Difference between Base Load and Peak Load Power Plants

The following table highlights all the noticeable differences between a base load power plant and a peak load power plant

Basis of Difference	Base Load Power Plant	Peak Load Power Plant
Definition	A power plant that supplies electrical power continuously throughout the year is called a base load power plant.	A power plant that supply electricity during the hours of peak load only is called a peak load power plant.
2.Working hours / day	The base load power plants operates for 24 hours of a day.	The peak load power plants runs only during the peak load hours of a day.
Generating capacity	The power generating capacity of a base load power plant is high.	The peak load power plants generally have low power generating capacity.
Firm power capacity	The firm power capacity (power generating capacity which can be guaranteed to be available at a given time) of a base load power plant is high.	The peak load power plants have low firm power capacity.
Starting time of plant	One can select both quick and large starting time power plant as a base load power plant.	The power plants with quick starting time are selected as a peak load power plant.
Per unit cost of power generation	The power generating plants with low cost per unit power generation are selected as the base load power plants.	For the peak load power plants, the cost of power generation per unit is high.
Load factor	The load factor of a base load power plant is high.	The load factor of a peak load power plant is low.

Utilization factor	The utilization factor of a base load power plant is high.	The utilization factor of a peak load power plant is low.
Examples	The examples of base load power plants are: thermal power plant, nuclear power plant, large-scale hydroelectric power plants geothermal power plants, etc.	The examples of peak load power plants are gas turbine power plant, diesel power plant, small-scale hydroelectric power plant, wind turbines, solar power plant, pumped storage hydro power plant, etc.

Lamont Boiler Definition:

Lamont boiler is a type of water tube boiler in which steams are generated from water by the burning of fuel which is coal and later that steams are used for the generation of electricity and so on. It is a high-pressure boiler.

Lamont Boiler Parts or Construction:

A **Lamont boiler consists of the following parts or construction** as you can see in the diagram below:

- **Feed Pump**
- **Grate**
- **Economizer**
- **Circulating Pump**
- **Distributing header**
- **Radiant Evaporator**
- **Convective Evaporator**

- **Steam separating drum**
- **Superheater**
- **Blower**
- **Air preheater** and
- **Combustion chamber**

Feed Pump:

Feed Pump is one of the important types of pump which is used at the boiler for supplying the feed water. It increases the pressure so that the feed water can enter into the boiler.

Grate:

The grate is located bottom side of the furnace. At the grate, we supply coal for burning at the combustion chamber.

Economizer:

Economizer is a device for increasing boiler efficiency. So the work of the economizer is to preheat the water by the use of remaining heat flue gases of the combustion chamber.

In the repetition, the feed water is first entered into the economizer before entering into the boiler because it will preheat the water that is the major advantage of it.

Circulating Pump:

A circulating pump is a centrifugal pump and it is driven by the turbine. The turbine takes steam from the boiler. It takes water from the steam separating the drum and sends it to the Distributing header to the radiant evaporator section.

Distributing header:

It is a component having an inlet at one end only and more than one outlet end.

Radiant Evaporator:

The water starts changing phase from liquid to saturated liquid and to the saturated steam. The heat receives here from the burning of fuel that is coal.

Convective Evaporator:

Here the complete saturation of water into the saturated steam process takes place.

Steam separating drum:

The main work of the steam separating drum is to separate the steam and water. Further, the steam is sent to the superheater and water is sent to the circulating pump.

Superheater:

A name itself indicates “superheater” which means more heat will supply to the steam so that there should not be any tiny liquid particles and it will fully convert into the steam and for rotating the turbine blades.

Here we can say superheater increases the temperature of the steam.

Blower:

Here it is an external component that receives the air and sends it to the air preheater.

Air preheater:

Air Preheater also helps to increase boiler efficiency. Here the air is preheating and then preheating air sends to the combustion chamber.

Combustion chamber:

In the combustion chamber, the coal is burned and produces hot flue gases that help to heat the water.

Lamont Boiler Working Principle Diagram:

Lamont Boiler works on the principle of forced circulation of water in the boiler with the help of a centrifugal pump.

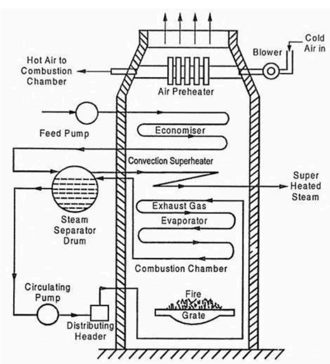


Fig1.30. La-Mont Boiler

This is a high-pressure boiler and works above 170 bar and temperature around 773k.

we will be understanding here in pointwise in depth so let’s start, The water is first supplied to the feed pump from a large water tank. From the feed pump, the water is entered into the economizer.

As we know it is a boiler efficiency increasing device so here if heat is available then the water will get heated before entering into the combustion chamber.

From the economizer, the water comes to a steam separator device where the separation of steam and water takes place.

The water is circulated by the centrifugal pump from the separator drum. Here distributor header is kept for controlling the water level entry into the boiler.

Now water reaches into the combustion chamber where flue gases surround them and it starts getting heating.

Now the water comes in the phase of radiant evaporator here major amount of water is converted into steam and then it sends to the convective heat transfer.

Here the remaining water is further converted into saturated steam. Now, this saturated steam is further sent to the separator drum for separating steam.

After separating steam now further sent to the superheater to superheat the saturated steam and make use of it further for the generation of electricity and more.

Lamont Boiler Advantages:

A Lamont Boiler has the following advantages:

- In terms of the design of the boiler are very simple and understandable.
- The drum size is small.
- It is easy to start. There is no such problem with starting.
- Steam generation capacity is very good and it is 50 tonnes per hour.
- The transfer rate of heat is also good and the major drawback is bubble formation.

Lamont Boiler Disadvantages:

The **major disadvantages of the Lamont boiler are bubble formation at the surface of the tubes that reduces the transfer rate of heat and causes low steam generation**.

Lamont Boiler Application:

A Lamont Boiler has the following application or uses:

- Lamont Boiler is mostly used in Power plants for producing steam which helps to run a turbine for the generation of electricity.
- It is also used in other industries like Sugar Mill, Chemical industry, and more.

What is a Loeffler Boiler?

Loeffler Boiler is a high-pressure, forced circulation, and internally fired water tube boiler. This type of boiler has a steam circulation pump which uses to circulate steam inside the boiler.

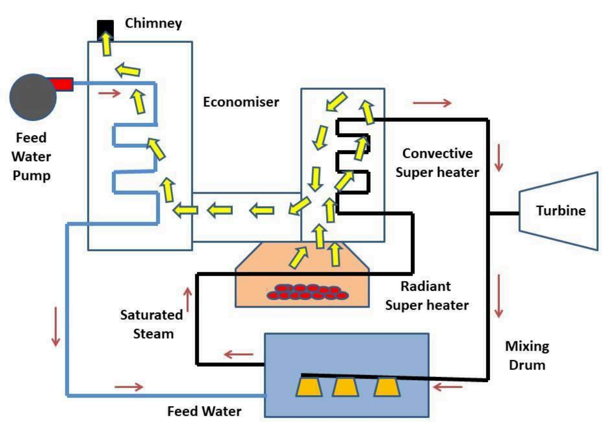
This is an improved model of the Lamont boiler. One main problem with the Lamont boiler is the build-up of salt and debris in the water pipes through which the water flows.

This build-up of debris and salts reduces the heat transfer rate in the water tube's internal area. The Lamont boilers may also face overheating issues due to the build-up of salts and debris. Due to these reasons, the scientist designed the Loeffler boiler and solved the Lamont boiler issues by blocking the flow of water inside the water tubes.In this boiler, **70%** part of the superheated steam is utilized for the water evaporation in the evaporating drum, and **30%** part of the superheated steam is utilized to run the steam turbine.

Working Principle of Loeffler Boiler

The main working principle of the Loeffler boiler is to evaporate the water by taking superheated steam from the superheater. The **30% steam** of the superheated steam is used to run the turbine, and **70% steam** is used to evaporate the water.

The Loeffler boiler works in the following way:



Loeffler Boiler

- A feed pump takes water from the external water source, increases the water pressure, and sends it into the economizer. This economizer preheats the water and sends it into the evaporator drum.
- The 70% part of the superheated steam is sent into the nozzles of the evaporator drum. The nozzle mixes the feed water with this received superheated steam and transforms water into saturated steam.
- After the generation of the saturated steam, the steam circulating pump uses to transfer this output saturated steam into the radiant superheater.
- The radiant superheater uses radiations produced by the fuel combustion, increases the temperature of the saturated steam, and transforms it into supersaturated steam.
- The tubes of the superheater are installed inside the furnace.
- As the steam converts into the superheated steam, it transfers into the convective superheater.
- The convective superheater installs in the path of the hot flue gases. This superheater further increases the temperature of the superheated steam up to 500°C and converts the remaining water particles into steam.
- After passing through the convective superheater, 70% steam is sent to the evaporating drum for evaporating the feed water, and 30% steam is used to run the prime mover of the steam turbine.
- As the steam strikes the steam turbine blades, the blades further transfer their rotation to the generator coil and produce electricity.
- The Loeffler boiler has the capability to generate 140 bar pressure and 100 tonnes/hour of steam.

1) Water feed Pump

The major component of the Loeffler boiler is the feed pump. This pump is employed to transfer the water into the economizer.

This pump receives water from a reservoir, increases the pressure of the water, and then transfers water to the economizer. The quantity of the pumped water must be equal to the evaporated water in the boiler.

2) Economizer

The main objective of the economizer is to preheat the water. It collects waste heat from the boiler and transfers this heat to the feed water. This water preheating process increases the efficiency of the boiler and saves energy costs. The economizer is made of cast iron. It is linked with horizontal pipes. After this preheating process, the water is transferred to the evaporating drum.

3) Evaporating Drum : The main purpose of the evaporating drum is to transform the preheated water into saturated steam.The evaporating drum uses the superheater’s superheated steam for this process. It has mixing nozzles used to mix preheated water with superheated steam and evaporate the water.

4) Centrifugal Pump or Steam Circulating Pump: The Loeffler boiler has a centrifugal pump which uses for the steam circulation in the boiler. It installs between the radiant superheater and evaporating drums.

5) Mixing Nozzle: The mixing nozzle plays an important role in the conversion of the water into steam. This nozzle is located inside the evaporating drum. This nozzle uses to mix the preheated feed water and the superheated steam and evaporates the water.

6) Drain: The drain uses to clean the evaporating drum. When the contaminations are gathered inside the evaporating drum, the drain uses to clean and remove the contamination from the drum.

7) Radiant Superheater

This Superheater takes heat from the radiation of the combustion chamber and increases the temperature of the saturated steam. It converts the saturated into superheated steam.

8) Convective Superheater

After passing through the radiant superheater, the produced superheated steam is transferred to the convective superheater. The convective superheater increases the steam temperature up to 500℃ and fully converts water vapors into steam. This process increases the temperature of the boiler.

After this process, the 30% superheated steam transfers to the steam turbine, and the remaining 70% steam sends to the evaporating drum.

9) Turbine

As the steam enters the turbine, it strikes the blades of the turbine. The steam turbine blades extract the pressure energy of the steam and convert this energy into the shaft's rotational energy. This rotational energy of the shaft uses to rotate the generator coil, which produces electricity.

The turbine has two types:

1. High-Pressure Turbine: This steam turbine uses to extract the pressure energy from the high-pressure superheated steam.
2. Low-Pressure Turbine: It uses to extract pressure energy from the low-pressure superheated steam.

10) Fan Blower

It uses to direct the air from the air preheater inside the combustion chamber for burning the fuel.

Advantages of Loeffler Boiler

- The Loeffler boiler has the capacity to use salt water for steam production.
- It has a compact design.
- It has a quiet operation.
- These types of water tube boilers have a clean operation.
- It has the capability to work under very high pressure than fire-tube boilers.

Disadvantages of Loeffler Boiler

- It uses an additional evaporating drum which increases the weight of the boiler.
- It has large size.
- There is the formation of bubbles on the water's surface, which reduces the rate of heat transfer.
- It has a high cost.

Applications of Loeffler Boilers

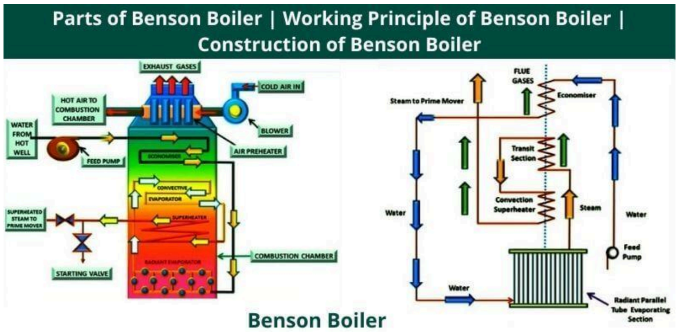
- Loeffler boilers are most commonly used to generate steam for power production.
- They are used in the marine industry.

Benson Boiler Definition:

Benson Boiler is a high-pressure super critical water type boiler in which no bubble is formed because the water is compressed at super critical pressure and it directly converts into steam.

In other words, The formation of a bubble does not take place because of supercritical pressure, and at this pressure, the density of water and steam becomes the same.

As the water which is entered into the boiler is being compressed to supercritical pressure. Therefore the latent heat of water is reduced to zero. So the water directly changes into steam without the formation of bubbles.



Benson Boiler Advantages:

The **main advantages of Benson Boiler** are:

- The Benson boiler cost is cheaper as there is no presence of a steam drum.
- It produces higher power pressure, so there is no pressure limit to attain supercritical pressure.
- The attaining of high pressure avoids the bubble collection in the tubes and increases the maximum heat rate. The presence of bubbles in the boiler causes lower efficiency power of the boiler.
- It's lightweight than any other boilers.
- The boiler is efficient in running, starts in 15mins due to welded joints.
- Boiler transportation is simple and easy.
- The boiler is efficient and achieves a thermal efficiency of up to 90%.
- The boiler consists of small tubes with lesser diameters. It helps in creating negligible situations prone to explosion hazard risks.

Benson Boiler Disadvantages:

The **disadvantages of Benson Boiler** is:

An overheating of the tubes can cause insufficient water supply.

- Since the storage capacity is small, it requires close coordination between steam, feedwater, and feed inlet.
- The evaporation process gets accompanied by the salts and solid in tubes if the water present is impure. It can cause severe damage and blockage to the boiler tubes.
- You may face some problems and difficulties controlling the boiler for variable loads.
- Its movements require continuous inspection in every duration to prevent an explosion. It happens due to the presence of supercritical pressure.

Benson Boiler Application:

The main application of Benson Boiler is:

- The high-pressure supercritical boiler is used in various industry, to produce steam and generate electrical power.
- The boiler's average optimum pressure is 250 bar with a temperature of 50 degrees celsius and a capacity to produce about 135 tons/ hour.

What is a Steam Turbine: **A steam turbine is a mechanical device that transforms the thermal power of steam into mechanical work in form of rotational energy. This turbine is known as a steam turbine because it uses steam as a working fluid.**

6) Based on turbine blade design

i. Reaction Turbines
ii. Impulse Turbines

What is a Reaction Turbine?

A reaction turbine generates torque by reacting to the fluid's mass or pressure. A reaction turbine has fixed rotor blades and a rotating nozzle.

Newton's third law of motion (actions and reactions are equal but opposite in direction) describes the working of the reaction turbine (RT). It produces force due to the water movement over the fixed blades of the rotor. In the case of a **reaction turbine**, the water first strikes the **rotor** and then strikes the nozzle. These turbines are best suitable for low and medium head flow rates.

While impulse turbines use for high head flow rates. And also, in the case of an **impulse turbine** (IT), the water first hits the fixed nozzle and then hits the rotor blades. Reaction turbines have many types that we will discuss in the next section, but wind turbine is the most common type.

Reaction Turbine Working Principle

The **reaction turbine** works according to **Newton's third law**. It has a simple working principle that is given below with an example.

Using a rotor with a moving nozzle and high-pressure water coming out of the nozzle will help us to understand the reaction turbine working principle in a good way. The nozzle receives a reaction force when the water departs the nozzle. This reaction force causes the rotor to spin at high speed.

Similarly, in a reaction turbine, the reaction force is produced by the moving fluid over the runner blades. The reaction force generated by the runner blade causes the runner to rotate. As the water passes through the impeller blades, it ends up in the drain and finally in the tail race

What is an Impulse Turbine?

An Impulse turbine is a type of turbine in which a high-velocity jet of water strikes the turbine blades and rotates the turbine to generate electricity.

The impulse turbine works on the principle of **Newton's second law. Frenchmen Real and Pichon invented the compound impulse turbine in 1827.**

The impulse turbine is one of the most famous types of turbine. It contains a series of blades and a series of nozzles. Nozzles and blades are the major components of this turbine. It usually contains bucket-shaped blades.

The impulse turbine has multiple static nozzles that convert the pressure of the water jet into kinetic energy. After passing through the nozzle, the water strikes the runner blades. These blades extract almost all of the kinetic energy of the water jet and convert it into water velocity.

The main difference between reaction turbines and impulse turbines is that in an impulse turbine all hydraulic energy of the water is transformed into K.E through nozzles and there is no pressure change during the process. In contrast, in reaction turbines, only a certain amount of existing energy is transformed into kinetic energy.

Impulse Turbine Working Principle:

The impulse turbine working principle is according to the basic impulse principle. **Newton's second law** of motion explains the **impulse turbine working principle**. For impulse turbines, the water is stored in high places and flows through the turbine nozzles.

An impulse turbine works in the following way:

- A jet of water flows from a **reservoir** or **dam** into the fixed nozzle of the turbine.
- As the water enters the nozzle, the nozzle converts the potential energy of the water into kinetic energy and increases the water speed.
- After discharging through the nozzle, this high-speed water jet hits the runner blades and rotates the runner along its own axis.
- The turbine shaft is connected to the runner. As the runner rotates, it transfers its motion to the shaft.
- The turbine shaft is further connected to the coil of the generator. The shaft transfers its rotary motion to the generator coil and rotates the coil.
- As the generator coil rotates, it converts received mechanical power (i.e., rotary motion) into electrical power. This produced electricity further delivers to different industries and houses.

Reaction Turbine	Impulse Turbine

More maintenance is required for it.	It requires less maintenance.
Only some quantity of the hydraulic energy is transformed into K.E.	The total amount of hydraulic energy is transformed into K.E.
Water flows in an axial and radial direction to the turbine wheel.	The direction of the flow of water is tangential to the turbine wheel.
Its degree of reaction is between 0 to 1.	Its degree of reaction is zero.
It requires high and medium water discharge.	It requires low water discharge.
The reaction turbine works at low and medium water heads.	It works at the high head.
The reaction turbine has comparatively high hydraulic efficiency.	Impulse turbine has comparatively less efficiency.
Francis and Kaplan turbines are its example.	Pelton Wheel turbine is its example.
Water enters around the runner.	Water is entered only in the form of jets.

The runner must be closed in a water-tight casing.	In these turbines, casings are not compulsory. Casing works as a safeguard.
Velocity and pressure vary as the fluid passes through the runner. The pressure at the suction point is much more than the discharge point.	The velocity of the water jet varies the pressure through the remaining atmospheric pressure.
The flow control takes place via the guide vane. Other important parts are the scroll casing, stay ring, runner, and draft tube.	The flow control takes place via a needle valve fitted into the Nozzle.
The reaction turbine doesn't contain symmetrical blades.	The impulse turbine has symmetrical blades.
The pressure of water is decreased during its flow.	The pressure of water remains constant during its flow.
It has high working speed than an impulse turbine.	It has low working speed than a reaction turbine.
The efficiency of buckets is high.	The efficiency of buckets is low.

These turbines require less space.	It requires high space as compared to the reaction turbine.
Newton's 3rd law defines the energy transfer from reaction turbines.	Newton's 2nd law defines the energy transfer from impulse turbines.

Advantages and Disadvantages of Impulse Turbine

Advantages of Impulse Turbine

- It has easy maintenance.
- Its construction is very simple.
- The efficiency of the impulse turbine is high.
- These turbines have easy assembly.
- It works at atmospheric pressure.
- It has a high rotational speed.

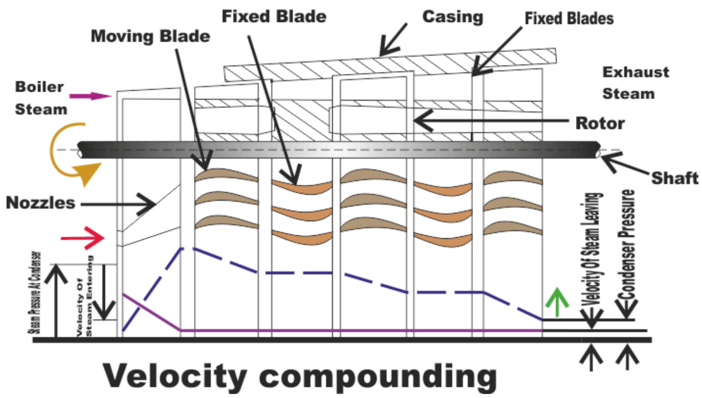
Disadvantages of Impulse Turbine

- Its size is large compared to other turbines.
- It requires a high head which is difficult to manage.
- The efficiency decreases over time.
- High installation costs.
- It is not a best suitable turbine for high flow rates.
- It is best suitable only for low-discharge applications.

Applications of Impulse Turbine

- The impulse turbines are most commonly used to produce electricity in hydroelectric power plants.
- They are used in drinking water supply systems.

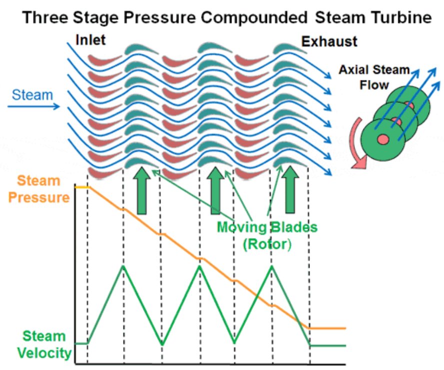
Velocity Compounding of Steam Turbine



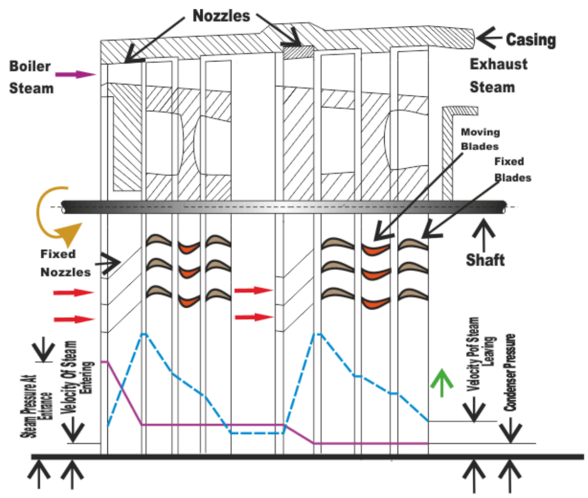
There are various methods employed for compounding steam turbines, and one of them is velocity compounding. Velocity compounding involves a progressive reduction in the velocity of steam across multiple stages. This method comprises several key components, including a single set of nozzles in the initial stage, sets of moving blades attached to a rotor, and sets of fixed blades mounted within the casing.

Pressure Compounding of Steam Turbine

Pressure compounding is a steam turbine compounding method that involves dividing the total pressure drop into multiple stages, enhancing the efficiency of the energy conversion process. In a pressure-compounded steam turbine, the key components include sets of nozzle rings and sets of moving blades. The configuration of a pressure-compounded steam turbine is depicted in the.



Pressure-Velocity Compounding of Steam Turbine



Pressure Velocity Compounding

The pressure-velocity compounded steam turbine represents a fusion of the advantageous features found in both pressure compounding and velocity compounding methods. In essence, it combines the benefits of these two compounding techniques.

In this method, the pressure reduction occurs in multiple stages, each functioning like a velocity-compounded turbine, while the collective assembly of all stages functions as a pressure-compounded turbine. The schematic diagram below illustrates the configuration of a pressure-velocity compounded steam turbine:
The operation of a pressure-velocity compounded turbine unfolds as follows:

- High-pressure steam enters the first stage through a set of nozzles (N), where the initial high pressure of the steam is partially reduced to elevate its velocity. Subsequently, this high-velocity steam flows over a set of moving blades (M), where its velocity is partly diminished to facilitate the rotation of the moving blades. After this velocity reduction, the steam proceeds over fixed blades (F), redirecting it towards the next set of moving blades. This cycle continues, alternating between fixed and moving blades until the steam's velocity is substantially diminished.
- Upon exiting the first stage, the steam is directed over a set of nozzles in the second stage, where, once again, the steam's pressure is reduced to increase its velocity. With this heightened velocity, the steam is passed through a series of moving and fixed blades. In each set of moving blades, some of the steam's velocity is employed to drive the rotor. This process recurs through each stage, allowing the pressure of the steam to be progressively utilised as it moves through the turbine.

STEAM TURBINE GOVERNING SYSTEM

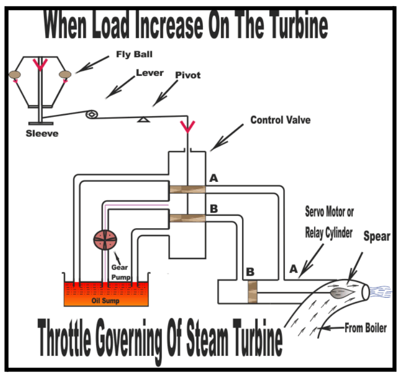
Steam turbine governing system is a method, used to maintain a constant steady speed of turbine. The importance of this method is, the turbine can maintain a constant steady speed irrespective of variation of its load. A turbine governor is provided for this arrangement. The purpose of the governor is to supply steam into the turbine in such a way that the turbine gives a constant speed as far as possible under varying the load. So, basically **Steam turbine governing system** is a process where turbine maintains a steady output speed irrespective of variation of load. The different types of steam turbine governor of are:

1. **Throttle Governing Of Steam Turbine**
2. **Nozzle Control Governing Of Steam Turbine**
3. **Bypass Governing Of Steam Turbine**

1. Throttle Governing Of Steam Turbine:-

Throttle Governing of steam Turbine is most popular and easiest way to control the turbine speed. When steam turbine controls its output speed by varying the quantity of steam entering the turbine is called Throttle Governing. It is also known as Servomotor methods.

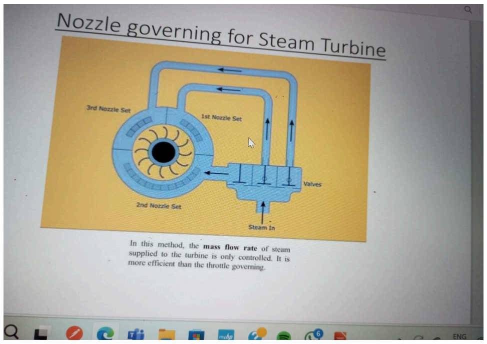
In this system, a centrifugal governor is driven from the main shaft of turbine by belt or gear arrangement. A control valve is used to control the direction of oil flow which supplied by the pipe AA or BB. The servomotor or relay valve has a piston which moves towards left or right depending upon the pressure of oil flow through the pipes AA or BB. This cylinder has connected a needle which moves inside the nozzle.When the turbine is running at normal speed, everything in the turbine such as such control valve, servomotor, piston position, fly balls of centrifugal governor will be in their normal position as shown in the figure. The mouth of both pipes AA or BB is closed into the control valves.



Assume that the turbine's load increases. It will decrease its speed which will decrease the centrifugal force of the turbine. Now fly balls of the governor will come down thus decreasing their amplitude. These fly balls also bring down the sleeve. The sleeve is connected to a control valve rod through a lever pivoted on the fulcrum. This down word sleeve will raise the control valve rod. Now oil is coming from the from the oil sump, pumped by gear pump is just stay at the mounts of both pipes AA or BB which are closed by the two wings of control valves. So, raise of control valve rod will open the mouth of the pipe AA but BB is still closed. Now the oil pressure is coming from the pipe AA. This will rush from the control valve which will move the right side of the piston. As a result, the steams flow rate into the turbine increases which will bring the speed of the turbine to the normal range. When speed of the turbine will come to its normal range, fly balls will come into its normal position. Now, sleeve and control valve rod will back to its normal position.

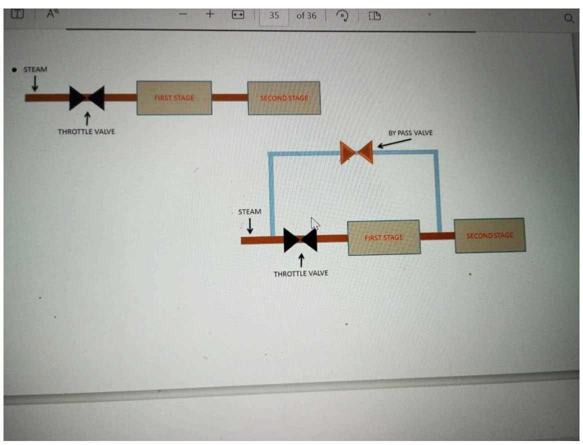
2. Nozzle Control Governing Of Steam Turbine:-

It is another interesting method by which turbine's speed can be controlled. Nozzle control governing of steam turbine is basically used for part load condition. Some set of nozzles are grouped together (may be two, three or more groups) and each group of the nozzle is supplied steam controlled by valves. Every valve is closed by the corresponding set of nozzle. Steam's flow rate is also controlled by these nozzles. Actually, nozzle control governing is restricted to the first stage of turbine whereas the subsequent nozzle area in other stage remains constant. According to the load demand, some nozzles are in active and other inactive position. Suppose turbine holds ten numbers of nozzles. If the load demand is reduced by 50% then five numbers of nozzles are in open condition and rest is closed. This method is suitable for [SIMPLE IMPULSE TURBINE](). It is a process where rate of steam flow is regulated depending on the opening and closing of set of nozzles rather than regulating its pressure.



3. **Bypass Governing Of Steam Turbine:-**

Bipass governing of steam turbineis a method where a bypass line is provided for the steam. Especially this is used when turbine is running in overloaded condition. The bypass line is provided for passing the steam from first stage nozzle box into a later stage where work output increase. This bypass steam is automatically regulated by the lift of valve which is under the control of the speed of the governor for all loads within its range. Bypass valve is open to release the fresh stem into the later stage of the turbine. In the later stage output, work is increased and the efficiency is low due to the throttle effect.



Electrostatic Precipitator (ESP) – Construction and Working Principle:

Electrostatic Precipitator is located between the boiler and the chimney, it extracts the fly ash from the flue gases and thus prevents the fly ash from entering the atmosphere. Electrodes are used to attract the fly ash when the flue gas coming out of the boiler is passed through the ESP.

Working Principle of Electrostatic Precipitator:

In this, the dust particles are separated from flue gases by electrostatic attraction. It has two steps of operation. One is charging of dust particles and other is to collect dust particles. In charging section, the flue gas is ionized and in collecting section dust particles are collected on the collector electrodes.

Construction:

The Fig. 1.51(a) shows the general layout of an electrostatic precipitator. In a single stage electrostatic precipitator, a pair of electrodes serve both the particle charging and collecting function and in two stage electrostatic precipitator, two pair of electrodes are used – one for charging and other for collecting. The discharge electrode is connected to the high tension power supply. The collector electrode is earthed. An electro static field is setup in between two electrodes. A weight is kept to align the electrode along the cylinder axis.

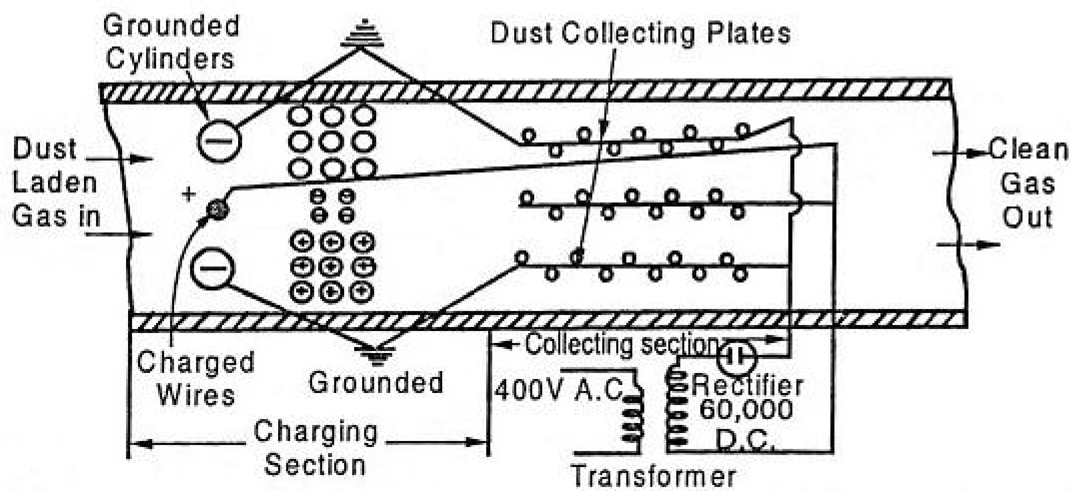


Fig: 1.51 (a) Layout of Different Components of Electrostatic Precipitator

In Fig.1.51(b) the flue gas is passing through the bottom of the precipitator. When gas moves upward, the dust particles and the flue gases are ionized by the high voltage (30,000 to 60,000 volts) applied between the conductors. The electro static field exerts a force on the dust particles and they are driven towards the grounded plates. The dust particles are deposited on the collector electrodes and they are removed by rapping (Shaking motion given to electrode) by means of cams. The dust particles are collected in hopper and removed periodically.

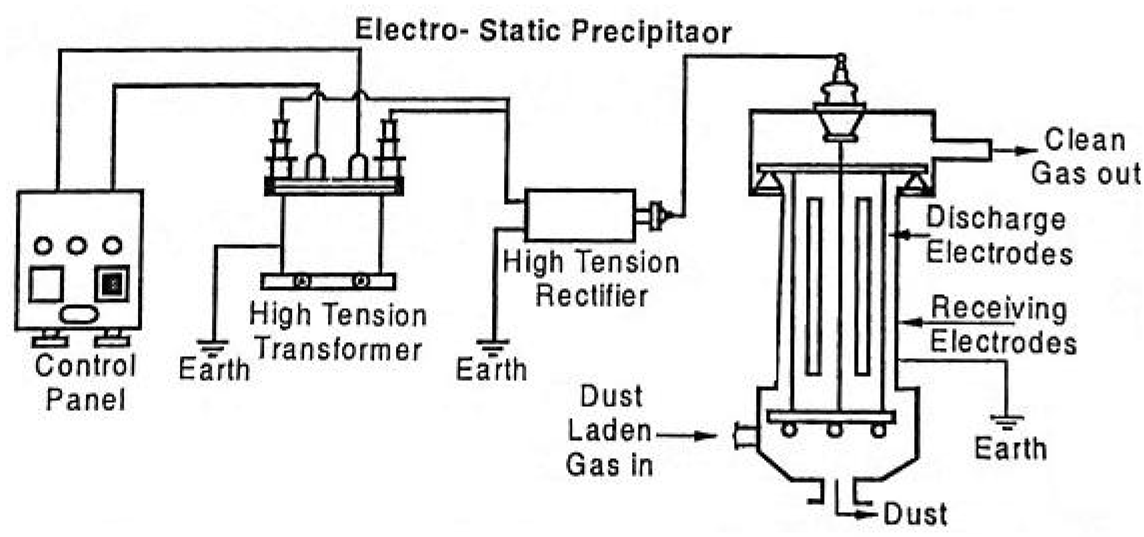


Fig: 1.51 (b) General Arrangement of an Electrostatic Precipitator

Advantages:

1. Best suitable for high dust laded gases.
2. Very small particles, mist and fly ashes enter the atmosphere.
3. The dust is collected in dry form and can be removed in dry or wet form.
4. Maintenance cost is less compared to other types.
5. It has efficiency of 99.5%.

Disadvantages:

1. Power requirement is high for charging the dust particles and fly ash.
2. Space requirement is more than wet system.
3. Efficiency varies inversely with the gas velocity
4. The dust carried with the gases increases with an increase of gas velocity. Electrical equipment's are needed for conversion of low voltage to high voltage. This increases the capital cost.

Even though its cost is more, it is frequently used with pulverised coal firing system because of its effectiveness.