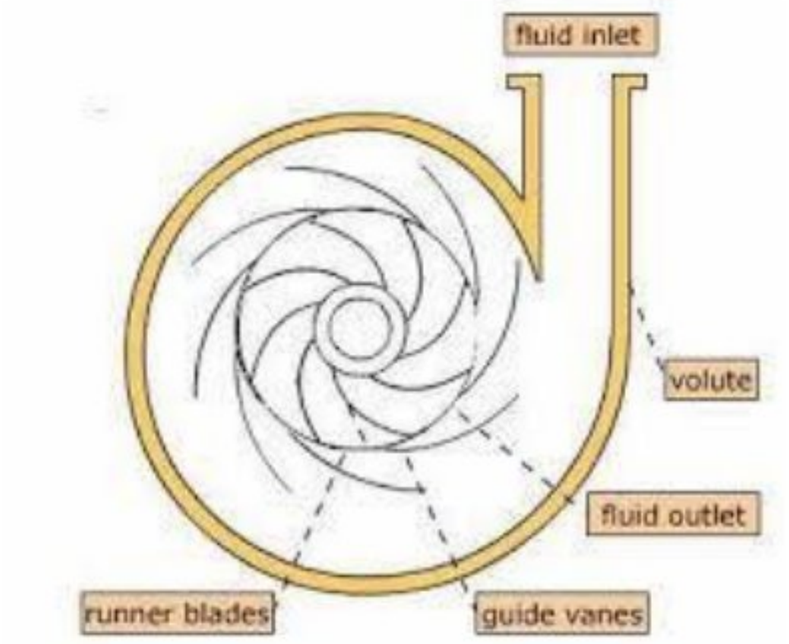
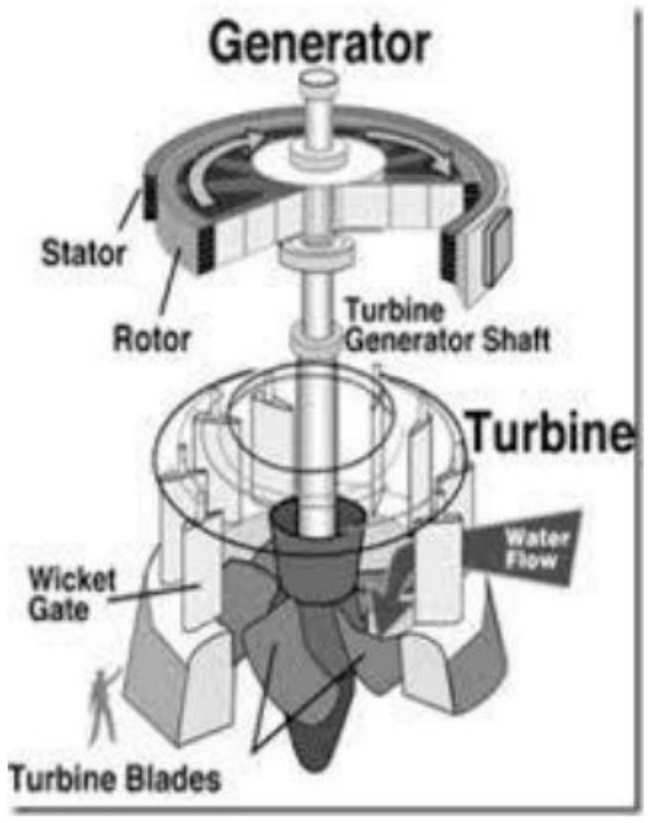



fig:-pelton wheel turbine




Francis turbine

fig:-francis Turbine




Kaplan turbine

## CONCLUSION

Hence we have successfully studied about different types of turbines and pumps.

## VIVA QUESTION:

# EXPERIMENT NO-08

## AIM OF THE EXPERIMENT:-

**Study of Cochran Boiler**

## APPARATUS REQUIRED:-

| Sl.No | Name of the Apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Cochran Boiler | Model | 01 |

## THEORY:-

- It is one of the best type of vertical tubular boiler and has a no of horizontal fire tube .
- Dimension of Cochran Boiler:-

  Shell dimention-2.75mHeight-5.79m

  Working pressure-6.5 barSteam capacity-3500 kg/hr

  Heating surface-120m$^2$Efficiency-70-75% (depending on fuel used)
- Cochran Boiler consists of a cylindrical shell with a dome shaped top where the space is provided for steam.
- The furnace is one piece construction and is seamless.
- Its crown has a hemi-spherical shape and thus provides maximum volume of space.
- The fuel burnt on the grate and ash is collected and disposed in form of ash pit.
- The gases of combustion produced by the burning of fuel enter the combustion chamber through the fuel tube and strikes against fire brick lining.
- Then passes through number of horizontal tubes, being surrounded by water.
- Then, the gases escape to the atmosphere through smoke box and chimney.
- Due to heat of combustion gases the steam will produced & move towards top to enter into nozzle & turbine.
- The various boiler mountings are:-

1-Water level gauge,2-safety valve,3-steam stop valve,4-blow off cock,5-man hole ,6-pressure gauge.

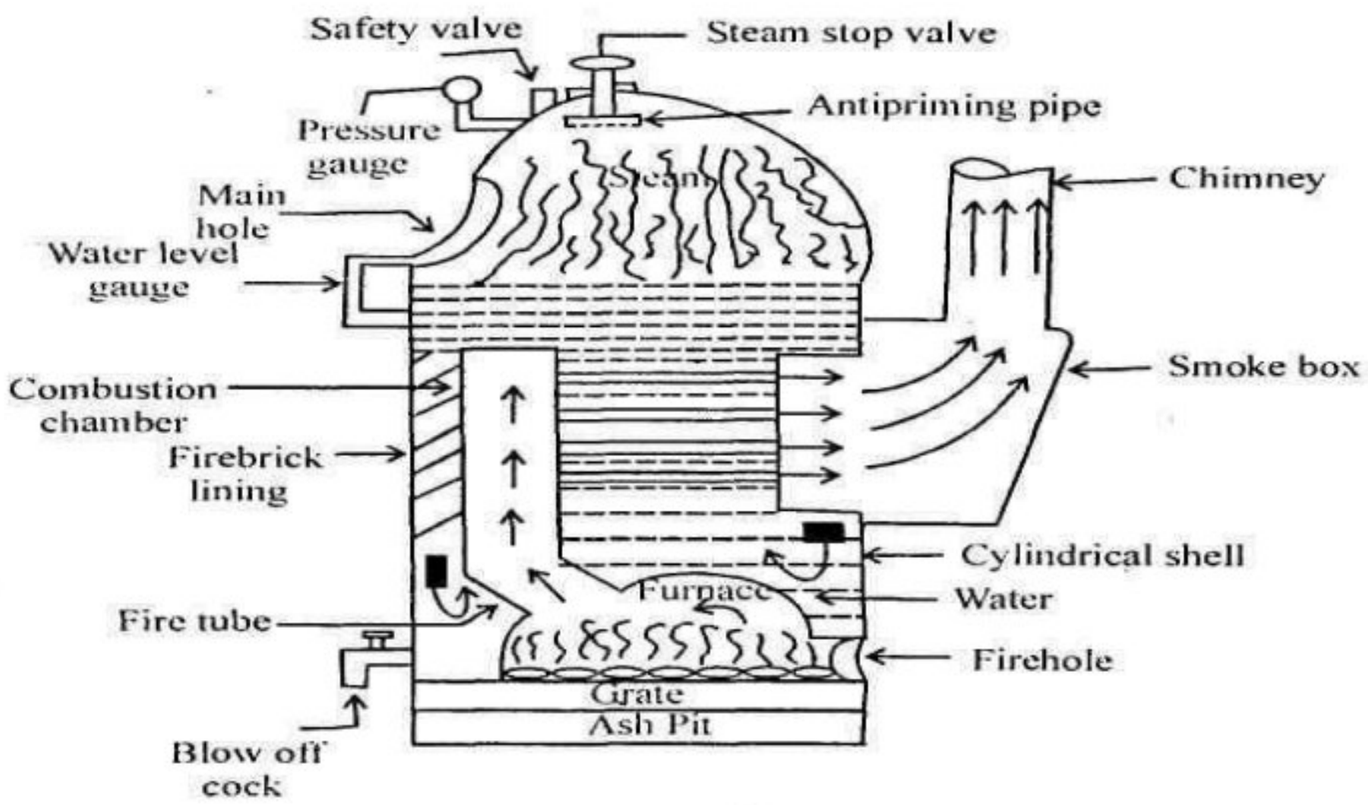



*Fig. Cochran Boiler*

## CONCLUSION

## VIVA QUESTION:

# EXPERIMENT NO-09

## AIM OF THE EXPERIMENT:-

Study and demonstration of steam engine.

## APPARATUS REQUIRED:-

| Sl.No | Name of the Apparatus | Specification | Quantity |
|---|---|---|---|
| 01 | Simple steam engine | Model | 01 |

## THEORY:-

- In all steam engines, the steam is used as the working substance .These engines operate on the principle of first law of thermodynamics.
- In steam engines ,the steam is converted into mechanical work by the reciprocating motion of piston.
- The steam engines are classified as follows:-
    1. According to the no. of working stroke
        (a)Single acting steam engine.
        (b)Double acting steam engine.
    2. According to the position of the cylinder.
        (a) Horizontal steam engine
        (b) Vertical steam engine.
    3. According to the speed of the crankshaft.
        (A) Slow speed steam engine (N<100 rpm)
        (b) Medium speed steam engine (100<N<250)
        (c)High speed steam engine (N>250)
- Important parts of steam engine are:-
    1. Frame:-It supports all stationary and moving parts and holds them in proper position. It is made of up Cast Iron.
    2. Cylinder:-It is a hollow cylindrical vessel made of up cast iron in which piston reciprocates.
    3. Steam Chest:-It supplies steam to the cylinder with the movement of D-slide valve.
    4. D-slide valve:-It moves in the steam chest with S.H.M and exhaust steam from the cylinder at proper movement.
    5. Inlet and exhaust ports:-These are the holes provided in the body of the cylinder for the movement of steam.

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6. Piston:-It is acylindrical disc,moving to and fro,in the cylinder because of the steam pressure. Its function is to convert heat energy of the steam into mechanical work.
7. Piston Rod:-It is a circular rod, which is connected to the piston on one side and cross head to the other.Its main function to transfer motion from the piston to the cross-head.
8. Cross Head:-It is a link between the piston rod and connecting rod. Its function is to guide motion of the piston rod and to prevent it from bending.
9. Connecting Rod:-It connects both cross head and the crank, converts reciprocating motion of the piston into rotary motion of crank.
10. Crank shaft:-It is the main shaft of the engine having a crank.
11. Eccentric:-It is generally made of cast iron and is fitted to the crank shaft.Its function is to provide reciprocating motion to the slide valve.
12. Eccentric rod and valve rod:-It is made of up forged steel, connects eccentric with valve rod.Its function is to convert rotary motion of the crank shaft into to and fro motion of the valve rod.
13. Flywheel:-It is mounted on the crank shaft which prevents the fluctuation of engine. Made of Cast iron.

**WORKING PRINCIPLE:-**

- The superheated steam at a high pressure from the boiler is led into the steam chest.
- After that the steam makes its way into the cylinder through any of the ports ‘a ‘or ‘b’ depending upon the position of the D-slide valve.
- When port ‘a ‘isopen, the steam rushes to the left side of the piston and forces it to the right.
- At this stage, the slide valve covers the exhaust port and the other steam port ‘b’.
- Since the pressure of steam is greater on the left side than that on right side, the piston moves to the right.
- When the piston reaches near the end of the cylinder, it closes the steam port ‘a’ and exhausts port.
- The steam port ‘b’ is now open, and the steam rushes to the right side of the piston.
- This forces the piston to the left and at the same time the exhaust steam goes out through the exhaust pipe, and thus completes the cycle of operation.
- The same process is repeated in other cycles of operation, and as such the engine works.

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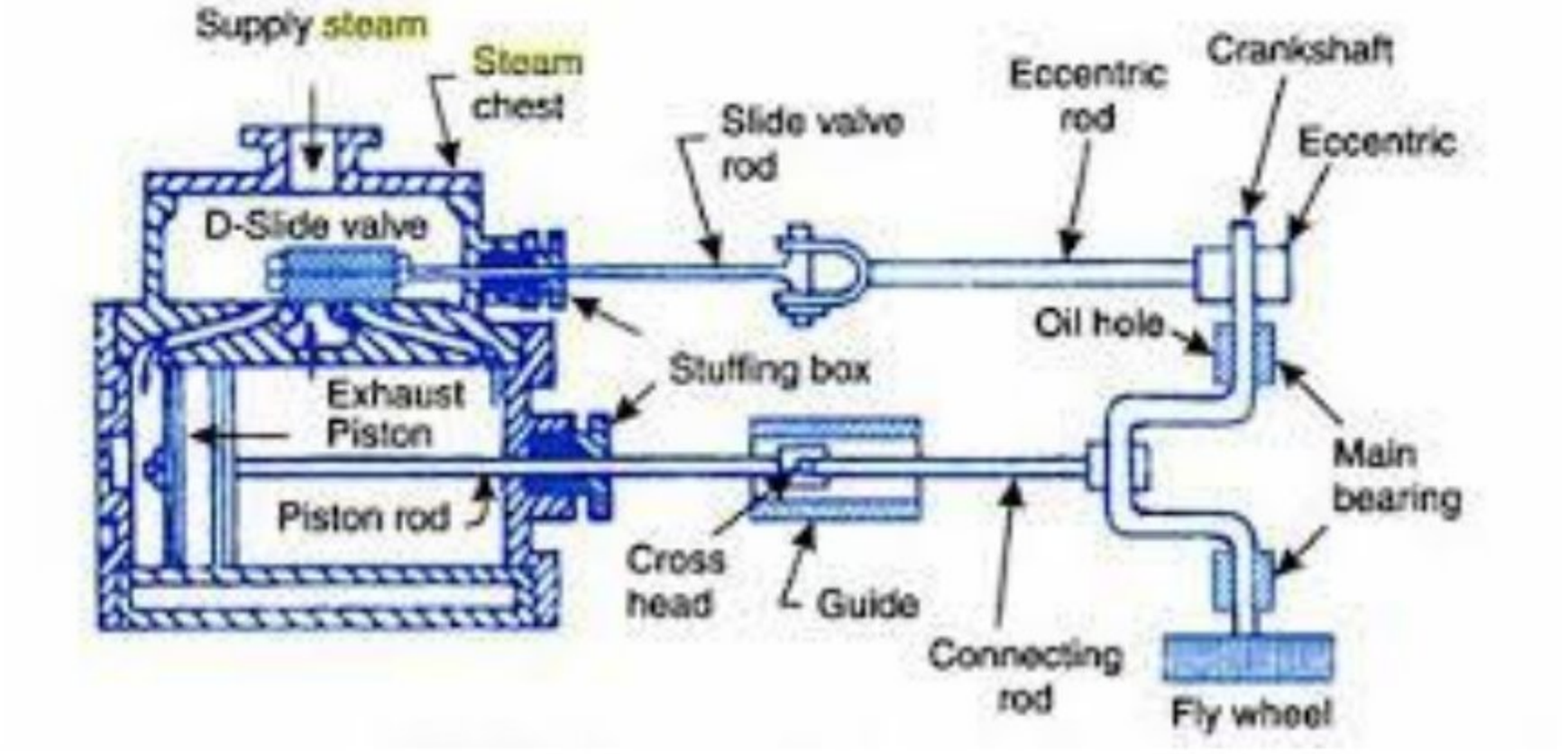


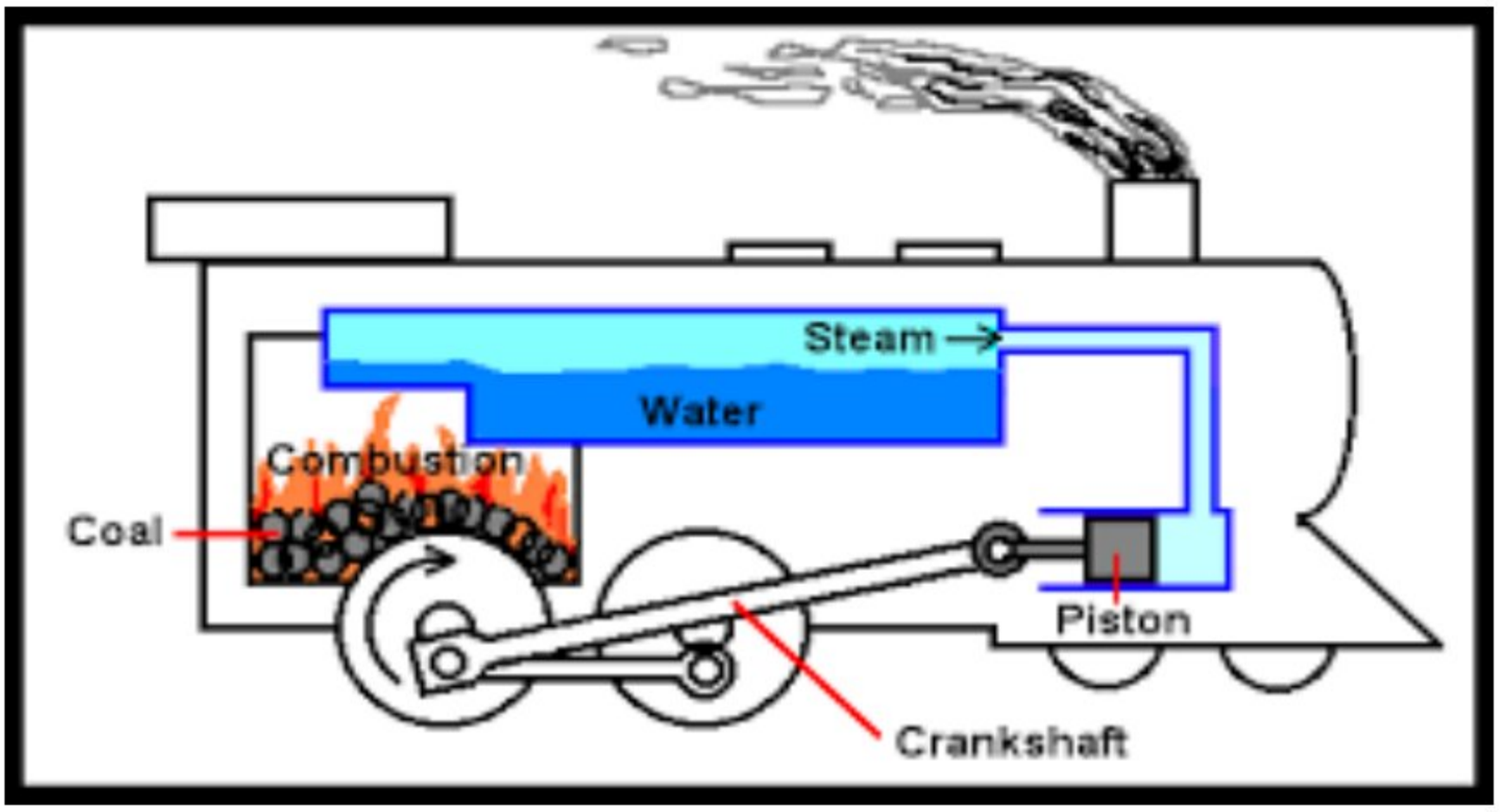


Fig- steam engine.

**CONCLUSION**

- Hence we have successfully studied about steam engine.

**VIVA QUESTION:**