



### Experiment No: 3

**Title:-**To study the working and construction details of fire tube boilers (Cochran and Locomotive Boiler).

**Apparatus:** - Demonstration model and charts of Cochran and Locomotive Boiler.

**Theory:-**

#### **COCHRAN BOILER:**

Cochran boiler is a vertical, multi-tubular, fire tube, internally fired, natural circulation boiler.

#### **Construction:**

A Cochran boiler consists of a vertical cylindrical shell having a hemispherical top and furnace is also hemispherical in shape. The fire grate is arranged in the furnace and the ash pit is provided below the grate. A fire door is attached on the fire box. Adjacent to the fire box, the boiler has a combustion chamber which is lined with fire bricks. Smoke or fire tubes are provided with combustion chamber. These tubes are equal in length and arranged in a group with wide space in between them. The ends of these smoke tubes are fitted in the smoke box. The chimney is provided at the top of the smoke box for discharge of the gases to the atmosphere. The furnace is surrounded by water on all sides except at the opening for the fire door and the combustion chamber. The smoke tubes are also completely surrounded by water. Different boiler mountings and accessories are located at their proper place as shown in Figure.

#### **Working:**

The hot gas produced from the burning of the fuel on the grate rises up through the flue pipe and reaches the combustion chamber. The flue gases from the combustion pass through the fire tubes and the smoke box and finally are discharged through the chimney. The flue gases during their travel from fire box to the chimney gives heat to the surrounding water to generate steam.

#### **Specifications of Cochran Boiler:**

Diameter of the drum – 0.9 m to 2.75 m

Steam pressure - 6.5bar up to 15bar

Heating surface -  $120\text{m}^2$

Maximum evaporative capacity - 4000Kg/hr of steam

Height of the shell - 5.79m

No of tubes – 165

Efficiency – 70 to 75 %

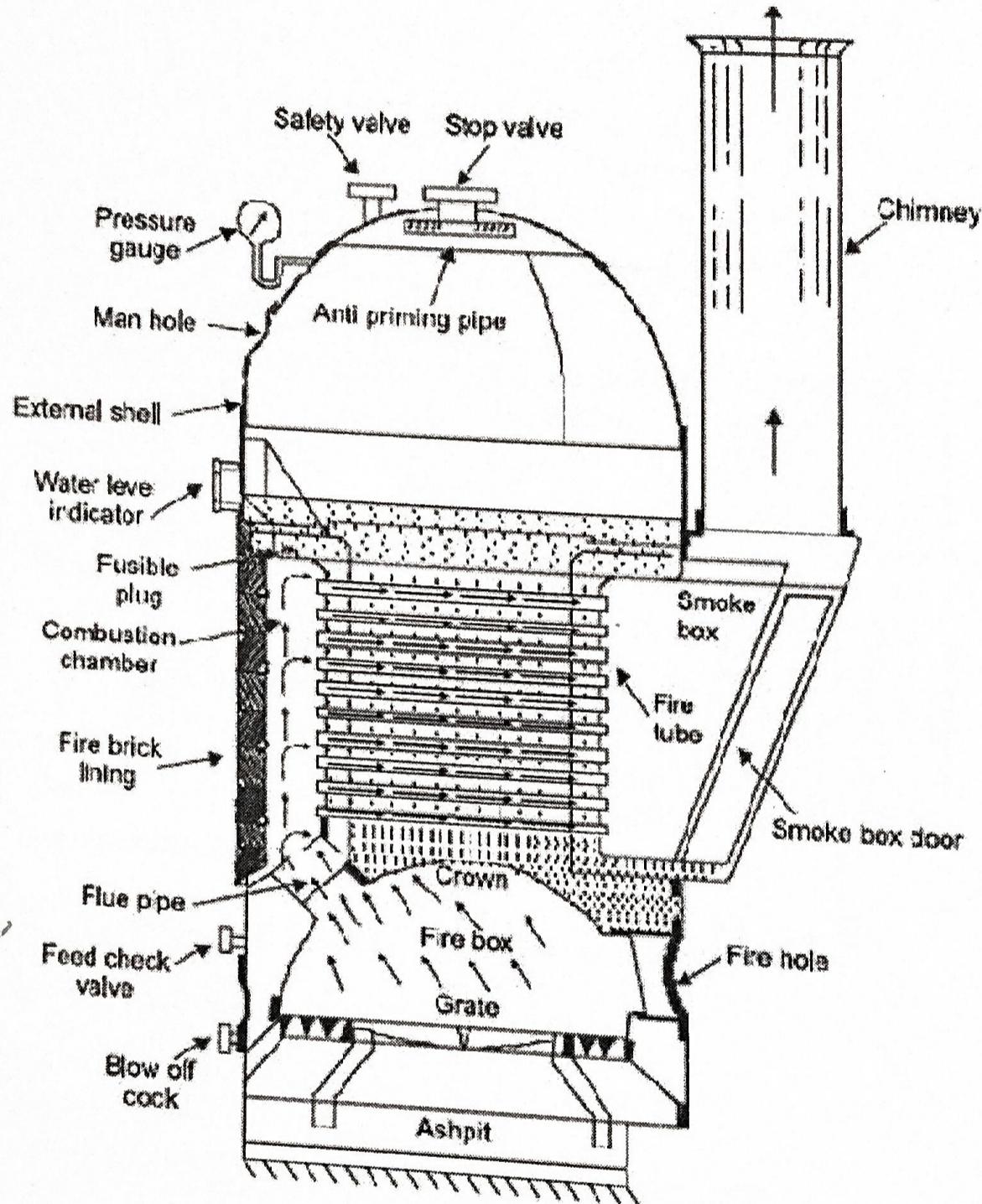
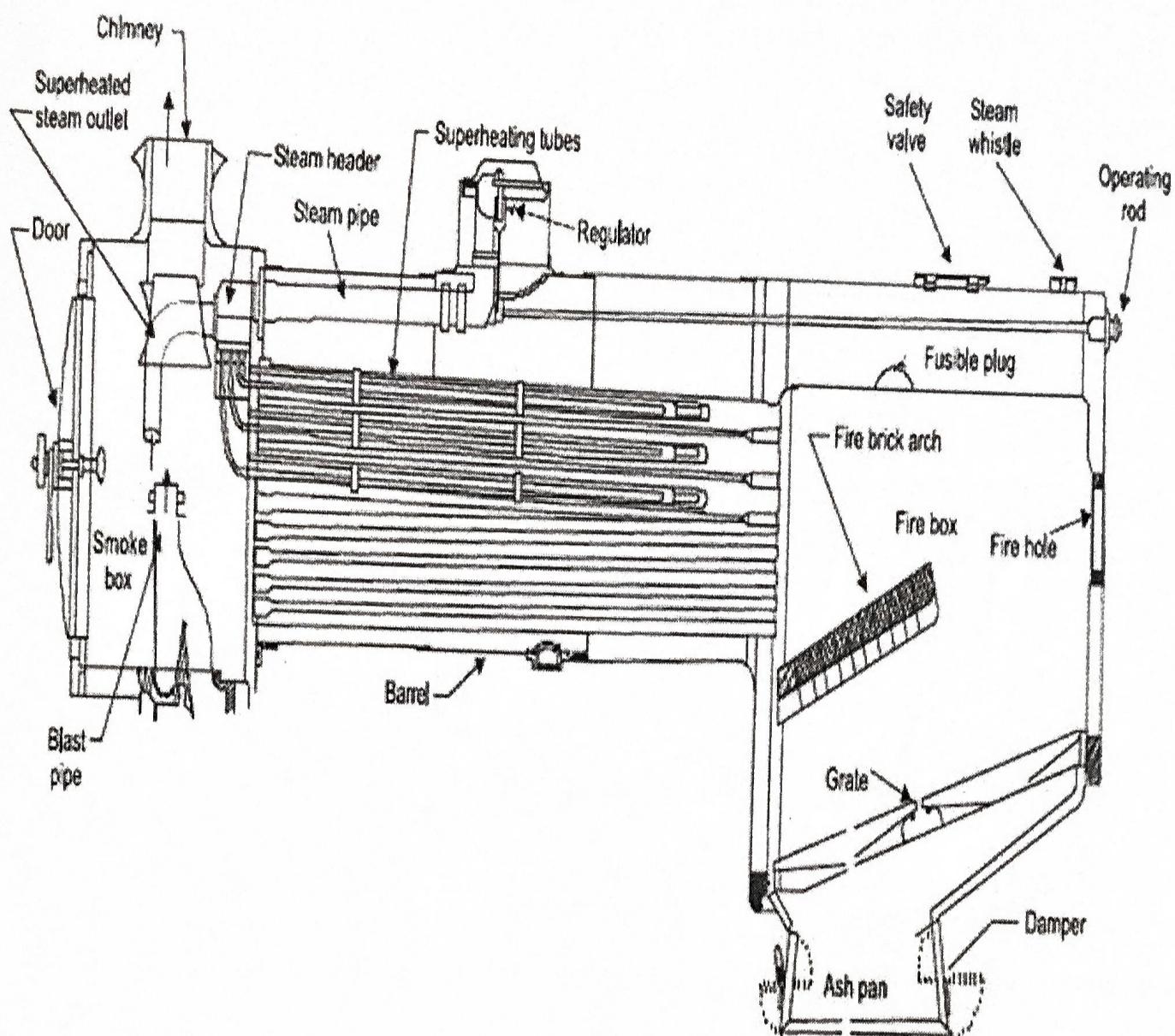


Fig. 11.7 Cochran boiler

### LOCOMOTIVE BOILER

It is horizontal multi-tubular, fire tube, induced draught, internally fired mobile boiler. It has very short chimney and is used in railways.



### ***Construction and working***

It consists of a horizontal steel cylindrical shell with internal firebox at one end and smoke box at the other end. The fire box is rectangular in shape and made of steel. It has inclined grate. An ash pit and inclined brick arch to divert the flue gases. Similarly the inclined brick arch also deflects the flue gases thereby delay the entrance to the flue tubes until the combustion of coal gets completed in the furnace.

The boiler shell contains large number of horizontal tubes through which flue gases pass from one end to other end. The boiler shell has two sizes of the tubes; usually the bottom one 148 to 160 tubes of 4.75 cm diameter and upper one 21 to 24 tubes of 13 cm diameter are fitted. The large diameter tube accommodates super heater tubes which try to superheat the steam. The steam is collected from the highest point of the boiler, usually in a dome. The flow of steam through outlet pipe is regulated by means of a rod connected by a wheel in the driver's cabin. This steam is then passed through the super heater with the help of header and from where superheated steam is taken out. This superheated steam is supplied to run the steam engine. It is not possible to provide high chimney to exhaust the flue gases to the atmosphere as these



boilers are running from one place to the other at a high speed, in which high chimney may cause vibrations. Hence artificial induced draught is used in these boilers. This is achieved by supplying exhaust steam from steam engine to the smoke box through blast pipe. Thus move's out speedily through the chimney and carries the flue gases. This produces vacuum in the smoke box. The air is drawn in the furnace due to this vacuum, so hot gases flow towards the smoke box. A large door at the front end of the smoke box is provided which can be opened for cleaning the flue tubes and smoke box.

### **Mountings**

The following necessary mountings provided to safe and easy working of the boiler as an essential components

#### **Feed Check valve**

It is provided in the front side of driver's cabin for supply of feed water from the reservoir and checks the reverse flow of water from the shell to reservoir. It is non return flow control type valve.

#### **Water level indicator**

The water level indicator is also fitted in front side of the driver's cabin which indicates the level of water inside the boiler with the help of glass tube. It helps to maintain a particular level of water inside the boiler; other wise overheating may take place which in turn may burn out the tubes.

#### **Pressure Gauge**

It is fitted on top of the boiler shell in steam space. This indicates the pressure of steam inside the boiler when boiler is working. It is also fitted in driver's cabin.

#### **Safety Valve**

The safety valve is fitted on the top of the crown of the boiler shell and in steam space. The function of the safety valve is to maintain a required pressure in the boiler shell. If pressure in the boiler shell increases then extra steam is released to atmosphere through opening of safety valve.

#### **Steam stop valve**

The steam stop valve is fitted upper side of the boiler shell in the steam space. The stop valve is used for regulating the supply of generated steam in the boiler shell. It is used to regulate the superheated steam available from super heater. The steam is used for running the steam engine and also for creating artificial draught in the smoke chamber.

#### **Fusible plug**

The fusible plug is mounted above the furnace and below the water level in the shell. This plug under normal condition is immersed in water in the boiler which keeps the temperature of fusible metal in the fusible plug below its melting point.

When the water level in the shell falls below the fusible plug level, the fusible metal of the fusible plug melts by the heat of the flue gases in the furnace. Thus the plug drops out and the high pressure steam/water rushes to the furnace and puts off the fire in the furnace. Thus boiler is protected from overheating and mishappening.



### ***Blow off cock***

*Blow off cock* is fitted at the bottom most position of the water level in the shell. During annual maintenance and also in other special occasions, it is necessary to empty the boiler in order to clean, inspect and repair internally by blowing off the water and other sediments from boiler.

### ***Special features***

The special features of Locomotive boilers are

1. It is very compact boiler
2. Large quantity of steam generation is needed so that more number of small and large diameter tubes are provided to increase heating surface area
3. The installation cost of boiler is less because of no brickwork, foundation and chimney
1. High quality of steam is readily available with this boiler as super heater is installed