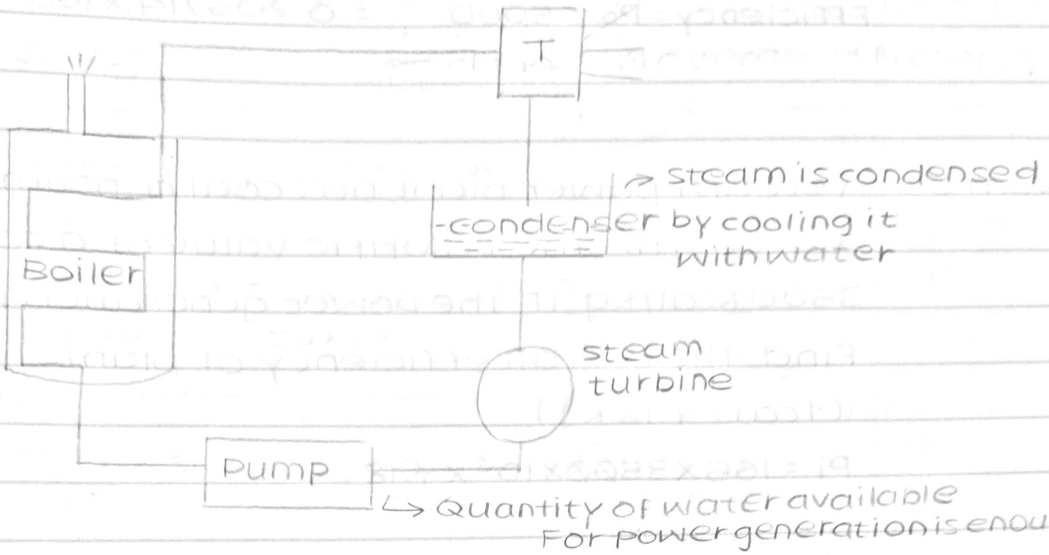
POWER PLANT



1) The condensate water is drawn back from the condenser by extraction pump and send it to low pressure feed heater

2) Types - Thermal — Steam
Diesel — Gas
Nuclear — Bio-Gas

3) Advantages
- ★ Unit capacity is more
- ★ Long Lasting
- ★ Low cost price
- ★ No Harmful

Disadvantages
- ★ space req is more
- ★ less efficient

23/11/22

Num1 The coal consumption of thermal power plant is 100 tons of coal per day the calorific value of a coal is 21,000 KJ/kg. If the power generation is 5000 kWatt. Find the overall efficiency of power plant

$$Pi = \frac{100 \times 10^3 \times 21000}{24 \times 3600} = \frac{21 \times 10^6}{24 \times 36} = \frac{21 \times 10^6}{0.024864} = 0.024305 \times 10^6$$

$$= 24305.55$$

$P_o = 5000$ Watt

$$\text{Efficiency} = \frac{P_o}{P_i} = \frac{5000}{2430555} = 0.205714 \times 100 = 20.57\%$$

NUM 2 A steam power plant has coal consumption of 165 tons/Hr. The calorific value of a coal is 3500 kcal/kg. If the power generation is 250 Mwatt Find the overall efficiency of plant

(1 cal = 4.18 KJ)

$$P_i = \frac{165 \times 3500 \times 10^3 \times 4.18}{60 \times 60}$$

$$= \frac{24139.5 \times 10^3}{36}$$

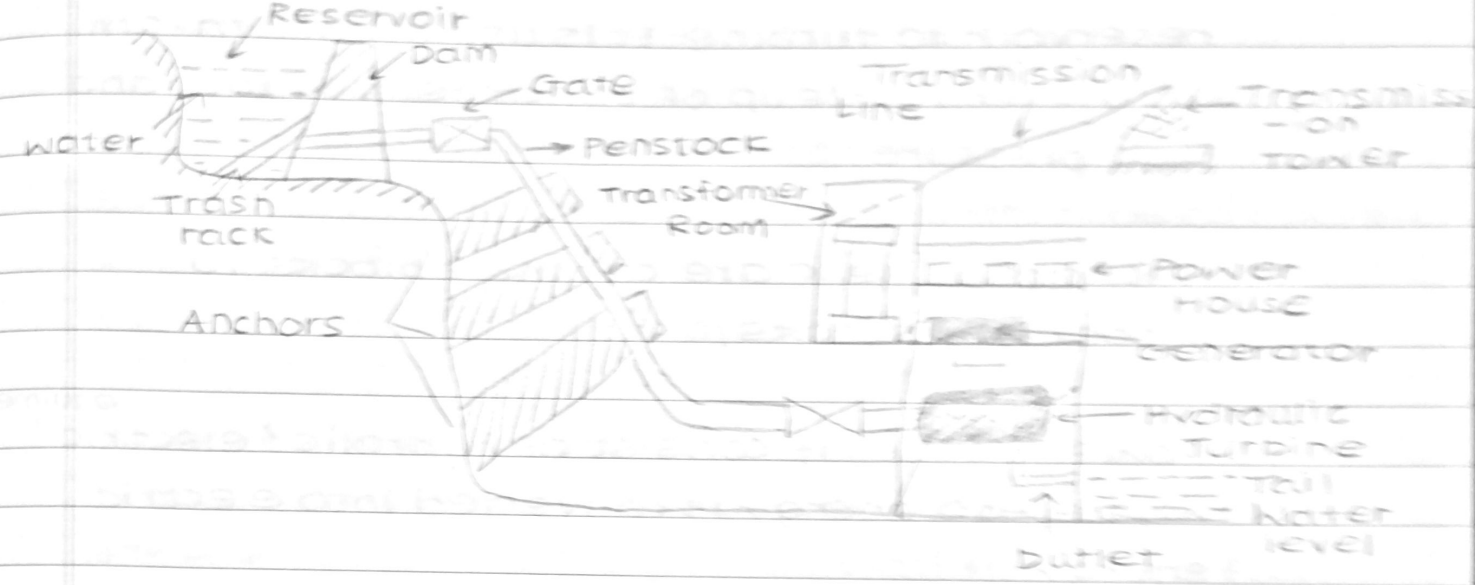
$$= 670 \times 10^3$$

$$\text{EFFICIENCY} = \frac{250}{670 \times 10^3} = 0.3731$$

NUM 3 A steam power plant has a coal comsption of 16200 kg/Hr with calorific valve of coal is 17793.9 KJ/kg. If the speed of turbine is 1 T/rpm and generated torque is 4777464.8293 Nm, Find input power, outputpower and efficiency

24/11/2022

HYDROELECTRIC POWER PLANT



* COMPONENTS

1) Reservoir: It is provided to store a water in rainy season and supplies it in dry season. It is used to run the hydroelectric reservoir.

2) Dam: It is a structure of considerable height build across the reservoir. It develops the reservoir to store H_2O & it build-up a working head for power generation.

3) Trash rack: It is provided for preventing the enter of dust, dirt from the dam because it can may damage the turbine bled and chock up the flow. It is generally made of steel.

4) Gate: It is provided to control flow the water from reservoir to turbine. Acc to requirement the gate opening can be changed

5) Penstock: A pipe which carries water from reservoir to turbine. It is usually of 1m-2m diameter made up of concrete to with stand high pressure

6) Anchors : These are concrete blocks to support penstocks.

7) Power House : It consist of hydrolic & electric equiments where H_2O energy is converted into electric energy

8) Hydrolic Turbines: These are used to convert KE energy of water into Mechanical Energy

9) Tail Race : It is path to lead H_2O discharged from turbine to river

* OPERATIONS

Water from reservoir flows thr penstock to hydrolicturbine & during the passage in its PE is converted into KE. This high velocity ject of H_2O stricks the hydrolicturbine wines where its KE converted into mechanical Energy A Generator coupled to hydroturbine converts the available mechanical to electric energy

* ADVANTAGES

1) Low operational and generation cost
2) No Fuel is to be burned to generate the power
3) Runing cost of power plant is low

4) These power plants are more rewenable
5) High ligh life
6) Non-polluting
7) Used For Irrigation & Flood-control
8) starting & stoping of plant takes short time compared to thermal & nuclear
9) Highly efficient over widly range of load

* DISADVANTAGES
1) Power developed depends upon availability of H_2O
2) These power plants are located far away from load centre which requires long transmission lines. So, the cost of these transmission lines & loss is more
3) Time req for setup of plant is more
4) Initial cost of setup is high

25-11-22

Num 1 In a thermal power plant the work done by the steam turbine is 900J/kg. The work consumed by boiler by work is 50 J/kg. The heat supplied to system is 2800 J/kg. Find net work done and its efficiency

- Net work done = work done - work consumed
  = 900 - 50
  = 850 J/kg

425
850
28
14

$$\text{Efficiency} = \frac{\text{(Net work done)}}{\text{2800 (Heat supplied)}} \times 100$$

$$= 30.35\%$$

Num 2 In a thermal power plant efficiency is 38%. The work done by turbine 1 KJ/kg. The heat supplied by boiler is 2.2 KJ/kg. Find work consumed

- $38 = \left(\frac{1\times10^3 - WC}{2.2\times10^3}\right) \times 100$

1000
836
164

3.8
22
176
760
936

$836 \times 10^2 = (1\times10^3 - WC)\times 100$

$836 = 1000 - WC$

$WC = 164$

Num 3 In a steam power plant, the heat supplied by boiler is 2900J/kg TFor this type of heat supplied the turbine work is 900 J/kg and pump work is 100 J/kg. Find IF it is req to increase the efficiency by 3%. Heat supplied for same turbine work then what is pump work

Net work done

- Net work done = 2900 - 900 = 2000

$$\text{Efficiency} = \frac{2000}{2900} \times 100$$

Date 28-11-22

THERMAL POWER PLANT

The Energy that comes from temp of heated substances

Hotter the substance, the more its particle move & higher its thermal energy

Ex. Heat from heater, Warm from SUN

OPERATION

Thermal or steam power plant uses steam to produce electric power

Generally, it consists of boiler, steam turbine, generator, feed pump, cooling Tower, condenser

In this type of power chemical energy OF fuel is used to H_2O into steam in High pressure boiler. This high pressure & steam is used in a turbine to produce mechanical energy

It finally is converted into electrical energy with help of couple generator.

The used steam is ~~connected~~ collected in condenser and converted in H_2O

This H_2O is again feed to boiler as inpot as a feed pump with help

BOILER

It used to generate high pressure & high temp steam. The input H_2O to boiler is supplied by feed pump

STEAM TURBINE CONDENSER

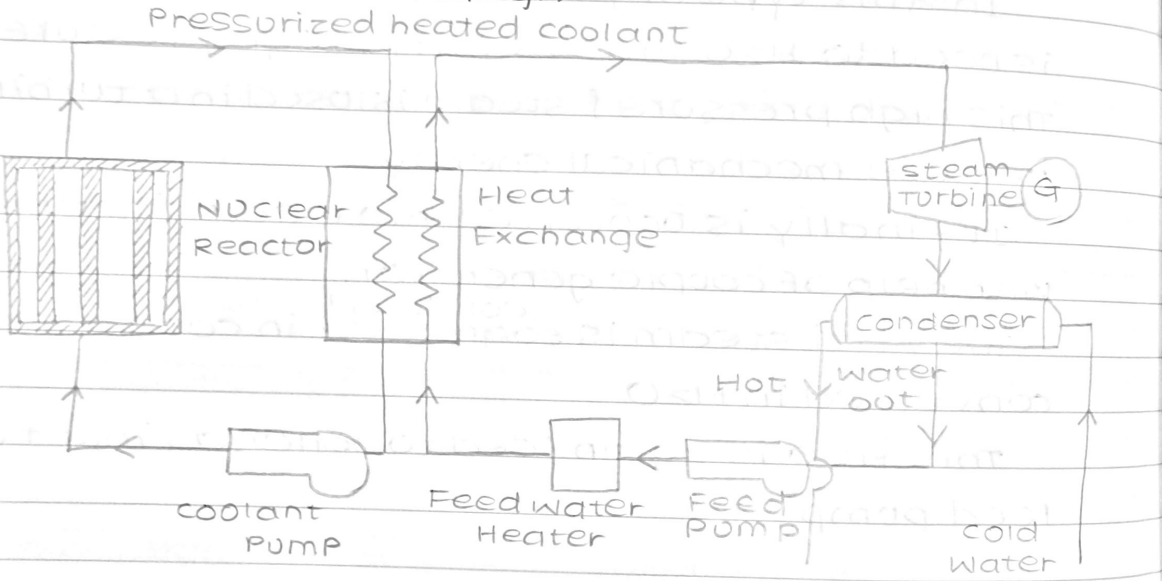
GENERATOR FEED PUMP

ADVANTAGES

1) Fuel used in boiler are coal, Natural Gas which are cheaper
2) It takes less space
3) Intial cost of setup is less than other
4) This powerplant can be located near at load shielded region

DISADVANTAGES

1) The timereq for setup is high
2) Large amount of H2O is requried
3) The handling of coal, ash is serious problem
4) Maintance cost is high



Nuclear power plant is similar to thermal The boiler of steam is replaced by nuclear reactor. Nuclear power uses nuclear energy produced by nuclear reaction for generation of steam. The heat is produced by nuclear fission of the atoms of fissionable material & it utilized in a special heat exchanger for production of steam. The commonly used fuels are Ur, T, aritifical elements Po.

This unstable atom liberate large amount of energy
1 kg of Uranium : Heat energy obtained by
4500 ton of coal

Nuclear Reactor

In it nuclear energy is produced by nuclear fission of unstable atom. This energy is transfer to circulating coolant

Heat Exchanger

It acts as boiler for Power Plant. The heat absorbed by coolant in reactor is tranfer to H_2O and steam is generated. The commonly used coolants are CO_2, He, liq metals like Na, K.

ADVANTAGES

1) Requires less space
2) Fuel required is negeliable compare to coal requirement
3) Fuel transport cost is less
4) R

DISADVANTAGES

1) Intial cost setup is high
2) Nuclear reactor Fuels aren't available
3) Problem in despogen
4) Cost of nuclear reactor Fuel is high
5) High degree of safety is

Date 29-11-22

ENERGY CONVERSION DEVICES

The system or device which are used for converting energy are called as Energy conversion Device

Types:

1) Power Producing Device
2) Power Absorbing Device

Power Producing

It operates on a cycle & produces mechanical power output on expense of supplied energy This devices generally absorb thermal energy from source & reject some part of it to a sink while doing so it produces a work as per Law of thermodynamics

Ex Boiler, steam & gas turbine, Hydrolic Turbine

Power Absorbing

It uses work energy from outside source to increase the energy of working fuild during cycle.

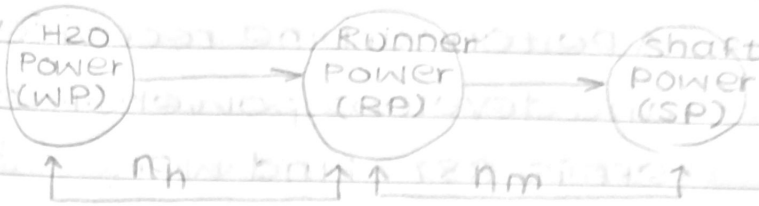
Ex Pump, Fan, Refigenerator

Hydrolic Turbine

It converts hydrolic energy of H_2O

Generally, Hydrolic turbine consists of runner, rotator, wheel having no. of special design wines, blends. The H_2O with large amount of hydrolic energy strikes the runner & makes it to rotate. Thus, the mechanical energy is supplied to generator coupled to runner to generate energy

$$\eta = \frac{\text{Output}}{\text{Input}} \times 100$$



$$\eta_h = \frac{RP}{WP} \times 100$$

Runner Power / Power supplied

$$\eta_m = \frac{SP}{RP} \times 100$$

Power available at shaft / Power developed by runner

Mechanical efficiency: Due to mechanical loss, the power available at shaft is less than power developed by Runner

Overall Efficiency = $\frac{\text{Power available at shaft}}{\text{Power supplied at entery of turbine}}$

$$\eta_o = \eta_h \times \eta_m$$

Num A Pelton wheel works under a H2O power of 1.3 MWatt. The hydrolic efficiency of turbine is 95%. Find the runner power if mechanical Eff is 90%. Find overall Eff and shaft power

$$\eta_h = \frac{RP}{WP} \times 100 \qquad \eta_m = \frac{SP}{RP} \times 100$$

$$95 = \frac{RP}{1.3\times10^9} \times 100 \qquad 90 = \frac{SP}{123.5\times10^{-2}} \times 100$$

$$95 \times 1.3\times10^9 = RP \times 100 \qquad 90 \times 123.5\times10^{-2} = SP \times 100$$

$$123.5 = RP \times 100 \qquad 1111.5\times10^{-4} = SP$$

$$123.5\times10^{-2} = RP$$

$$123.5\times10^{-2}\times10^9 = RP = 123.5\times10^7$$

$$95 \times 9 = 855$$

$$\eta_o = \frac{95}{100} \times \frac{90}{100}$$

$$= \frac{855}{1000} = 0.855 = 85\%$$

Num A Pelton turbine recevices H2O from penstock and develops power of 1000 Kwatt. If overall eff is 88%. Find WP

Also Find mechincal eff is RP is 11 MWatt

$\eta_h =$

$\eta_o = 88\%$

$\eta_m = ?$

RP = 11 MWatt

SP = 1000 Kwatt

WP = ?

$\eta_h = \frac{RP}{WP} \times 100$

$\eta_o = \eta_h \times \eta_m$

$\frac{88}{100} = \eta_h \times \frac{90}{100}$

$\eta_h = 97\%$

$\frac{97}{100} = \frac{11 \times 10^6}{WP} \times 100$

$WP = \frac{11 \times 10^{10}}{97} = 1134 \times 10^6$

$\eta_m = \frac{SP}{RP} \times 100$

$= \frac{10 \times 10^6}{11 \times 10^6} \times 100$

$= \frac{10}{11} \times 100$

$= \frac{10}{11} \times 100$

$\eta_m = 0.90 \times 100 = 90\%$

Steam Turbine

A steam turbine is mechanical device which extracts thermal engergy from pressted steam and converts to rotalary motion

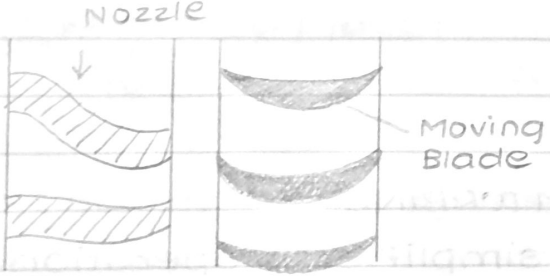
A steam turbine depends directly upon dynamic action of steam

High velocity jet of steam passes over curve blend which makes blend to rotate in direction of applied Force. The steam from boiler is expanded in nozzle where pressure of steam falls & thermal energy of steam is converted into KE. The change in flow direction of steam causes a force to be excrated on the blend & due to rotation of these blends power is being developed.

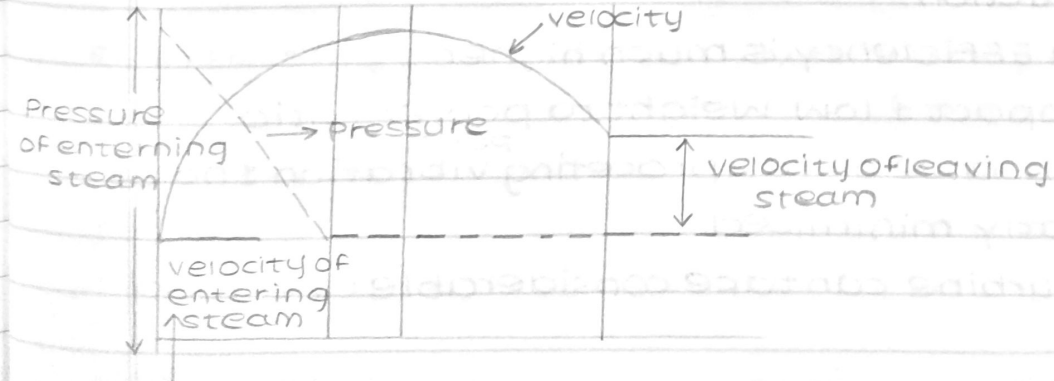
1) Impulse Turbine

In this turbine steam comes out at a very high velocity thr fixed nozzle & impinges on blend fixed at periferi of the rotater. The resultating force due to change in momentum causes the rotation of turbine shaft

Ex: De-Laval turbine, Curties Turbine

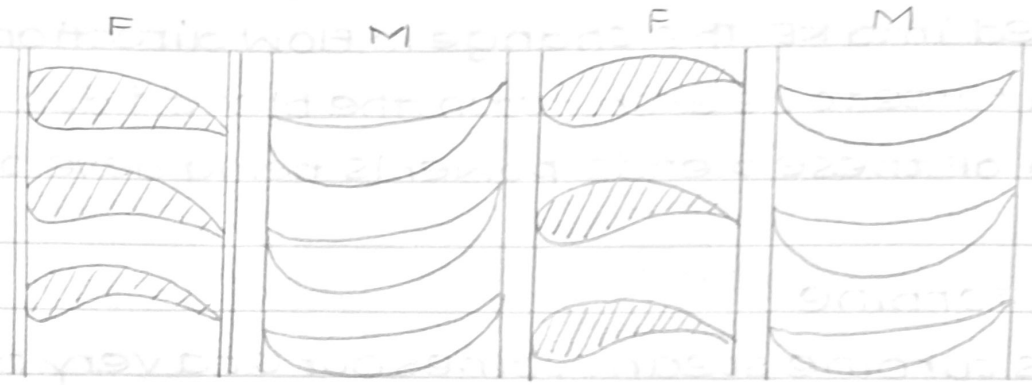


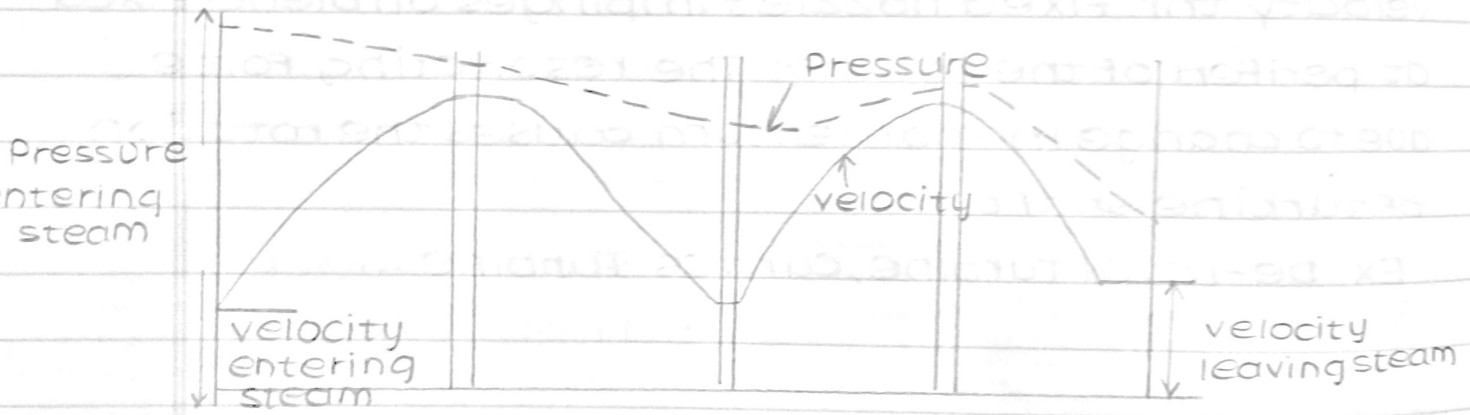
ARRANGEMENT OF TURBINES



Reaction Turbine

In this turbine the high pressure steam form boiler is passed thr nozzle, when steam comes out thr this nozzles the velocity of steam increases relative to rotating disk. This results in reacting force of the steam on nozzle which gives rotating motion to the disk & shaft. In this turbines steam expands both in fixed & moving blends continously when steam passes over them.





ADVANTAGES OF STEAM TURBINE

1) Steam Turbine is highly simplified in operation & construction.
2) Thermal Efficiency is much higher
3) It is compact & low weight to power ratio
4) Due to absence of resiproceting parts vibration & noice are greatly minimized
5) steam Turbine can take considerable over load

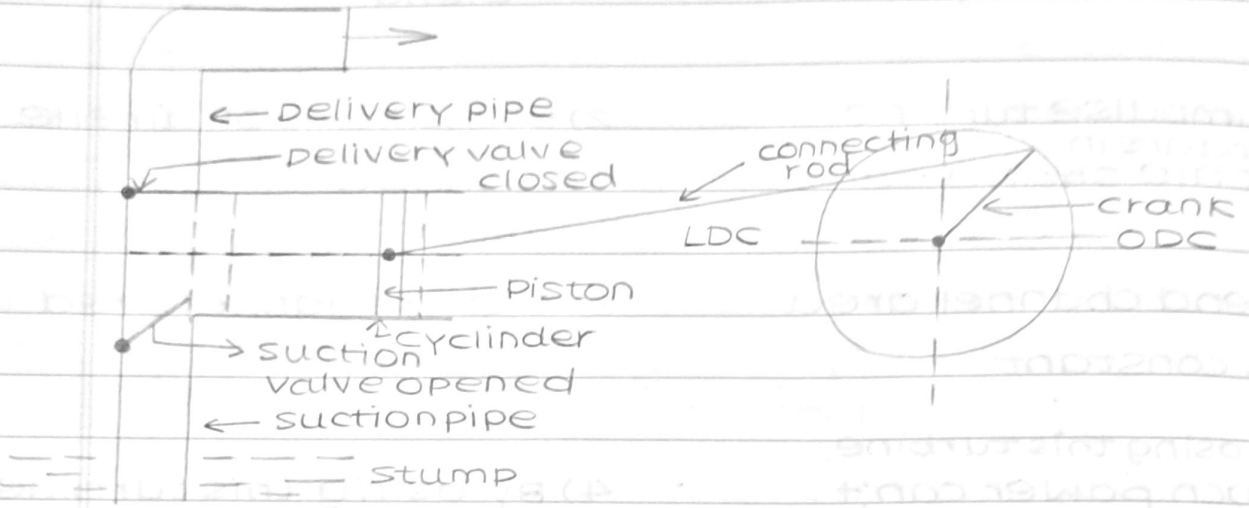
6) Life of steam turbine is high

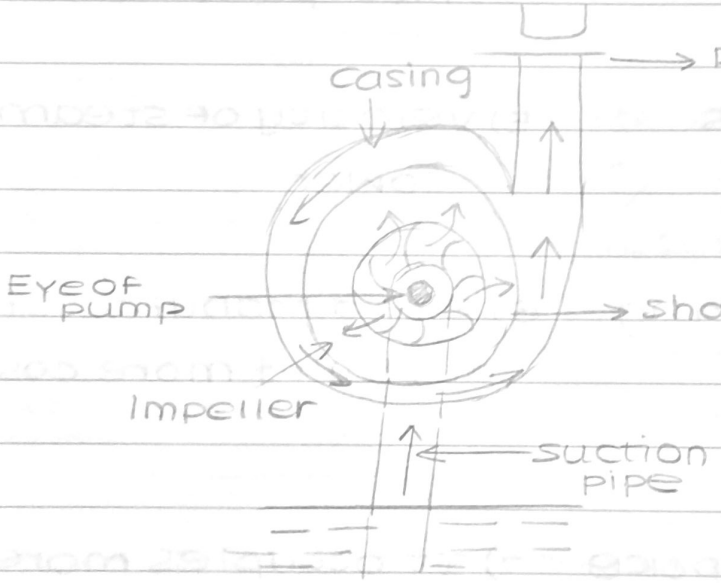
Impulse Turbine	Reaction Turbine
1) In this turbine pressure drops only in nozzle & not in moving blend	1) In this turbine pressure drops in nozzle & moving blend
2) In impulse turbine, blend are in profile shape	2) Blends are of airfile shape
3) Blend channel area is constant	3) Blend channel area is varing
4) By using this turbine much power can't be developed	4) By using this turbine much power can be developed
5) Velocity of steam is slightly higher	5) Velocity of steam is lower
6) Blend Manufacturing is ~~an~~ simple & less costly	6) Blend Manufacturing is difficult & more costly
7) It occupies less space for same power	7) It occupies more space for same power
8) Efficiency is low	8) Efficiency is high

UNIT 1

A PUMPS

Pump is a mechanical device which is connected to pipeline. It converts mechanical energy supplied to it into hydrolic energy & transfers it to liquid.





Impeller

It is a rotating part of circular pump. It consist of backward curve vens. It is mountained on shaft which is connected to electric motor.

casing

It is air tight passage surrounded to impeller

It is designed in such a way that KE of H_2O discharge of outlate of impeller converted to impeller energy before it leaves casing and enters delivery wall.

Suction Pipe

Pipe connected to inlet of pump & other dips in H_2O

B AIR COMPRESSOR

It is a device/machine providing air at a pressure is called air compressor.

It takes in the air & compress it & store it to storage

(1) According to type of motion

- Resiprocating
- Rotatary

(2) Acc to stages

- Single
- Multi

(3) Acc to working position of piston

- single acting
- Double acting

(4) Acc to discharge pressure

- LOW
- Medium
- High

(5) Acc to capacity of capacitor

- LOW
- High
- Medium

*Works like
Air filler in balloon