

BASIC CIVIL AND MECHANICAL ENGINEERING

UNIT IV

BOILERS

PART A (Question and Answers)

1. How boilers are classified?

(i) According to flow of water and gases

(a) Fire tube boiler (b) Water tube boiler

(ii) According to pressure

(a) Low pressure boiler (b) High Pressure

(iii) According to method of firing

(a) Internally fired boiler (b) Externally fired boiler

2. List out the advantages of high pressure boiler.

(i) Heat energy per kg of steam is increased at high pressure

(ii) Production rate of steam is high.

(iii) Superheated steam can be produced.

3. What are the various applications of steam boilers?

(i) Steam produced by the boiler is used for driving steam turbines for power generation

(ii) Steam is used in steam engine in railway locomotives.

(iii) Steam boiler is also used in industrial applications.

4. What is the purpose of an economizer in boilers?

The purpose of an economizer in a steam boiler is used to preheat the feed water from the tank, before it enters the boiler.

5. What is the purpose of superheater in boiler?

A superheater is used to increase the temperature the steam to convert the dry steam into super heated to steam. Superheated steam with high energy content is used to drive the turbine.

6. What is meant by forced circulation boiler?

In forced circulation boiler, water is circulated with high pressure by a pump driven by the motor. *Example: Lamont boiler.*

7. What is the purpose of a man hole in the boiler?

A man hole is a provision for a skilled personnel to enter into the boiler shell for cleaning, inspecting or for attending any repairs in the boiler.

8. What is meant by scaling in the boiler? What is its effect?

The impurities that are left behind when water is transformed into steam, forming a thin layer is called scaling in the boiler. When the scaling is more around in a water tube boiler, it leads to poor heat transfer.

9. At what pressure do the modern high pressure boilers produce steam?

Modern high pressure boilers produce steam at a pressure of 200 bar.

10. What is a grate in the boiler?

A grate is a part of the boiler over which solid fuel is burnt.

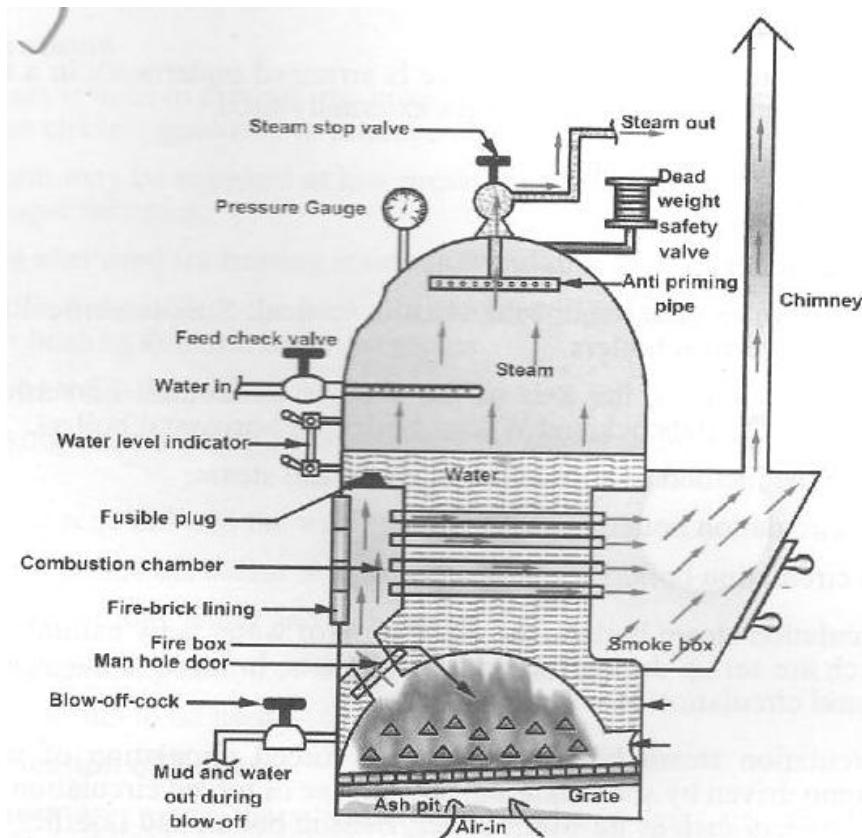
11. List the various boiler accessories.

- Economiser
- Air Preheater
- Super Heater
- Steam Separator
- Steam Trap
- Feed Pump

PART B

1. With a neat sketch, briefly explain about a Low pressure fire tube boiler.

Cochran boiler is a low pressure fire tube boiler. Steam produced by this boiler is below 80 bar. Coal is fed into the grate through the fire hole and burnt. Ash formed during the burning is collected in the ash pit provided just below the grate. Ash is then removed manually. The hot gases from the grate pass through the combustion chamber to the horizontal fire tubes and



transfer the heat by convection. The flue gases coming out of fire tubes pass through the smoke box and escape to the atmosphere through the chimney. Smoke box is provided with a door for cleaning the fire tubes and smoke box. The working pressure and steam capacity of cochran boiler are 6.5 bar and 3500 kg /hr respectively.

It consists of boiler mountings such as steam safety valve, water level indicator, fusible plug, etc., for safe operation of the boiler. To measure the pressure of steam produced by the boiler a steam pressure gauge is also mounted at the top of the boiler.

2. Explain with a neat sketch, the construction and working principle of a high pressure water tube boiler.

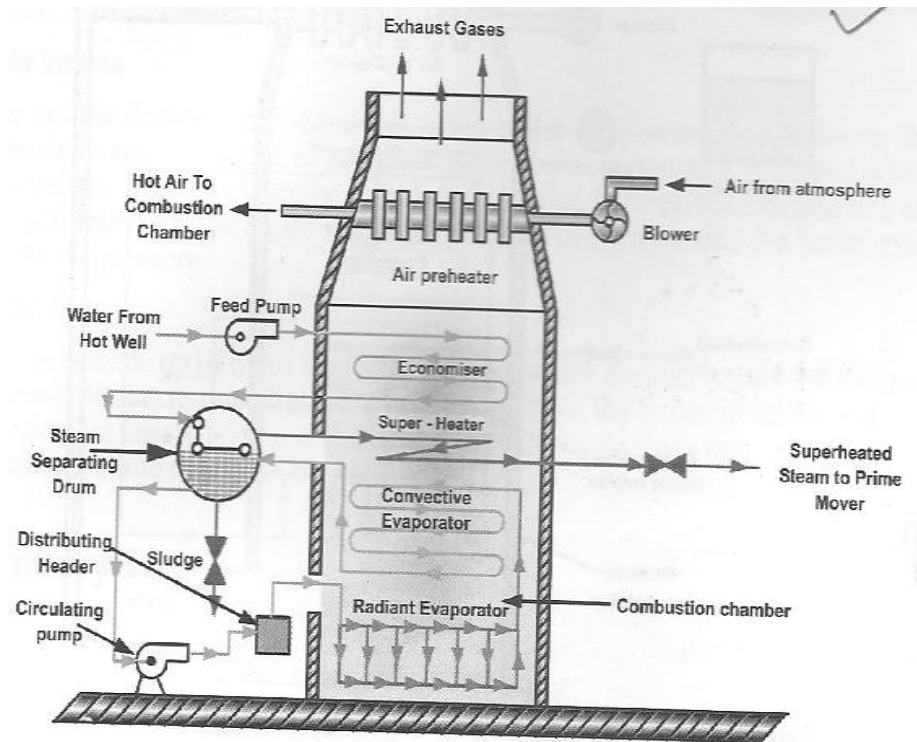
Lamont boiler is a water tube, forced circulation and externally fired high pressure boiler.

Construction :

- The capacity of the plant is 50 tonnes/hr
- Pressure of the steam generated is 170 bar.
- Temperature of the steam produced is 500o C

Working :

- Feed water is pumped to the boiler by the feed pump through the economiser.
- Economiser preheats the feed water by using hot gases leaving the boiler.
- The circulating pump circulates the water from the drum under high pressure to prevent the tubes from being overheated
- Water is evaporated into steam when passing through these tubes.
- The water and steam from the tube enters the boiler drum where the steam is separator.



- This steam is passed through a convection superheater and the steam is superheated by the flue gases.
- This super heated steam is supplied to the prime mover through steam outlet.

- The water level in the drum is kept constant by pumping the feed water into the boiler drum.
- The air is preheated by the flue gases before entering the combustion chamber to aid the combustion of the fuel.
- This type of boiler has a working pressure of 170 bar.
- They can produce the steam at the rate of 45000 kg per hour.

4. Differentiate between boiler mountings and accessories.

S. No.	Boiler mountings	Boiler accessories
1	Mountings are fitted for the safety of the boiler	Accessories are fitted to increase the efficiency
2	They form integral parts of the boiler	They are not integral part of the boiler
3	They are usually mounted on the boiler shell	They are usually installed outside the boiler shell
4	A boiler should not be operated without mountings	A boiler can be operated without accessories

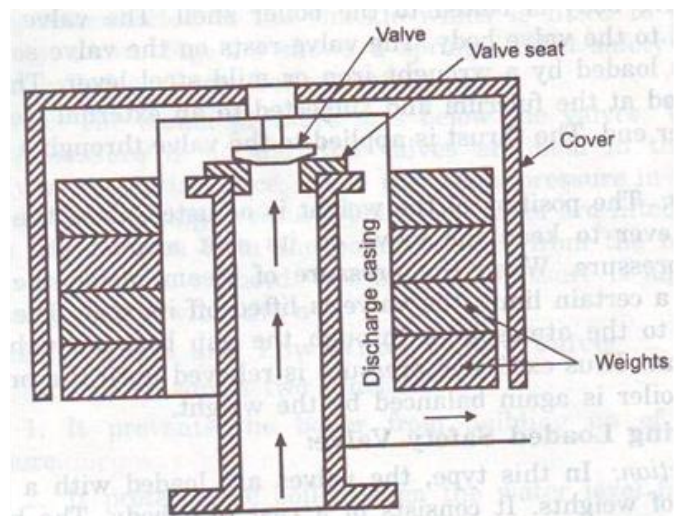
5. List out the various boiler mountings. Explain with sketches.

The boiler mountings are,

- Dead weight safety valve.
- Spring loaded safety valve
- Fusible plug
- Pressure gauge

(i). Dead weight safety valve

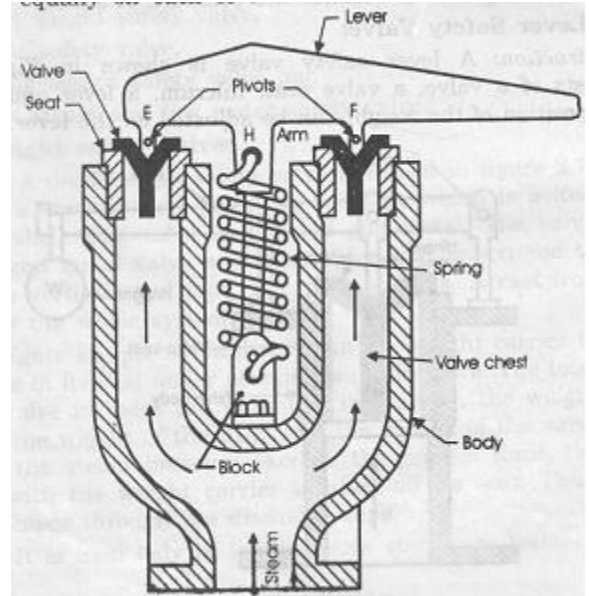
- Weights are placed sufficiently in the weight carrier.
- The total load on the valve includes the weight of the carrier, the weight of the cover, the weight of the discs and the weight of the valve itself.



- When the steam pressure exceeds the normal limit, the valve along with the weight carrier is lifted off its seat.
- Thus the steam escapes through the discharge pipe.

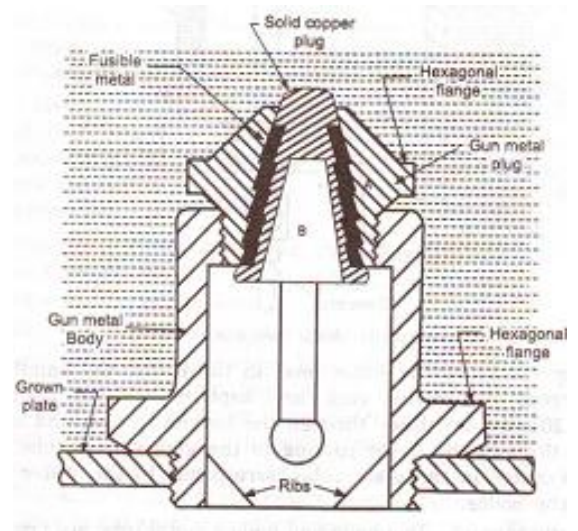
(ii). Spring loaded safety valve

- Weights are placed sufficiently in the weight carrier.
- The total load on the valve includes the weight of the carrier, the weight of the cover, the weight of the discs and the weight of the valve itself.
- When the steam pressure exceeds the normal limit, the valve along with the weight carrier is lifted off its seat.
- Thus the steam escapes through the discharge pipe.
- It is adjusted by loosening or screwing the nut.



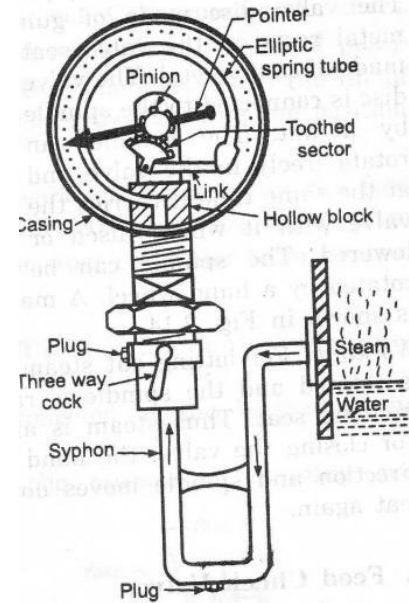
(iii) Fusible plug

- Under normal working conditions, the fusible plug is completely covered with water.
- Hence the temperature of the plug is not increased appreciably during combustion process.
- When the water level falls below the safe limit the fusible plug is uncovered from water and exposed to steam.
- The furnace heat over heats the plug and it melts the fusible metal and copper plug falls down.
- Due to this water steam mixture rushes into the furnace and the fire is extinguished



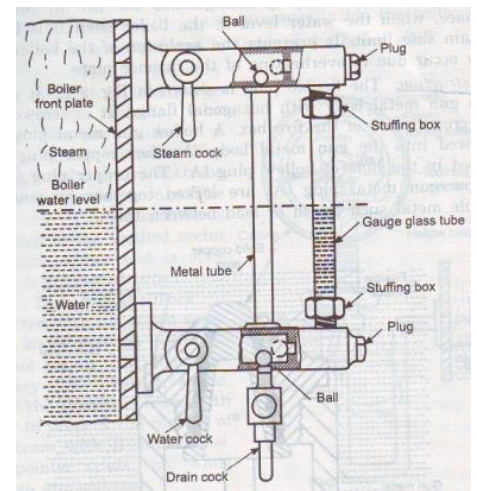
(iv) Bourdan Tube Pressure Gauge

- The steam pressure is applied to the Bourdon's tube.
- The elliptical cross section of the tube to straighten out slightly.
- The closed end of the Bourdon tube moves.
- This movement actuates the toothed sector and pinion rotates.
- The pointer is mounted on the pinion. Hence the pointer moves on the graduated dial in clockwise, to indicate the steam pressure.



(v) Water level indicator

- To know the water level in the boiler the handles of the steam cock and water cock are kept in vertical positions.
- Water rushes through the bottom casting and steam rushes through the upper casting to the gauge glass tube.
- The level of water corresponds to the water level in the boiler.



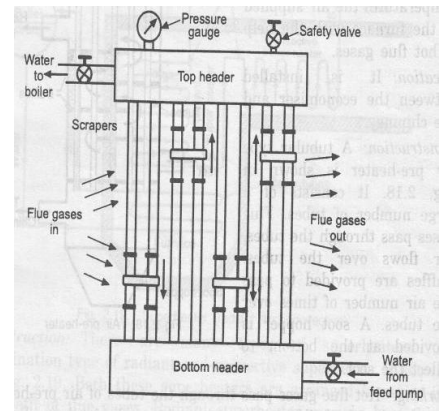
6. List out the boiler accessories. Explain with neat sketches.

The various accessories used in boiler are,

- Economiser
- Air Preheater
- Super Heater
- Steam Separator
- Steam Trap
- Feed Pump

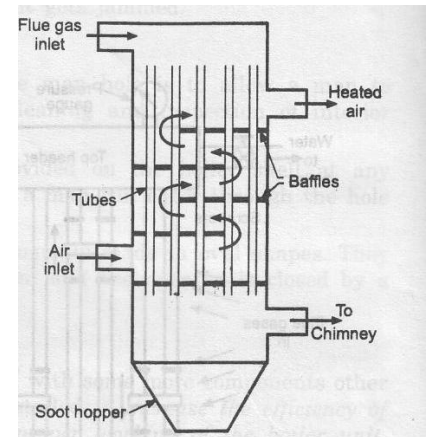
(i) Economiser

- The feed water is pumped to the bottom header and this water is carried to the top header number of vertical tubes.
- Hot flue gases are allowed to pass over the external surface of the tubes.
- The feed water which flows upward in the tubes is heated by the flue gases.
- This preheated water is supplied to the water.
- Scrappers are moved slowly moved up and down to clean the surface of the tubes.



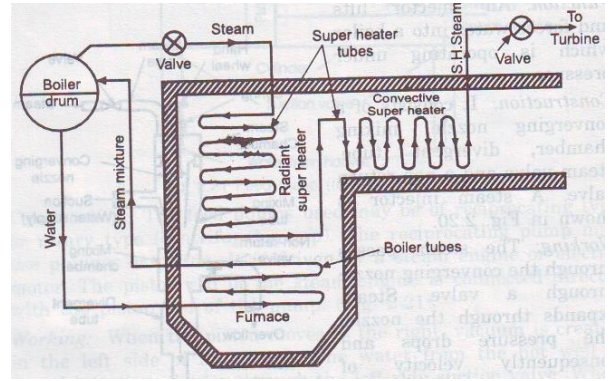
(ii) Air Preheater

- Hot flue gases pass through the tubes of air preheater after leaving the boiler or economiser.
- Air and flue gases flow in opposite directions.
- Baffles are provided in the air preheater and the air passes number of times over the tubes.
- Heat is absorbed by the air from the flue gases.
- This preheated is supplied to the furnace to aid combustion.



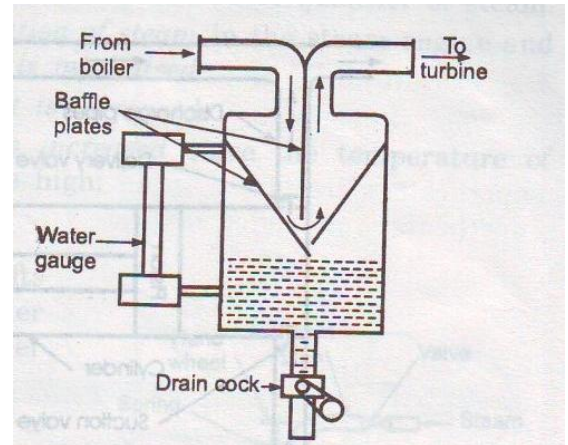
(iii) Super heater

- Steam stop valve is opened.
- The steam from the evaporator drum is passed through the super heater tubes.
- First the steam passed through the radiant super heater and then to the convective super heater.
- The steam is heated when it passes through these super heaters and converted into the super heated steam.
- This superheated steam is supplied to the turbine through the valve.

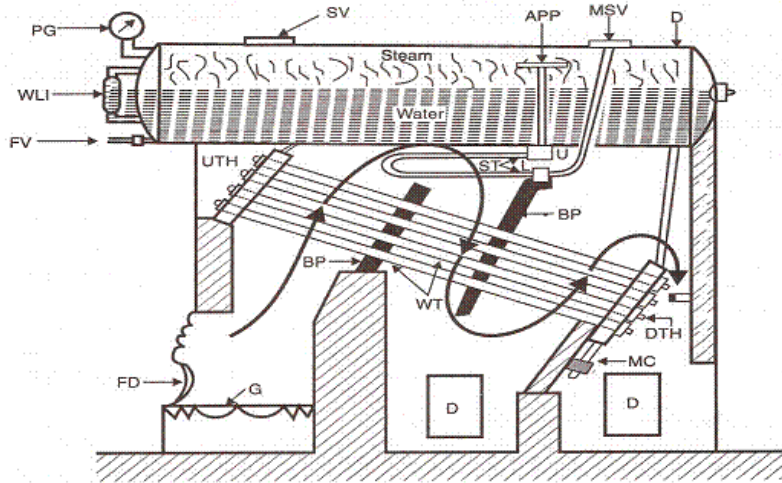


(iv) Steam Separator

- The steam is allowed into the separator.
- The steam strikes the baffle plates and the direction of flow is changed.
- As a result, heavier particles in steam falls down to the bottom of the separator.
- The separated steam is free from water particles. Then the steam is circulated to the turbine.



7. With a neat layout, briefly explain Babcock and Wilcox boiler.



Babcock and Wilcox is a water-tube boiler is an example of horizontal inclined tube boiler it also a High Pressure Boiler.

Construction: Babcock and Wilcox boiler with longitudinal drum. It consists of a drum connected to a series of front end and rear end header by short riser tubes. To these headers are connected a series of inclined water tubes of solid drawn mild steel. The angle of inclination of the water tubes to the horizontal is about 15° or more.

Working: The fire door the fuel is supplied to grate where it is burnt. The hot gases are forced to move upwards between the tubes by baffle plates provided. The water from the drum flows through the inclined tubes via down take header and goes back into the shell in the form of water and steam via uptake header. The steam gets collected in the steam space of the drum. The steam then enters through the anti priming pipe and flows in the superheater tubes where it is further heated and is finally taken out through the main stop valve and supplied to the Steam turbine or Steam engine when needed. At the lowest point of the boiler is provided a mud collector to remove the mud particles through a blow-down-cock.

