

fig. 11. Steam Power Plant

i) Explain various system & components used in steam Power Plant.



Elements or components of Steam Power Plant :

① Coal & ash circuit :

- i) Coal is burned and it is used for heating water.
- ii) After burning coal, ash is formed and collected separately.

② Steam Turbine & boiler :

- i) Boiler converts water into steam.
- ii) Steam passes over the blades of turbine and turbine starts rotating.
- iii) Turbines are connected to generators and generator produce electricity.

③ Electrical Circuit :

- i) Shaft of generator is connected to shaft of turbine and generator produce electricity.

④ Cooling Water Circuit :

- i) It contains condenser, cooling tower, cooling water tank and pump.
- ii) Steam is converted into ^{hot} cold water.
- iii) By using cooling tower & cooling water tank, warm water converted into cold water.
- iv) Economiser, Air ~~free~~^{pre}-heater, super heater are used in steam power station to improve efficiency.

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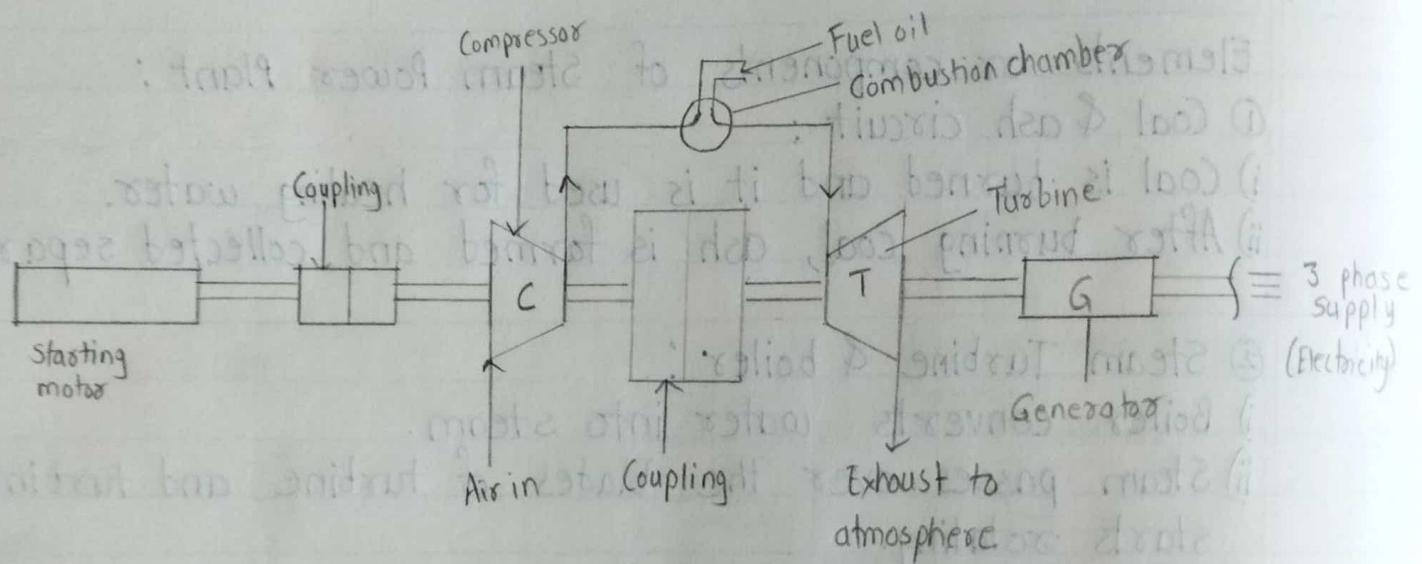


fig 1.2 Open Cycle Gas Turbine Power Plant

⑤ Air Preheater : Air is taken from atmosphere and passes through Air Preheater, it heated air by using heat or exhaust gaseous.

⑥ Economiser : It allows to pass only exhaust gaseous.

⑦ Superheater : Steam is again heated by using flue gaseous or exhaust gaseous in superheater.

2) Classify Gas turbine power plant. Explain various elements of Gas turbine power plant.

→ It is one of the thermal power plant. It converts heat energy into mechanical energy, electrical energy.

* Open cycle gas turbine power plant.

Working :

- i) This power plant consist of compressor, combustion chamber, generator, gas turbine.
- ii) Initially, starting motor is started by electricity. Motor is coupled through the compressor.
- iii) Compressor takes atmosphere air & compress it.
- iv) Pressure and temperature of air increased. That air supply towards combustion chamber.
- v) In combustion chamber, mixture of air and fuel is burned.
- vi) High pressure heat is produced in combustion chamber. That heat passes to turbine, turbine starts rotating, turbines are connected to generator.

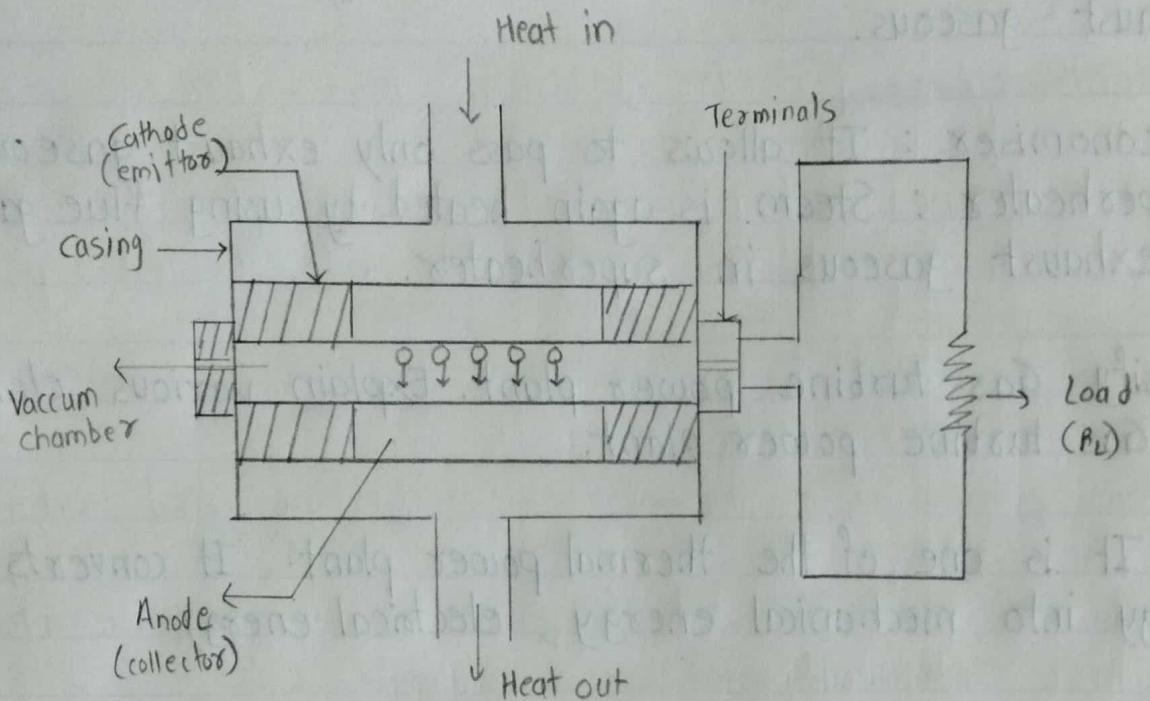


fig 1.3 Thermionic power generation.

vii) Generator produces electricity.

viii) Heat & gaseous coming out from the turbine are exhausted to atmosphere. Therefore it is known as Open cycle gas turbine power plant.

Advantages :

- i) It requires less space, there is no need of cooling water, condenser and cooling power.
- ii) Warm up time is less.

Disadvantages :

- i) Efficiency of this plant is less
- ii) Part of electricity is used to drive the compressor.
- iii) It require starting motor to drive the compressor.
- iv) It causes Air pollution.
- v) Erosion of blades of turbine occurs due to the heat.

3) Explain power generation by Thermionic.



Refer to fig. 1.3

Working :

- i) In thermionic power generation (TPG), emission of the e^- from metal surface due to the heat.
- ii) Thermionic generators converts heat energy into electrical energy.
- iii) In TPG, there are two diodes : Cathode and anode.
- iv) Cathode is emitter and Anode is collector.
- v) e^- are emitted from cathode due to heat and these e^- are collected by anode.

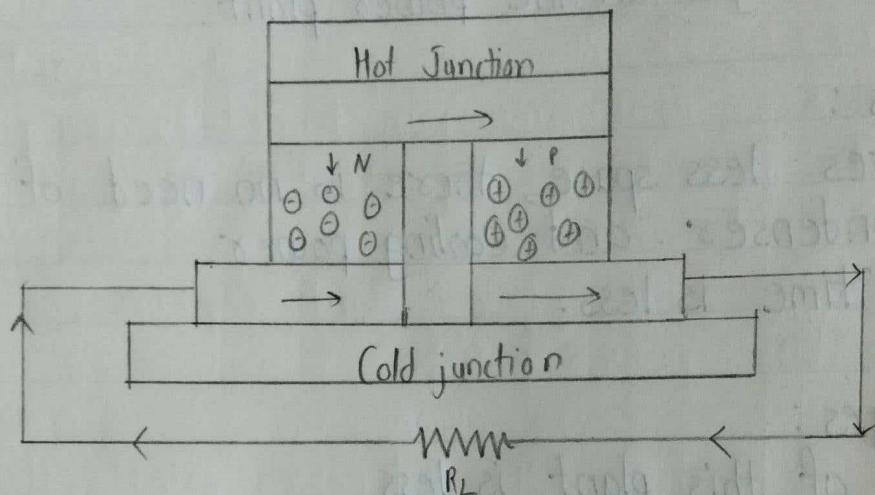


fig 1.4. Thermoelectric Generators.

- vi) Anode oppose these e^- for collecting
- vii) These resistance from e^- , for e^- to generate the electric potential difference (P.D) and e.m.f.
- viii) Load resistance is connected to circuit and current flow across the circuit.

4) Explain Thermoelectric generator.



Thermo electric power generators are the device which used to convert temperature difference betⁿ two junction into electrical energy.

Working of TEG is based on seebeck effect.

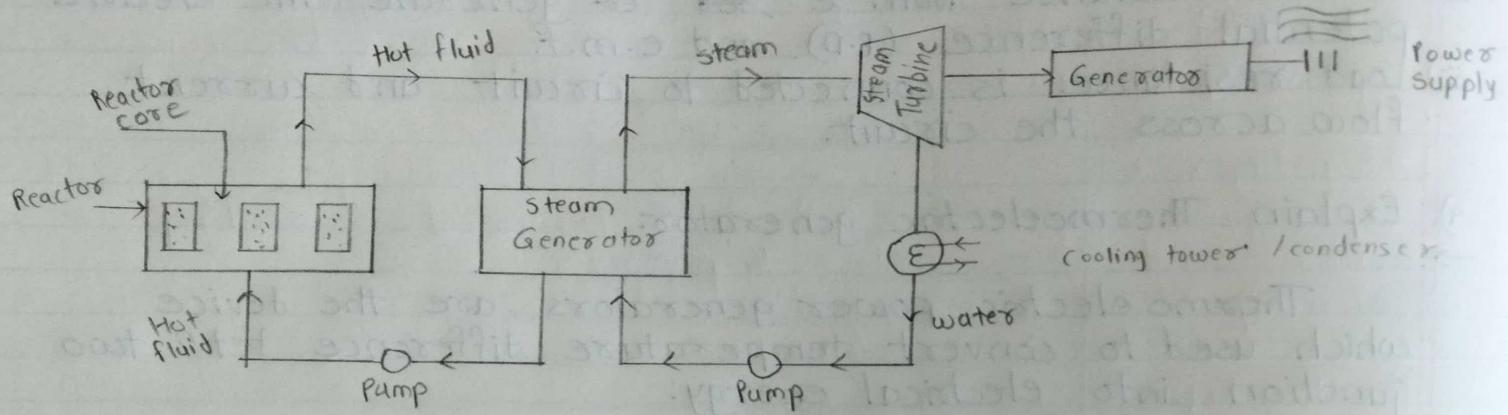
T.E.G is a device that converts heat energy directly into electricity.

The reverse effect i.e conversion of electrical energy into heat energy is called peltier effect.

Refer to fig. 1.4.

Working :

- i) T.E.G having heat source at one end and cold junction at other end.
- ii) Hot junction is kept at high temperature.
- iii) Temperature difference between 2 junctions is ΔT .
- iv) The applied heat to junction cause the e^- in 'n' type and hold in 'p' type semiconductor.
- v) -ve charge try to move towards the +ve charge but +ve charge resist to -ve charge.



- vi) There is producing the electrical potential difference (P.D) and e.m.f.
- vii) Current is flow through the load resistance.
- viii) The efficiency of generator is 2 to 5:1.

5(b) Explain nuclear power plant in following points.

- a) Schematic arrangement
- b) Working
- c) Disadvantages
- d) Selection of sites.



a) For schematic arrangement, refer to 1.5 figure.

b) Working :

- i) Reactor produces heat
- ii) Heat enter into steam generator and heat the water and produce high pressure steam.
- iii) Steam enter in steam turbine, turbine starts rotating. turbine connected to generator, produces electricity.
- iv) Steam was condensed and water is recirculated back by using pump.
- v) Hot fluid (heat) is also recirculated back by using pump.

c) Disadvantages :

- i) Radioactive elements emits radiations which are harmful to human.
- ii) Construction and maintenance cost is very high.
- iii) More safety, precaution is required.
- iv) It is very dangerous for handleing.
- v) Site selection is major problem.

- d) Selection of site
- i) Land availability
- ii) Access to electrical grid
- iii) Transportation facilities
- iv) Skilled Man Power
- v) Water availability
- vi) Disposal of Nuclear waste products.
- vii) Soil Type.

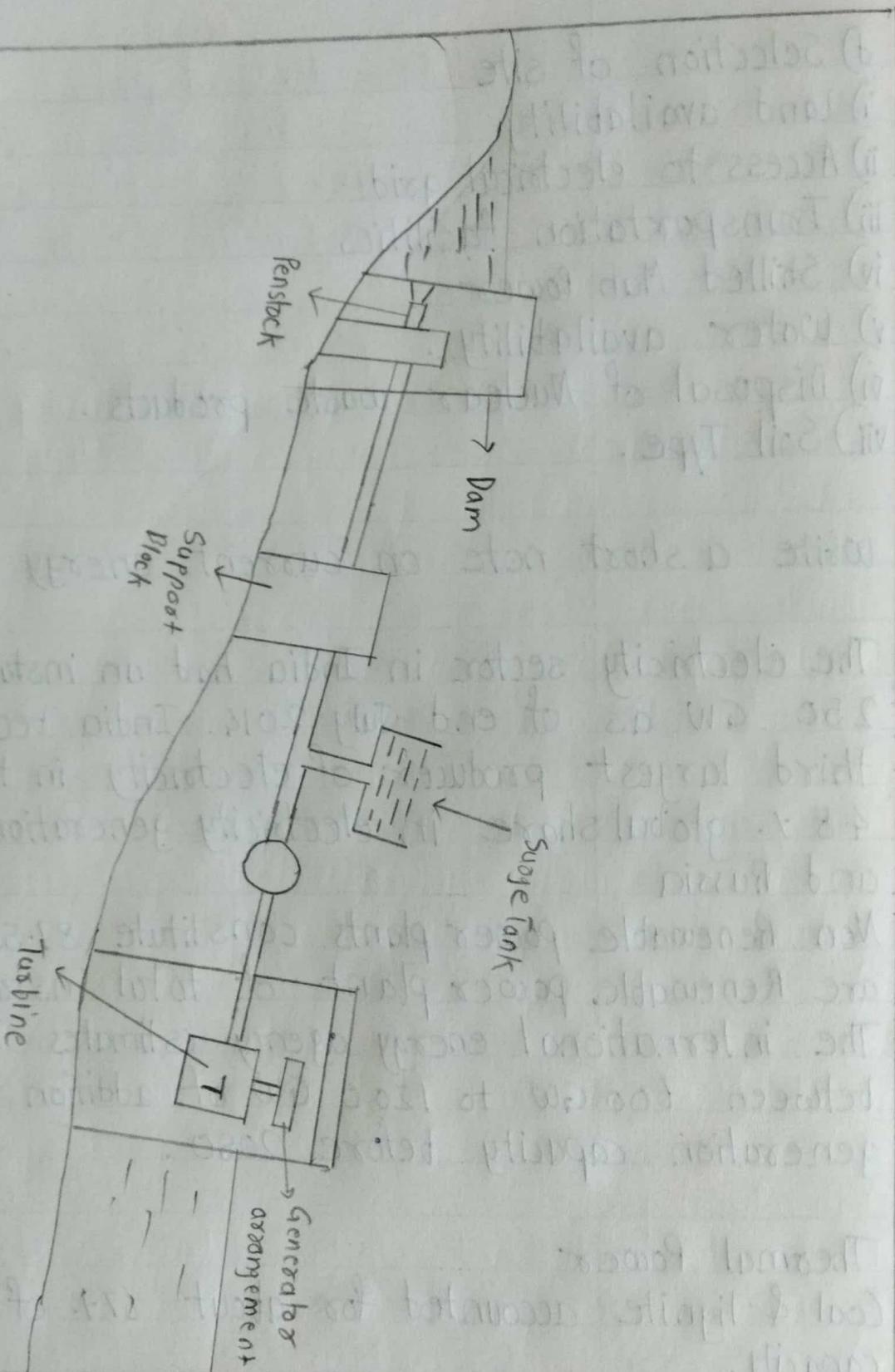
6) Write a short note on current energy scenario in India.

→

- i) The electricity sector in India had an installed capacity of 250 GW as of end July 2014. India became the world's third largest producer of electricity in the year 2013 with 4.8% global share in electricity generation surpassing Japan and Russia.
- ii) Non Renewable power plants constitute 87.55% and remaining are Renewable power plant of total installed capacity.
- iii) The international energy agency estimates India will add between 600 GW to 1200 GW of addition new power generation capacity before 2050.

* Thermal Power

- i) Coal & lignite accounted for about 67% of India's installed capacity.
- ii) India's electricity sector consumes about 80% of the coal product in the country. A large part of Indian coal is reserve is similar to Gondwana coal. On average, the Indian power plants using India's coal supply consume about 0.7 kg coal



to generate kWh.

- iii) VindhyaChal is the largest thermal power plant in India with capacity of 3260 MW.

* Nuclear Power Plant

- i) India's share of nuclear power plant generation is just 1.2% of worldwide making it the 15 largest nuclear plant.
- ii) India aims to supply 9% of its electricity needs with nuclear power by 2032.

* Hydro-electric power:

- i) India is one of the pioneering countries in establishing hydro-electric power plants.
- ii) India is blessed with immense amount of hydro-electric potential and ranks 5th in terms of exploitable hydro-potential on global scenario.

7) Explain Hydro Power Station. Write Advantages & Disadvantages.

→

Refer to Fig 1.6.

Elements / components of Hydroelectric Power Plant.

- ① Catchment Area : The area behind the DAM.
- ② Reservoir : It is used for to store the water.
- ③ Dam : It is used to raise the water level. Higher the water level, higher is the electricity generation.
- ④ Penstock : Prime movers : It converts hydroelectric energy into mechanical energy.

- ⑤ Surge Tank : It is used to control the pressure of water.
- ⑥ Draft tube : It is used to increase the pressure of back water.
- ⑦ Tail Race : Water is collected in tail race.
- ⑧ Power house & equipment : It is the arrangement for to generate electricity.

Advantages :

- i) No fuel charge and it is highly reliable.
- ii) Maintenance cost is low.
- iii) No problem of fuel transportation.
- iv) Long life plant.
- v) No pollution .

Disadvantages :

- i) Construction cost of plant is high .
- ii) It requires hilly area & long electricity supply lines
- iii) Electricity generation depends on quantity of water.

8) Explain environmental aspects for selecting the sites & location of power plant.



The principle factors to be considered for selection of power plants .

i) Availability of raw material & transport facilities :
Power plants require large amount of raw material
Transport facility like good quality of road , availability
of vehicles .

ii) Availability of water & fuel:

Large amount of water is needed for power plant, fuels also required.

iii) Skilled man-power availability:

Power plant require workers/labours for construction & operation

iv) Land acquisition cost:

Each site will have unique land acquisition requirement & cost.

v) Degradation of local air quality:

Operating power plant produce pollutants and exhaust gaseous, this pollutant are regulated and controlled by Central Pollution Control Board (CPCB)

vi) Land use impact: For power plant forest are valuable factors site evaluation use the forest resources & nearby land. Effect of power plant, construction and operation on this resources is important

vii) Transmission grid accessibility: Electrical grid is an interconnected network for delivering electricity from supplier to consumer, it consist of substation, high voltage transmission lines.

viii) Electricity consumption point:

A power plant must be located near the road to which it is supplying the power.

Q) What are conventional & non-conventional energy sources? Describe briefly.



The word 'Energy' defines the capacity to do work. Energy exists in many forms, including Kinetic Energy, Electrical Energy, Thermal Energy, Potential Energy, Nuclear, etc. Energy can neither be created nor destroyed but can only be transferred from one form to another. There are two prime sources of energy:

- i) Conventional energy sources
- ii) Non-Conventional energy sources

* Conventional Energy Sources:

- i) The conventional energy sources are also known as the non-renewable sources of energy, which are present in a limited quantity and are being consumed by human beings for many years now.
- ii) These non-renewable energy sources are decaying matters, which take over hundreds of years to form, for ex, coal, petroleum, etc.
- iii) So, if they are depleted once, they can never be generated at a speed or pace, which could sustain their rate of consumption.
- iv) As a common source of energy, electricity is commonly used for commercial and domestic purposes. Electricity can be produced using fossil fuels, nuclear power, hydro power, etc.

* Non-conventional energy Sources:

- i) The non-conventional energy sources are also known as the renewable sources of energy.

- ii) The energy sources which are replenished by natural processes, that too continuously.
 - iii) The non-conventional energy sources can't be exhausted easily and can be generated at a constant rate for their use over and over again.
 - iv) These energy sources do not pollute the environment and natural surroundings and require less expenditure.
 - v) A few examples of non-conventional sources of energy include wind energy, solar energy, tidal energy and biomass energy, etc.
- 10) What do you mean by energy conservation? Write down at least 10 ways by which energy can be conserved or saved in our day-to-day life.

→

- i) Energy conservation is not about making limited resources last as long as they can, that would mean that you are doing nothing more than prolong a crisis until you finally run out of energy resources altogether.
- ii) Conservation is the process of reducing demand on a limited supply and enabling that supply to begin to rebuild itself.
- iii) Many times the best way of doing this is to replace the energy used with an alternate source.
- iv) Without energy conservation, the world will deplete its natural resources.
- v) The goal with energy conservation techniques is to reduce demand, protect and replenish supplies, develop and use.
- vi) Energy can be conserved by following points:
 - ① Adjust your day-to-day behaviours to turn off devices and appliances which consume less energy.
 - ② Refrigerators are one of the main appliances that consume power. Keep the setting of the refrigerator low to save energy.

- ③ Using CFL and LED bulbs to save energy. Regular incandescent bulbs consume more energy than CFL & LED.
- ④ Using a laptop instead of desktop computers can save considerable energy.
- ⑤ Strip the dryer on a breezy day and dry clothes on the clothesline.
- ⑥ Use of smart automated devices can lower your energy bills even when you forget to.
- ⑦ Wash clothes at a cooler temperature and with a full load, you will be saving a lot of water and electricity.
- ⑧ Using more solar-powered electronics can go a long way and can also lower your maintenance.
- ⑨ We should use sunlight in our homes, school, etc during the daytime.
- ⑩ We should buy star-rated electrical appliances. An electrical device with a higher number of stars will consume less energy.

ii) Explain steam power plant with funcⁿ of Air preheater, economiser, superheater.



Elements or components of steam power plant :

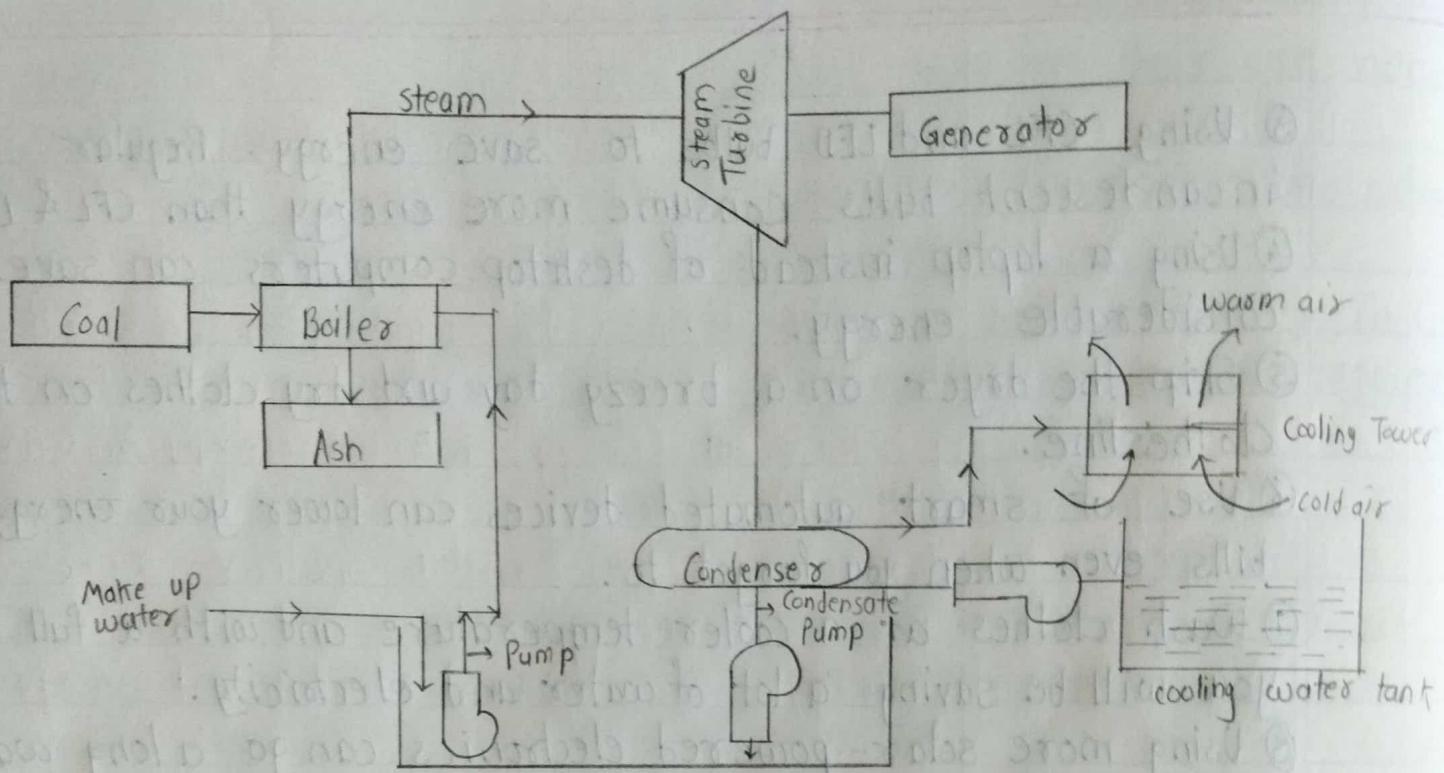
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④ Cooling Water Circuit:

- i) It contains condenser, cooling tower, cooling water tank & pump.
- ii) Steam is converted into hot/warm water.
- iii) By using cooling tower & cooling water tank, warm water converted into cold water.
- iv) Make-up water is supplied for filling the losses due to vapourisation.
- v) Economiser, Air preheater, superheater are used in steam power plant to improve efficiency.

of air pre heater, economiser, super heater

→ 1) Function of Air Preheater -

Air is taken from atmosphere and passes through Air Preheater, it heated air by using heat of exhaust gaseous or flue gaseous.

2) Function of Economiser -

Economiser allow to passes only exhaust gases or flue gaseous.

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Function of Super heater:

Steam is again heated by using flue gases or exhaust gases in super heater.