

Thermodynamic cycle

Power cycle

- +ve work
- clockwise (P-V & T-S)
- η
- Fluid Energy $\downarrow$

Refrigeration cycle

- -ve work.
- Anticlockwise (P-V & T-S)
- COP
- Fluid Energy $\uparrow$

Thermodynamic cycle

open cycle

- In every cycle new working substance is taken, used and exhausted to atmosphere.
working substance $\rightarrow$ Air.
- working substance and fuel mixed each other

closed cycle

- * The same working substances again and again recirculated in the cycle.
- $\rightarrow$ Any low grade fuel can be used.
- $\rightarrow$ No mixing of working substance and fuel.

Thermodynamic cycle

Gas

Very difficult to condensate out.

Fluid in single phase in the cycle.

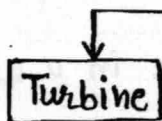
The working substance remains in single gaseous phase throughout the cycle.

Vapour

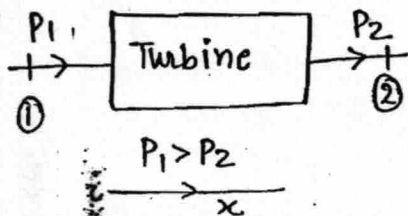
• Easily condensate.

- half cycle - liquid phase
- half cycle - vapour phase

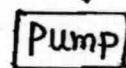
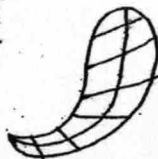
- working substance remains liquid phase for half the cycle and vapour phase for



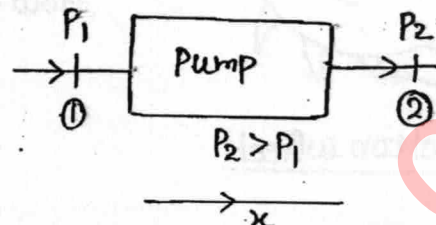
- +ve work
- $\eta \uparrow$



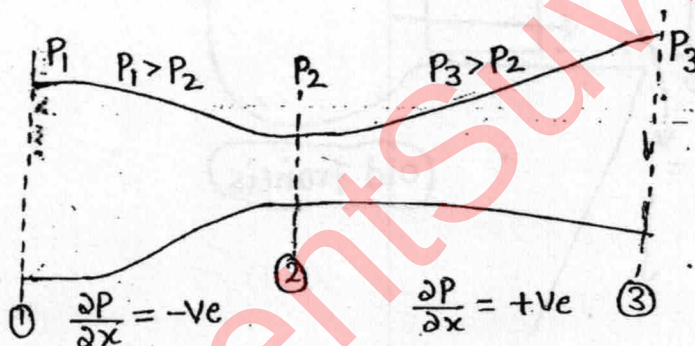
$$\frac{\partial P}{\partial x} = -ve$$



- -ve work
- $\eta \downarrow$



$$\frac{\partial P}{\partial x} = +ve \quad (\text{Flow separation})$$



$$101.325 \rightarrow 99.6^\circ C$$

$$50 \text{ kPa} \rightarrow 60^\circ C$$

$$2.5 \text{ kPa} \rightarrow 20^\circ C$$

$$2 \text{ kPa} \rightarrow 18^\circ C$$

- cavitation at exit.

- Inward flow

- cavitation at inlet.

- Outward flow

if temp = $20^\circ C$ and pressure decreases = 2 kPa

: then vapour formation (bubble formation)

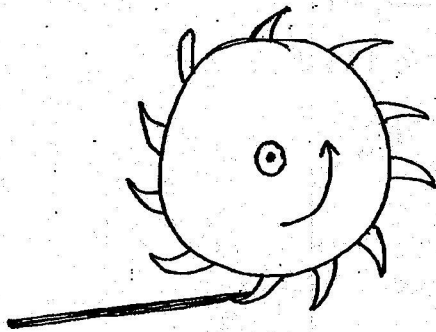
and if pressure increase again then temp increases

the water condensed and bubble burst and

pressure wave generated

Types of flow :-

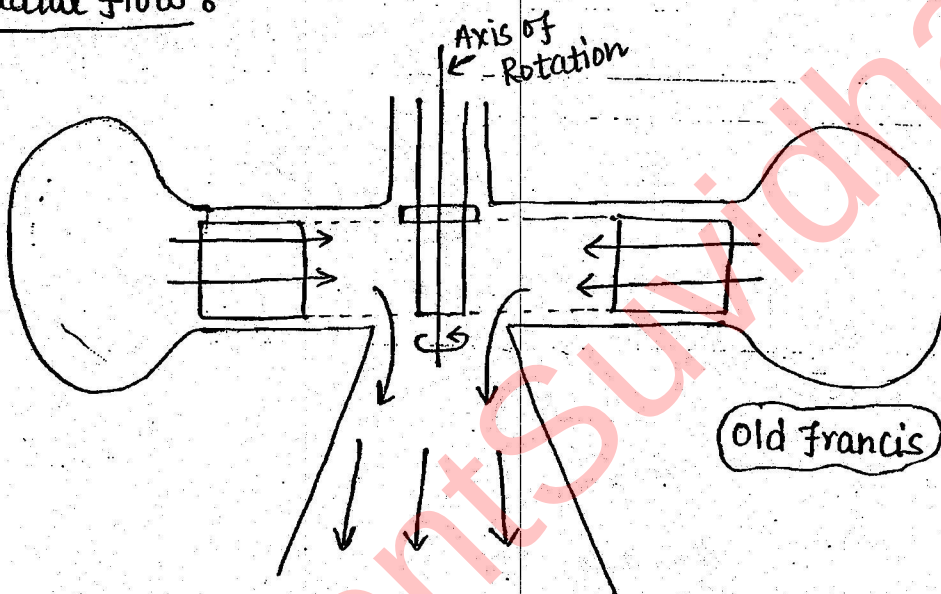
① Tangential Flow :-



Pelton wheel

When flow takes place in a direction tangential to the axis of rotation while passing through the moving part it is termed as tangential flow.

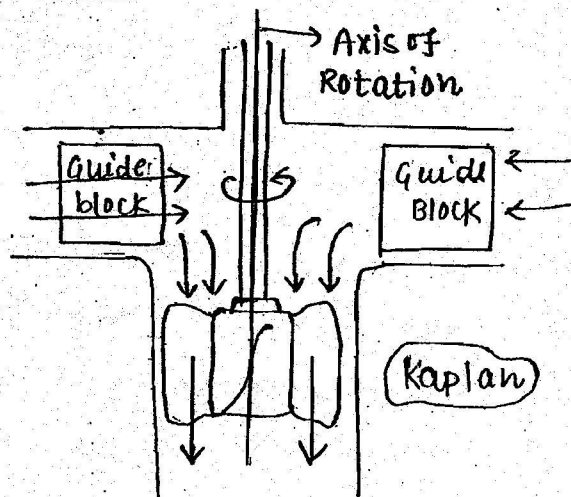
② Radial Flow :-



While passing through the moving part if the flow takes place in the direction $\perp$ to the axis of rotation it is termed as Radial Flow machine.

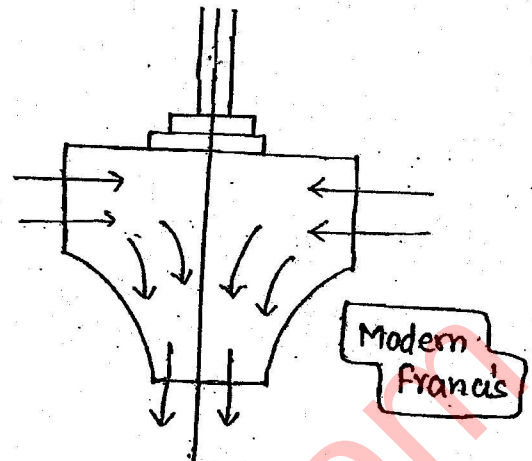
③ Axial Flow :-

While passing through the moving part if the flow takes place in a direction parallel or along to the axis of rotation it is termed as axial flow machine.



④ Mixed Flow :-

Radial at inlet and axial at outlet.



	Steam power plant (40%)	Gas Turbine P.P. (8-12%)	IC Engine P.P. (1-2)
• Cycle	Rankine	Brayton	Diesel or Otto
• Fuel	Coal, HSD, oil, Aromatic fuels	Natural Gas, Methane, Ethane etc.	Diesel, Petrol, Kerosene.
• Max. Temp.	620°C	1300°C	2500°C
• pressure ratio ($\frac{P_2}{P_1}$)	180 to 300	8 to 12	15 to 25
• weight/power Ratio.	55 kg/kw	20 kg/kw (Aircraft)	115 kg/kw
• η thermal	35 to 37%	20 to 25%	27 to 32%
• Pollution	Highest	lowest	Medium.
• Installation Period	3 to 4 yrs / 200MW	2 to 3 yrs / 200MW	1 to 2 months / 1-2MW

