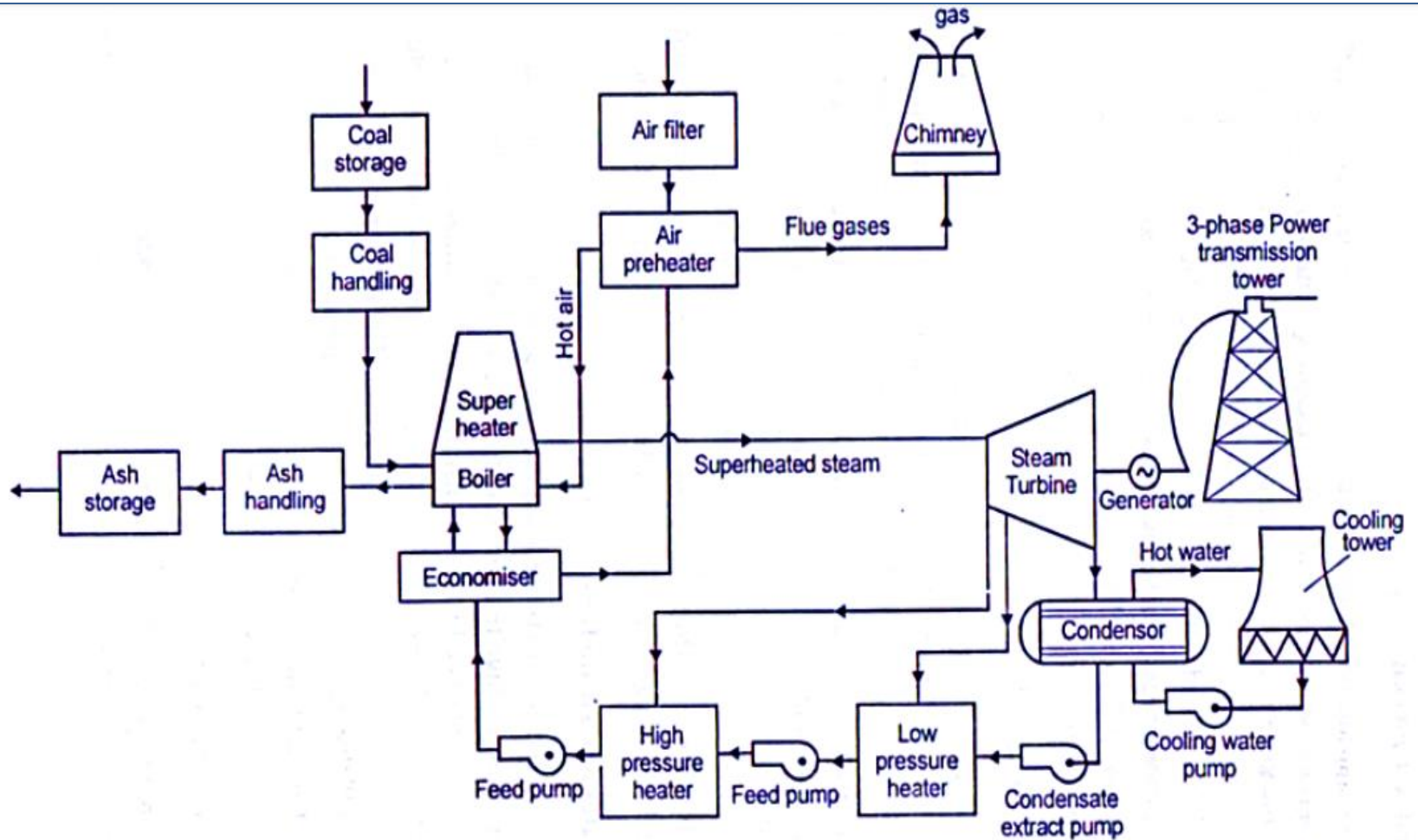


*INTRODUCTION ABOUT POWER
PLANT ENGINEERING*

STEAM POWER PLANT

- A thermal power station is a power plant in which the prime mover is steam driven.
- Water is heated ,Steam will produce then it strikes to steam turbine blades which produces Electricity , the process is known as Rankin's Cycle
- Some prefer to use the term energy center because such facilities convert forms of heat energy into electricity.
- A large proportion of CO₂ is produced by the worlds fossil fired thermal power plants; efforts to reduce these outputs are various and widespread

LAYOUT OF STEAM POWER PLANT



The four main circuits one would come across in any thermal power plant layout are.

1. Coal and Ash Circuit
2. Air and Gas Circuit
3. Feed Water and Steam Circuit
4. Cooling Water Circuit

1. Coal and Ash circuit in a thermal power plant layout mainly takes care of feeding the boiler with coal from the storage for combustion. The combustion in the Coal and Ash circuit is controlled by regulating the speed and the quality of coal entering the grate and the damper openings.
2. Air from the atmosphere is directed into the furnace through the air preheated by the action of a forced draught fan or induced draught fan. The exhaust gases from the combustion heat the air, which goes through a heat exchanger and is finally let off into the environment.

3. The steam produced in the boiler is supplied to the turbines to generate power. The steam that is expelled by the prime mover in the thermal power plant layout is then condensed in a condenser for re-use in the boiler. To make up for the lost steam and water while passing through the various components of the thermal power plant layout, feed water is supplied through external sources.

4. The quantity of cooling water required to cool the steam in a thermal power plant layout is significantly high and hence it is supplied from a natural water source like a lake or a river. It is passed through the condenser where the steam is condensed. Cooling water circuit can also be a closed system where the cooled water is sent through cooling towers for re-use in the power plant.

Advantages

1. Generation of power is continuous.
2. Initial cost low compared to hydel plant.
3. Less space required.
4. This can be located near the load centre so that the transmission losses are reduced.
5. It can respond to rapidly changing loads.

Disadvantages

1. Long time required for installation.
2. Transportation and handling of fuels major difficulty.
3. Efficiency of plant is less.
4. Power generation cost is high compared to hydel power plant.
5. Maintenance cost is high.

HYDEL POWER PLANTS

Hydroelectric power plants convert the hydraulic potential energy from water into electrical energy. Such plants are suitable where water with suitable head are available.

Coal Handling Systems

- Coal handling systems for coal fired boilers. Coal handling at utilities requires specialized technology and equipment from unloading to crushing and dust control to fire protection.
- Coal from the coal wagons is unloaded by Tipplers in the coal handling plant. This coal is transported up to the coal storage bunkers through conveyor belts.
- Coal is then transported to the Crush house by conveyor belts where it is crushed to small pieces and light dust is separated. The crushed coal is then transported to the bowl mill by coal feeders.
- In the bowl mill, coal is grounded to a powder form. The mill consists of a round metallic table on which coal particles fall. The crushed coal is then taken to the Boiler through coal pipes with the help of hot and cold air mixture.



ASH HANDLING EQUIPMENT

Ash Handling means are required for the disposal of ash. The handling equipment should perform the following functions:

- (1) Capital investment, operating and maintenance charges of the equipment should be low.
- (2) It should be able to handle large quantities of ash.
- (3) Clinkers, soot, dust etc. create troubles, the equipment should be able to handle them smoothly.
- (4) The equipment used should remove the ash from the furnace, load it to the conveying system to deliver the ash to a dumping site or storage and finally it should have means to dispose of the stored ash.
- (5) The equipment should be corrosion and wear resistant.

Commonly used ash handling system

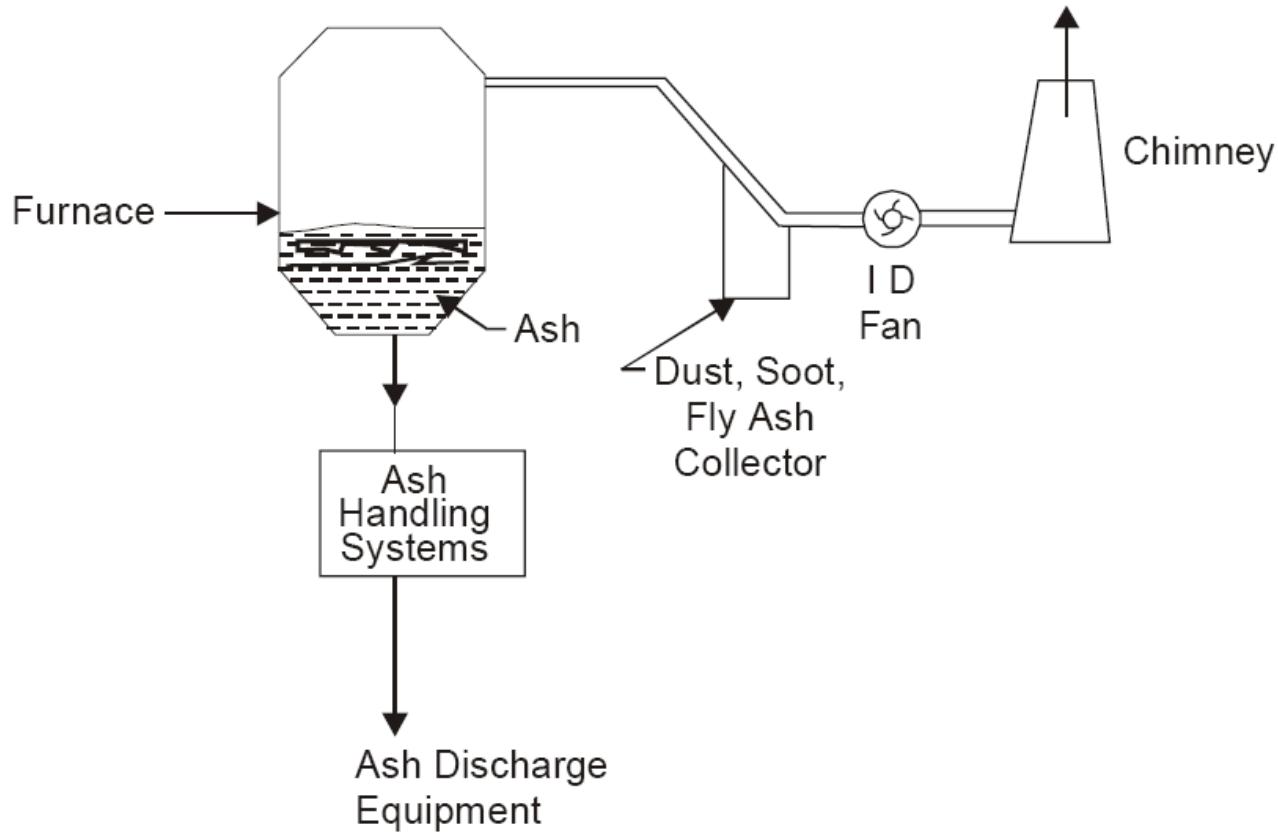


Fig. 4.33. Ash Handling and Dust Collections System.

Hydraulic system

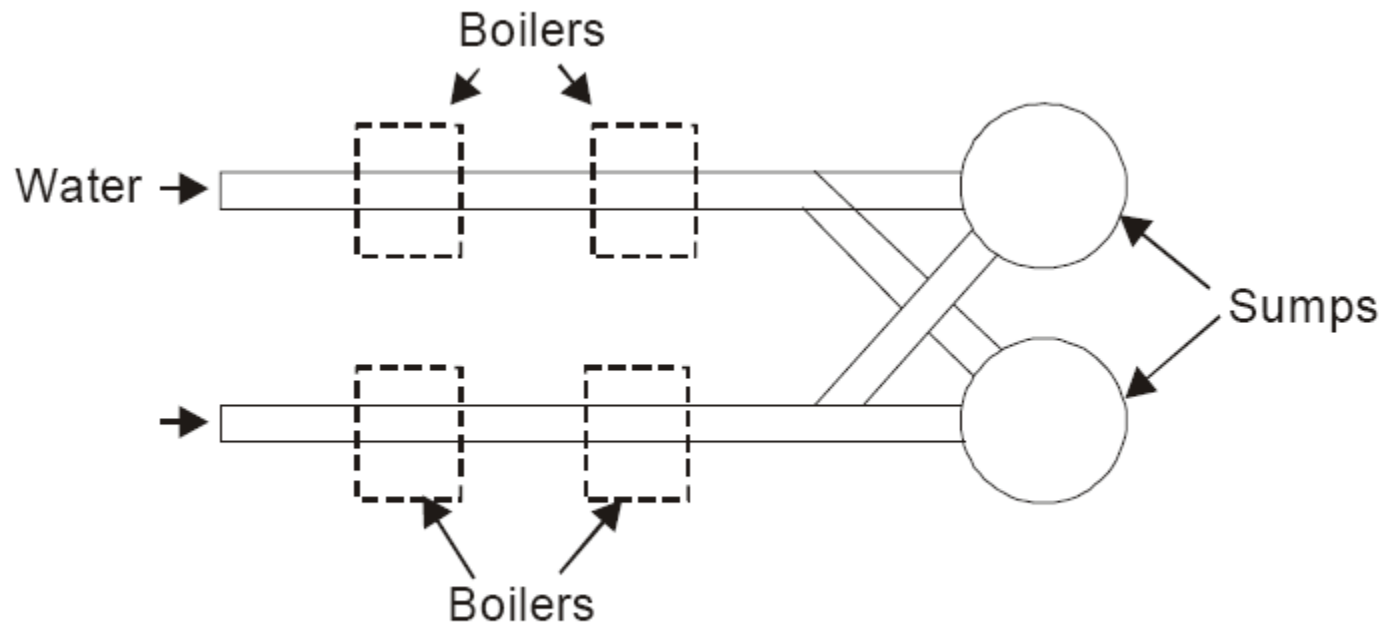


Fig. 4.34. Hydraulic System.

Water Jetting

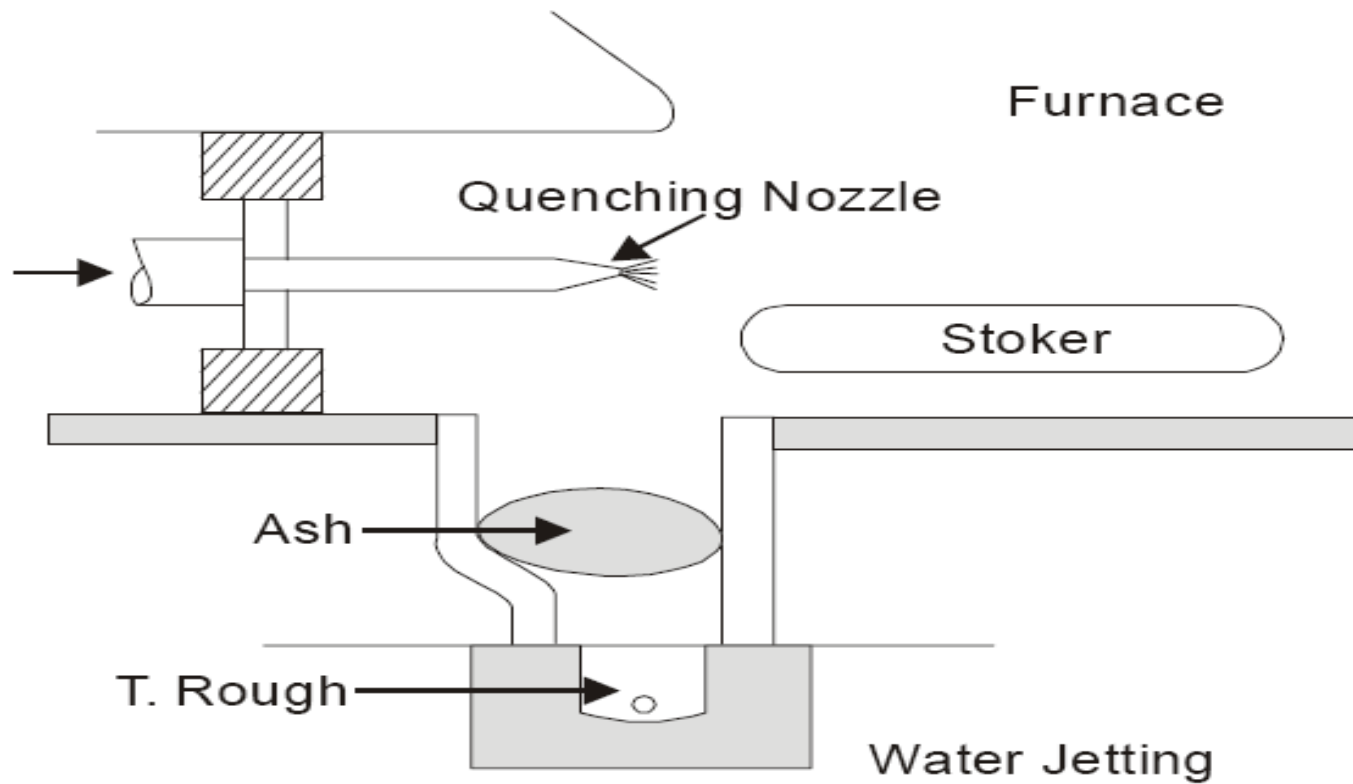


Fig. 4.35. Water Jetting of Ash.

Ash Sluice Ways and Ash Sump System

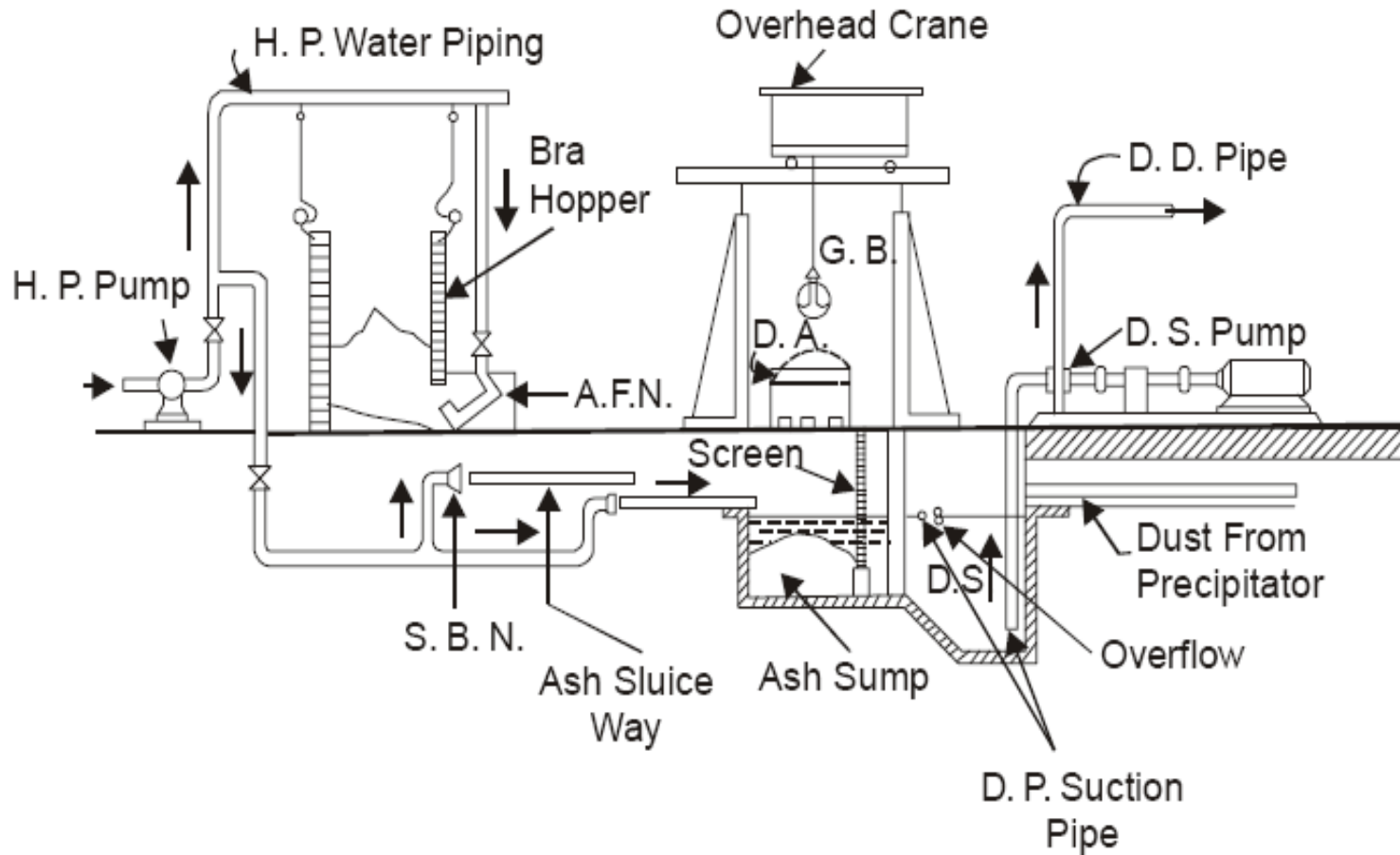


Fig. 4.36. Ash Sump System.

Pneumatic system & Mechanical ash handling system

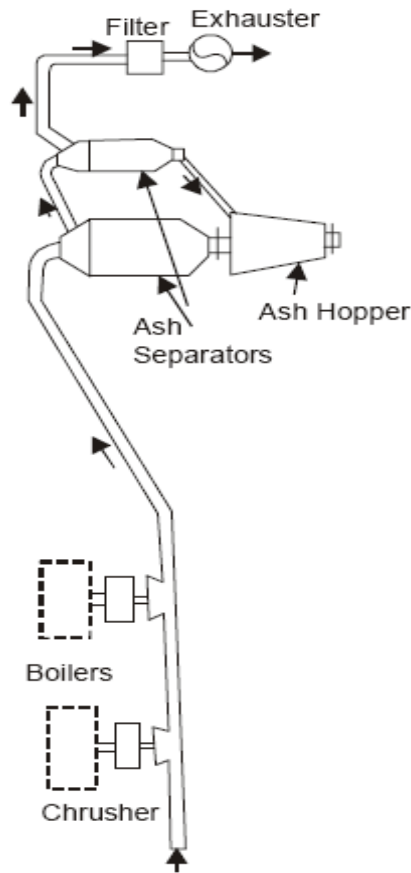


Fig. 4.37. Pneumatic System.

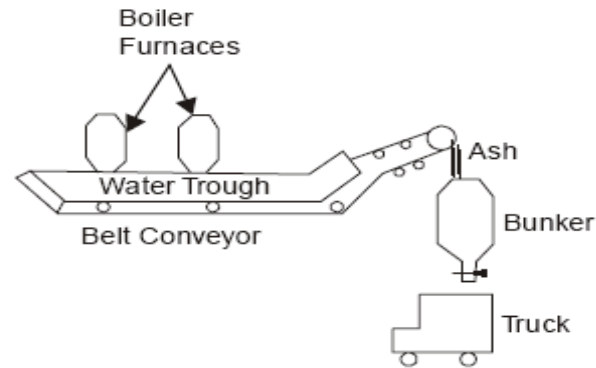


Fig. 4.38. Mechanical Ash Handling.

METHOD OF FUEL FIRING

- The solid fuels are fired into the furnace by the following methods :
 1. Hand firing.
 2. Mechanical firing.

HAND FIRING

- This method of fuel firing is discontinuous process, and there is a limit to the size of furnace which can be efficiently fired by this method

Hand Fired Grates.

- A hand fired grate is used to support the fuel bed and admit air for combustion.
- While burning coal the total area of air openings varies from 30 to 50% of the total grate area.
- The width of air openings varies from 3 to 12 mm.
- The construction of the grate should be such that it is kept uniformly cool by incoming air. Hand fired grates are made up of cast iron.

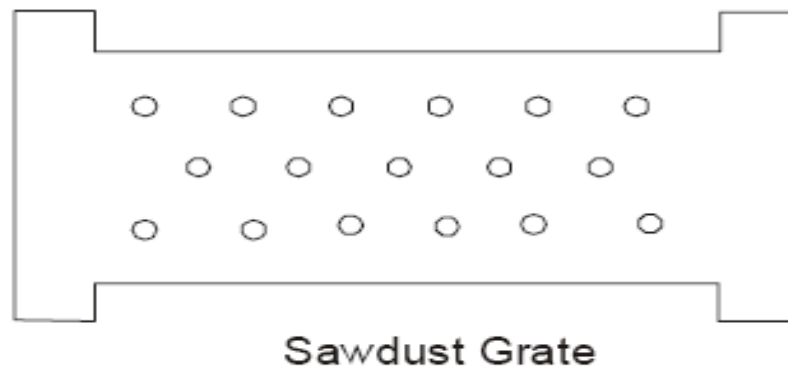
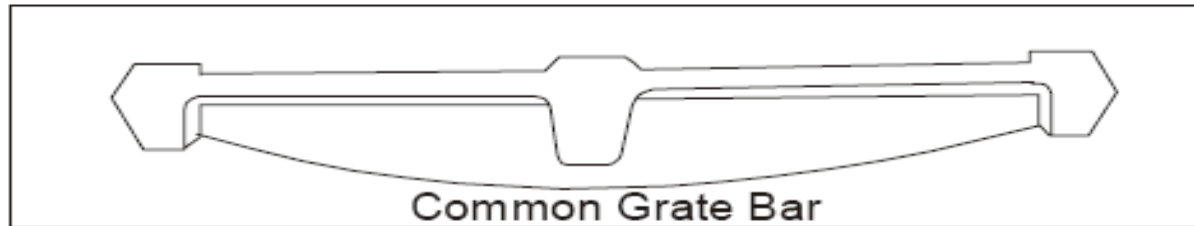
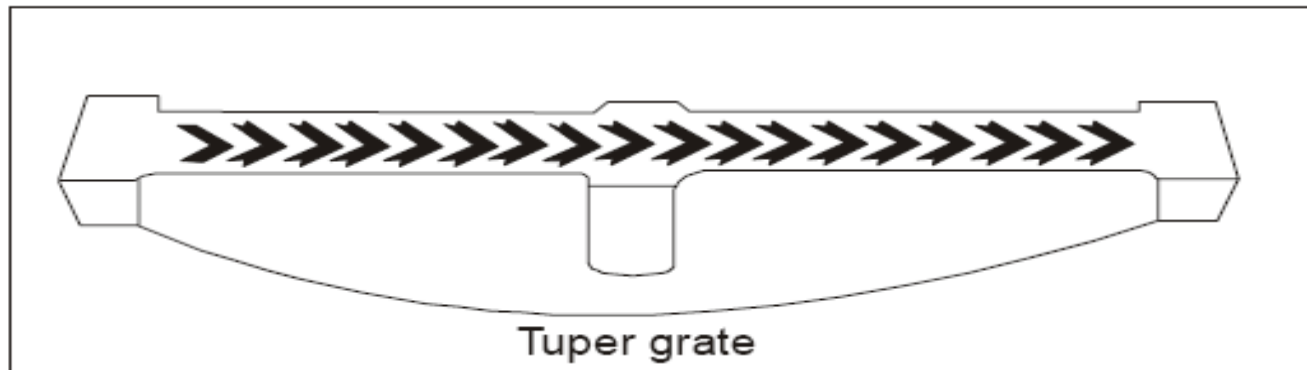


Fig. 4.10. Various Types of Hand Fired Grates.

MECHANICAL FIRING (STOKERS)

- Mechanical stokers are commonly used to feed solid fuels into the furnace in medium and large size power plants.

The various advantages of stoker firing are as follows :

(i) Large quantities of fuel can be fed into the furnace. Thus greater combustion capacity is achieved.

(ii) Poorer grades of fuel can be burnt easily.

(iii) Stoker save labour of handling ash and are self-cleaning.

(iv) By using stokers better furnace conditions can be maintained by feeding coal at a uniform rate.

(v) Stokers save coal and increase the efficiency of coal firing. The main disadvantages of stokers are their more costs of operation and repairing resulting from high furnace temperatures.

- **Principles of Stokers**

- 1. **Overfeed Principle**

- According to this principle the primary air enters the grate from the bottom.
 - The air then passes through a layer of incandescent coke where oxygen reacts with coke to form CO_2 and water vapours accompanying the air react with incandescent coke to form CO_2 , CO and free H_2 .
 - Then additional air known as secondary air is supplied to burn the combustible gases.

- 2. **Underfeed Principle**

- In underfeed principle air entering through the holes in the grate comes in contact with the raw coal (green coal).
 - Then it passes through the incandescent coke where reactions similar to overfeed system take place.
 - Underfeed principle is suitable for burning the semi-bituminous and bituminous coals.

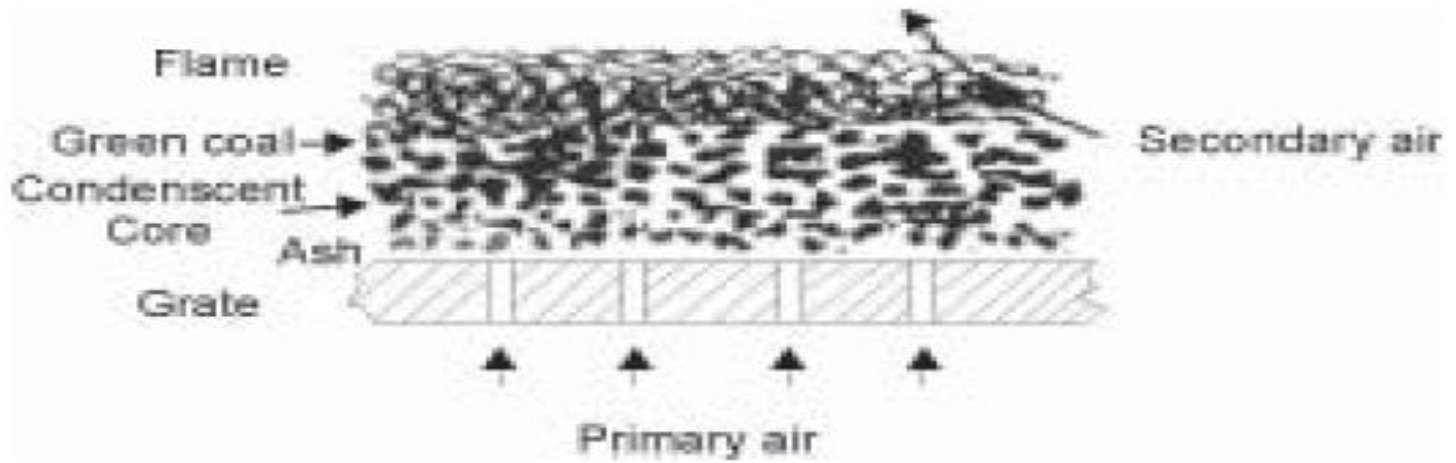


Fig. 4.13. Stokers

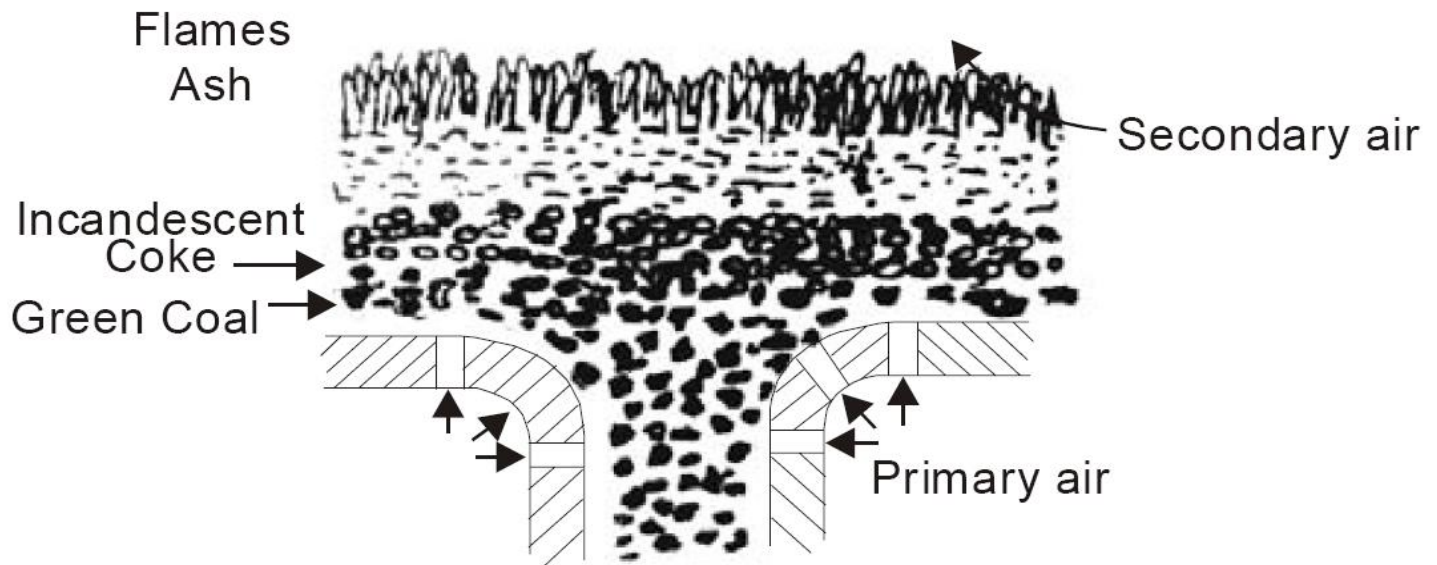


Fig. 4.14. Underfeed Principle.

Types of Stokers:

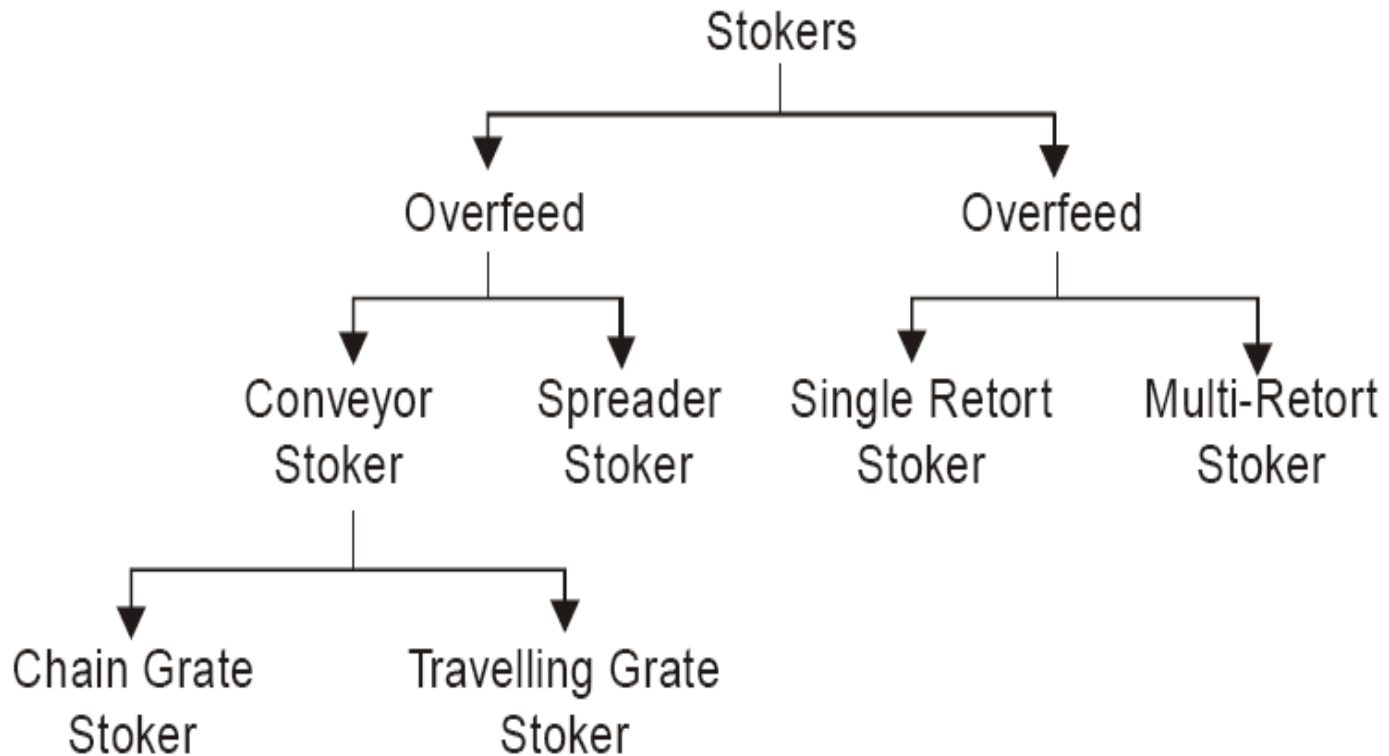


Fig. 4.15. Various Types of Stokers.

- Charging of fuel into the furnace is mechanized by means of stokers of various types. They are installed above the fire doors underneath the bunkers which supply the fuel. The bunkers receive the fuel from a conveyor.
- **(i) Chain Grate Stoker.**

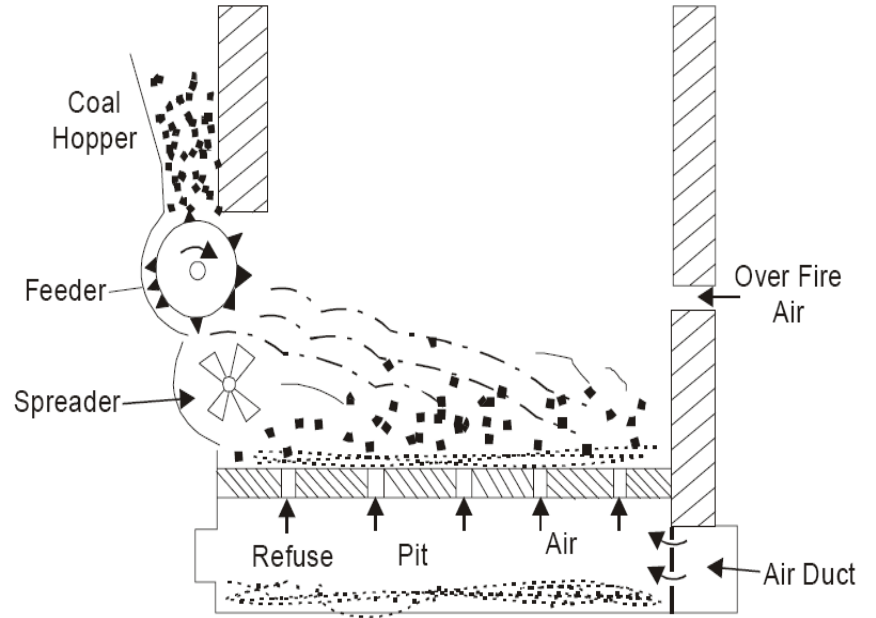
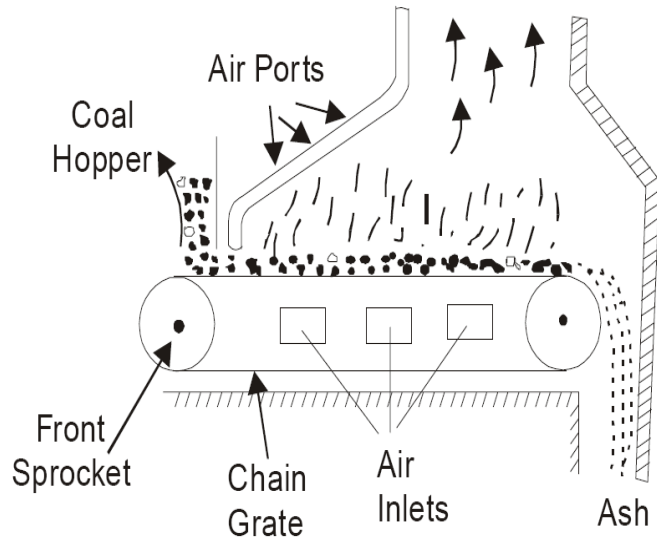


Fig. 4.17. Spreader Stoker.

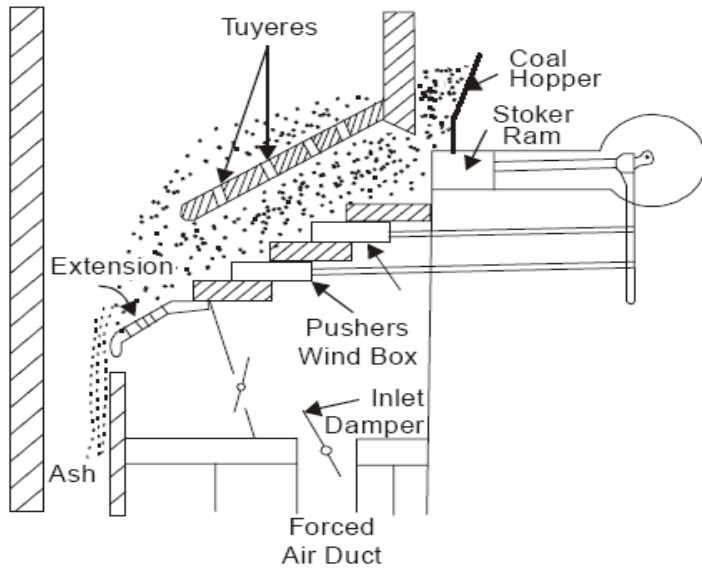


Fig. 4.18. Multi-retort Stoker.

PULVERISED COAL FIRING

Pulverized coal firing is done by two system :

(i) Unit System or Direct System.

(ii) Bin or Central System.

(i) Unit System or Direct System:

Advantages

(i) The system is simple and cheaper than the central system.

(ii) There is direct control of combustion from the pulverising mill.

(iii) Coal transportation system is simple.

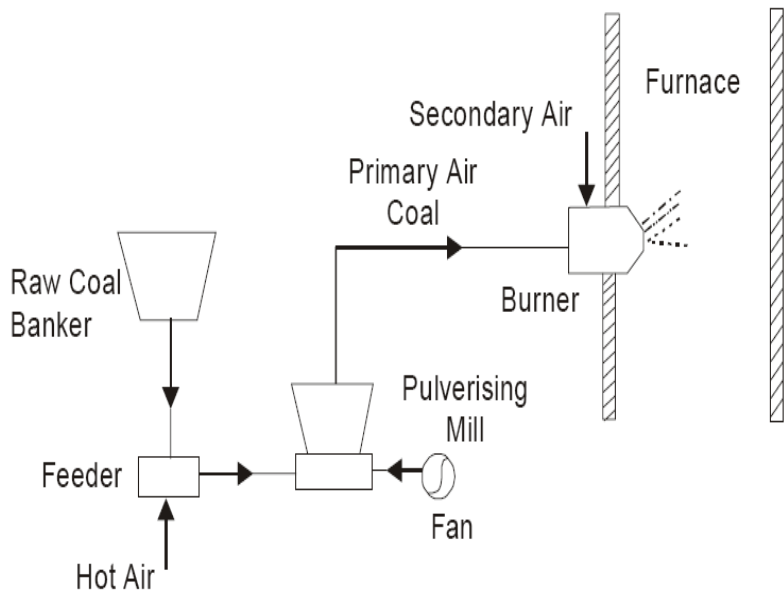


Fig. 4.25. Unit or Direct System.

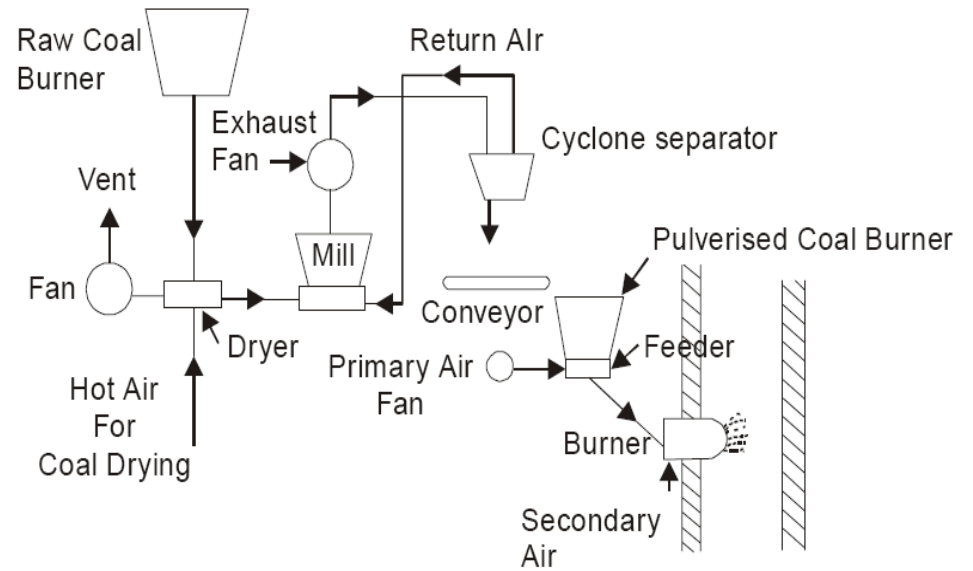


Fig. 4.26. Bin or Central System.

PULVERISED COAL BURNERS

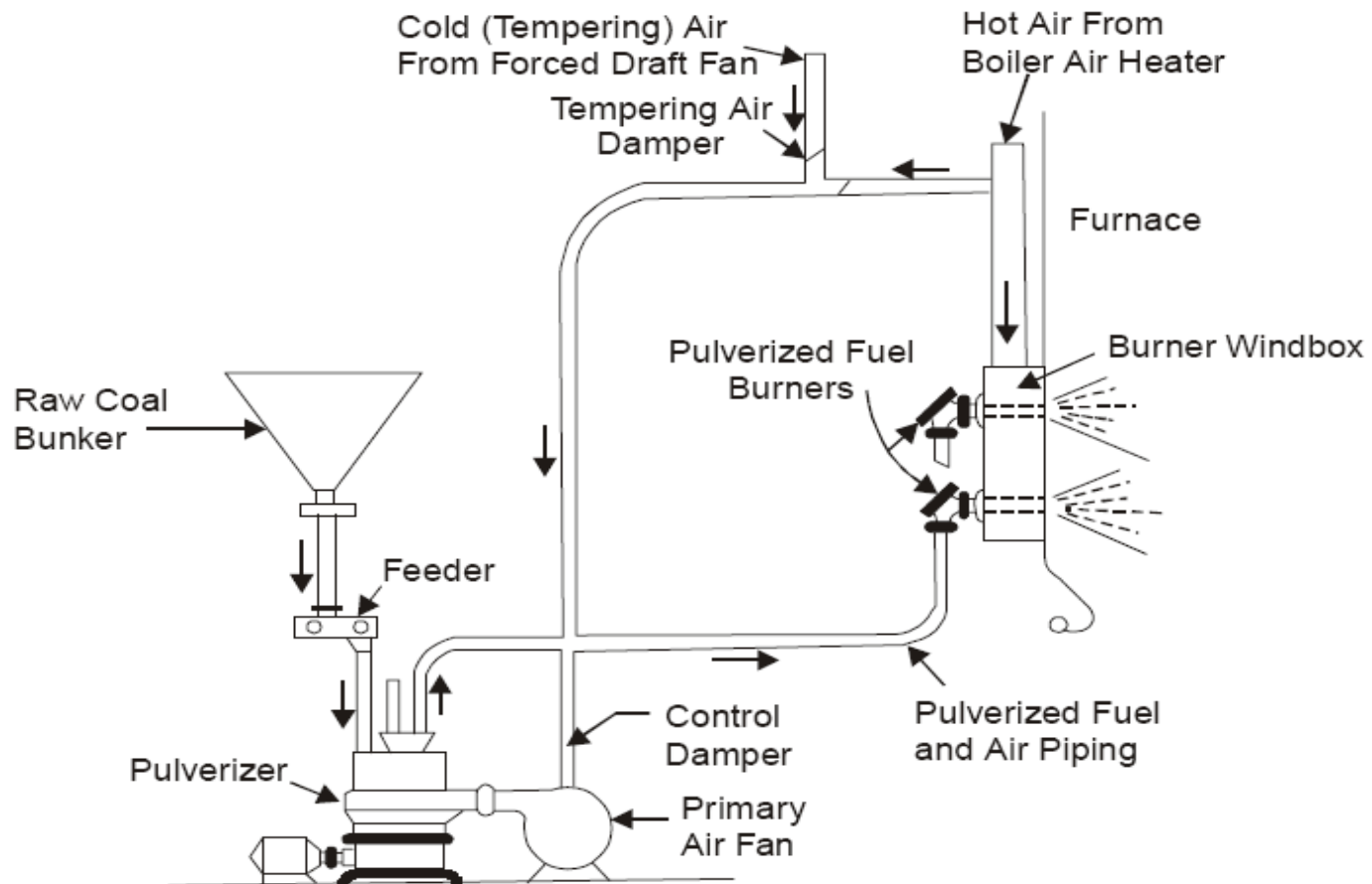
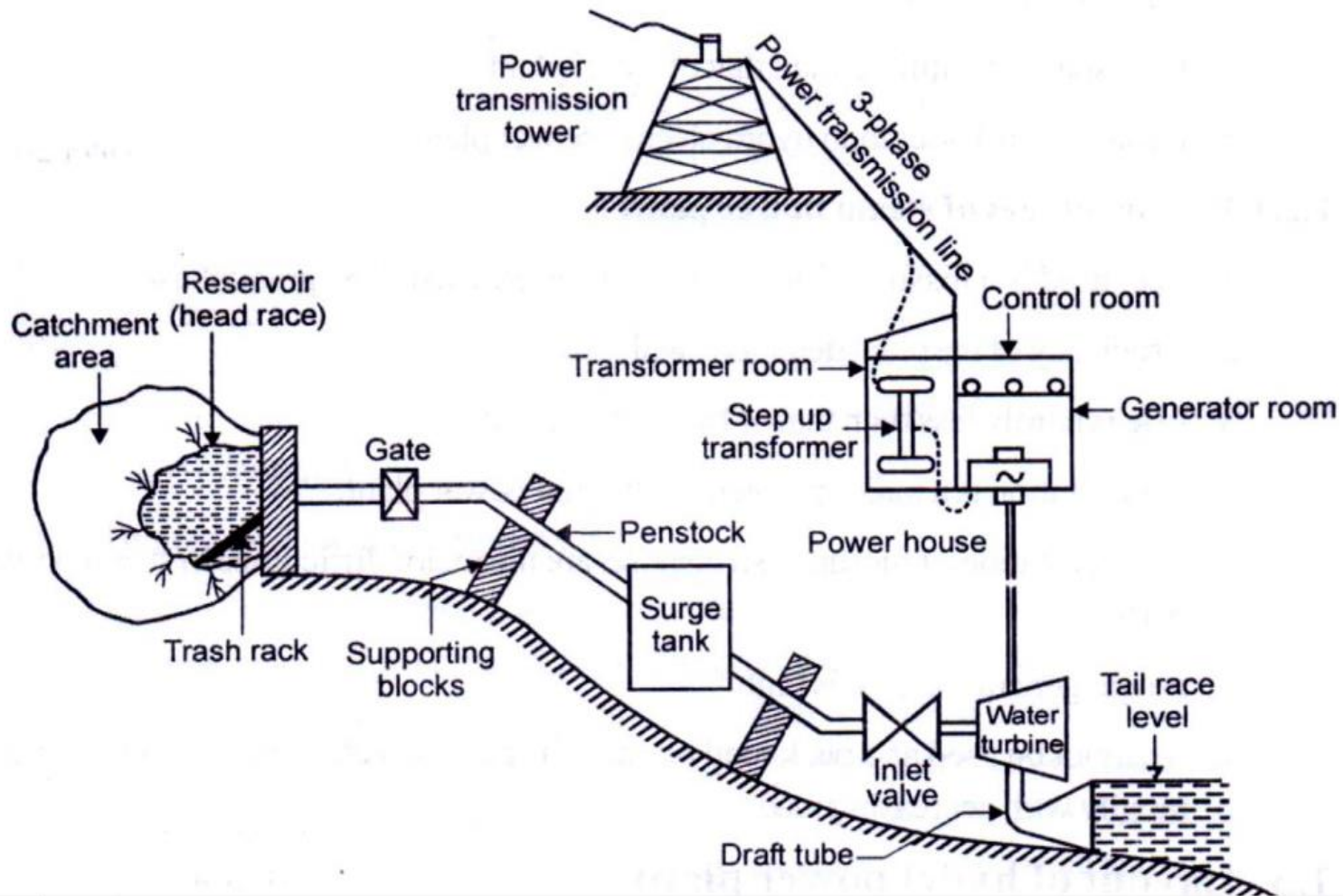


Fig. 4.28. A Pulverised Coal Burner System.

LAYOUT OF HYDEL POWER PLANT



- (1) Dam : Dams are structures built over rivers to stop the water flow and form a reservoir. This water is diverted to turbines in power stations. There are different types of dams such as arch dams, gravity dams and buttress dams. The height of water in the dam is called head race.
- (2) Spillway: A spillway as the name suggests could be called as a way for spilling of water from dams. Spillways could be controlled type or uncontrolled type. The uncontrolled types start releasing water upon water rising above a particular level. But in case of the controlled type, regulation of flow is possible.
- (3) Penstock and Tunnels: Penstocks are pipes which carry water from the reservoir to the turbines inside power station. A tunnel serves the same purpose as a penstock. It is used when an obstruction is present between the dam and power station such as a mountain.
- (4) Surge Tank : Surge tanks are tanks connected to the water conductor system. It serves the purpose of reducing water hammering in pipes which can cause damage to pipes. when the water requirements increase, it supplies the collected water thereby regulating water flow and pressure inside the penstock.
- (5) Power Station: Power station contains a turbine coupled to a generator. The water brought to the power station rotates the vanes of the turbine producing torque and rotation of turbine shaft. This rotational torque is transferred to the generator and is converted into electricity.

The used water is released through the tail race. The difference between head race and tail race is called gross head and by subtracting the frictional losses we get the net head available to the turbine for generation of electricity.

Advantages

1. Water the working fluid is natural and available plenty.
2. Life of the plant is very long.
3. Running cost and maintenance are very low.
4. Highly reliable.
5. No fuel transport problem.
6. No ash disposal problem.

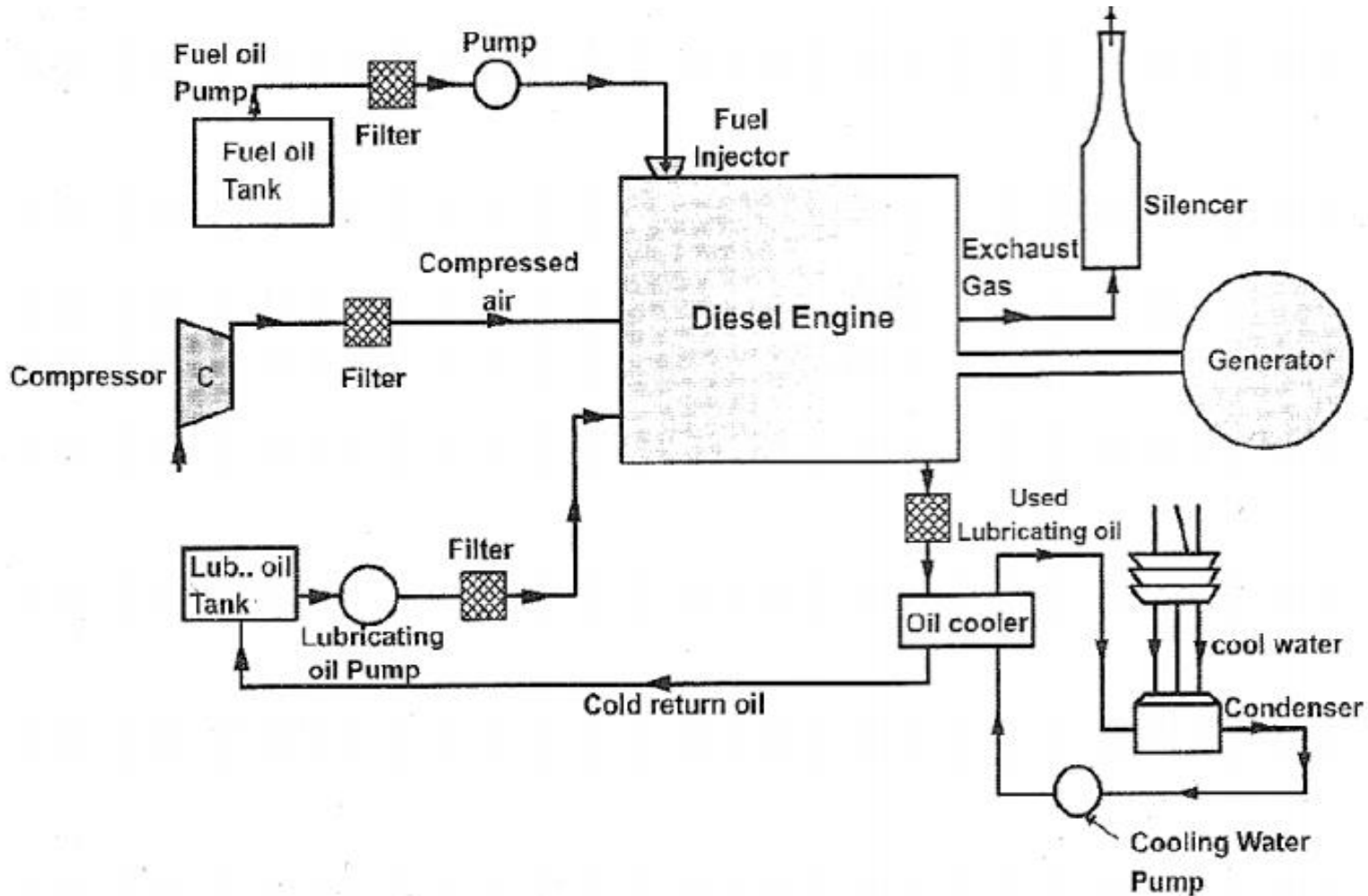
Disadvantages

1. Initial cost of plant is very high.
2. Power generation depends on quantity of water available which depends on rainfall.
3. Transmission losses are very high.
4. More time is required for erection.

Introduction about Diesel power plant

- Diesel power plants produce power in the range of 2 to 50MW, are used as central stations for supply authorities and work.
- They are used as standby sets for continuity of supply such as hospitals, telephone exchanges, radio stations, cinema theatres and industries.
- They are suitable for mobile power generation and widely used in railways and ships.
- Used as Peak Load Plants, Mobile Plants, Stand By Units, Emergency Plants, Starting Stations, Central Stations, Industries where power requirement is small 500kW.

LAYOUT OF DIESEL POWER PLANT



Advantages

1. Diesel power plants can be quickly installed and commissioned.
2. Quick starting.
3. Requires minimum labour.
4. Plant is smaller, operate at high efficiency and simple compared to steam power plant.
5. It can be located near to load centres.

Disadvantages

1. Capacity of plant is low.
2. Fuel, repair and maintenance cost are high.
3. Life of plant is low compared to steam power plant.
4. Lubrication costs are very high.
5. Not guaranteed for operation under continuous overloads.
6. Noise is a serious problem in diesel power plant.
7. Diesel power plant cannot be constructed for large scale.