[illegible] steam, during its passage through tubes (10), gets further heated and becomes superheated. The steam is now taken through the outlet pipe (14) to the stop valve (15).

The boiler is fitted with usual mountings, such as safety valve (19), feed valve (20), water level indicator (8) and pressure gauge (9).

13.13. La-Mont Boiler

This is a modern high pressure water tube steam boiler working on a forced circulation. The circulation is maintained by a centrifugal pump, driven by a steam turbine, using steam from the boiler. The forced circulation causes the feed water to circulate through the water walls and drums equal to ten times the mass of steam evaporated. This prevents the tubes from being overheated.

A diagrammatic sketch of La-Mont steam boiler is shown in Fig. 13.8. The feed water passes through the economiser to an evaporating drum. It is then drawn to the circulating pump through

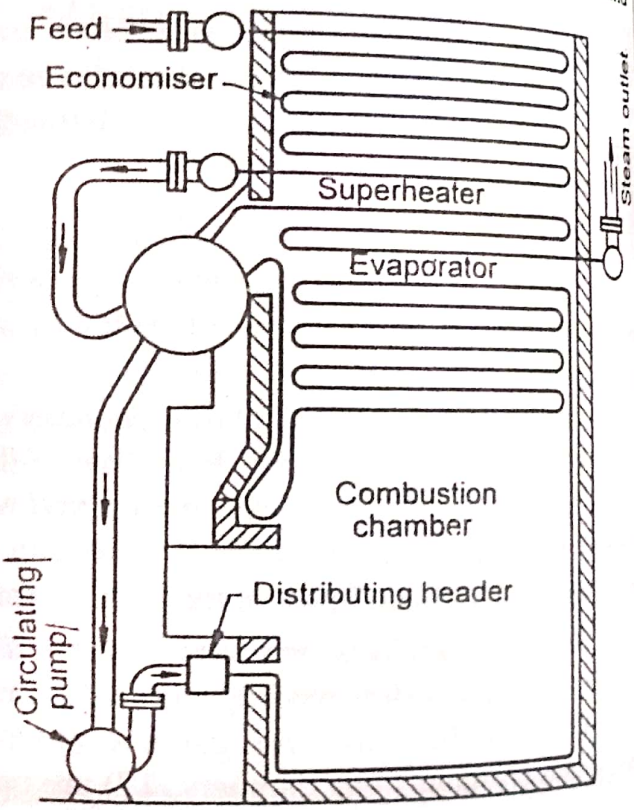


Fig. 13.8. La-Mont boiler.

the tube. The pump delivers the feed to the headers, at a pressure above the drum pressure. The header distributes water through nozzles into the generating tubes acting in parallel. The water and steam from these tubes passes into the drum. The steam in the drum is then drawn through the superheater.

13.14. Loeffler Boiler

This is a water tube boiler using a forced circulation. Its main principle of working is to evaporate the feed water by means of superheated steam from the superheater. The hot gases from the furnace are used for superheating.

A diagrammatic sketch of a Loeffler steam boiler is shown in Fig. 13.9. The feed water from the economiser tubes is forced to mix with the superheated steam in the evaporating drum. The saturated steam, thus formed, is drawn from the evaporating drum by a steam circulating pump. This steam passes through the tubes of the combustion chamber walls and then enters the superheater. From the superheater, about one-third of the superheated steam passes to the turbine and the remaining two-third is used to evaporate the feed water in the evaporating drum.

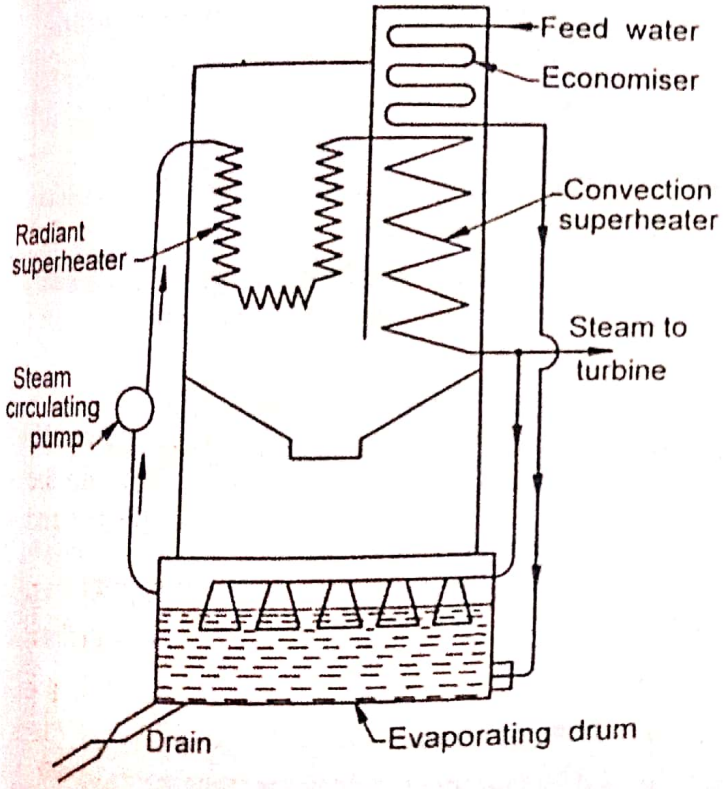


Fig. 13.9. Loeffler boiler.

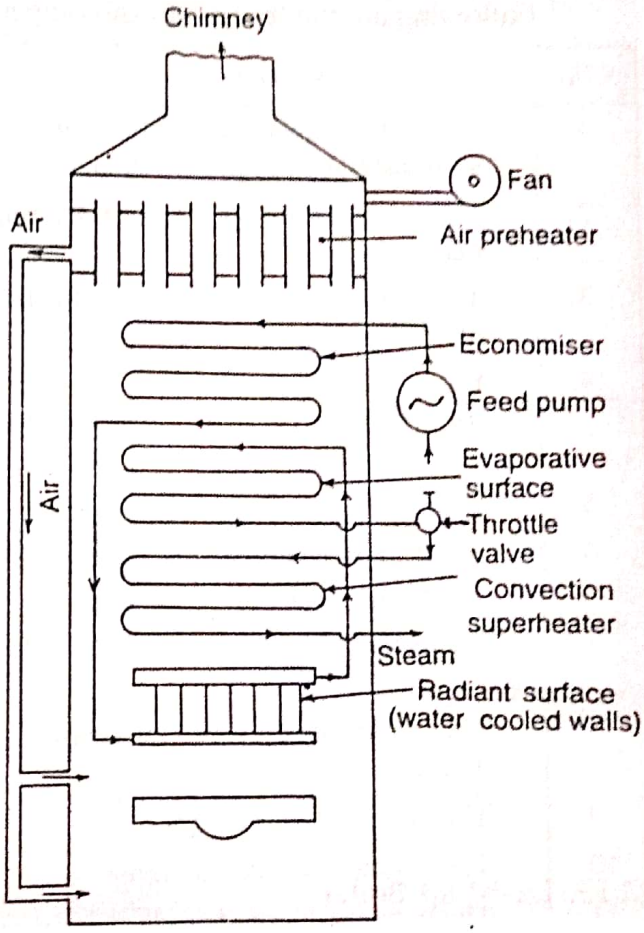


Fig. 13.10. Benson boiler.

13.15. Benson Boiler

It is a high pressure, drum less, water tube steam boiler using forced circulation. In this boiler, the feed water enters at one end and discharges superheated steam at the other end. The feed pump increases the pressure of water to supercritical pressure (*i.e.* above the critical pressure of 225 bar) and thus the water directly transforms into *steam without boiling.

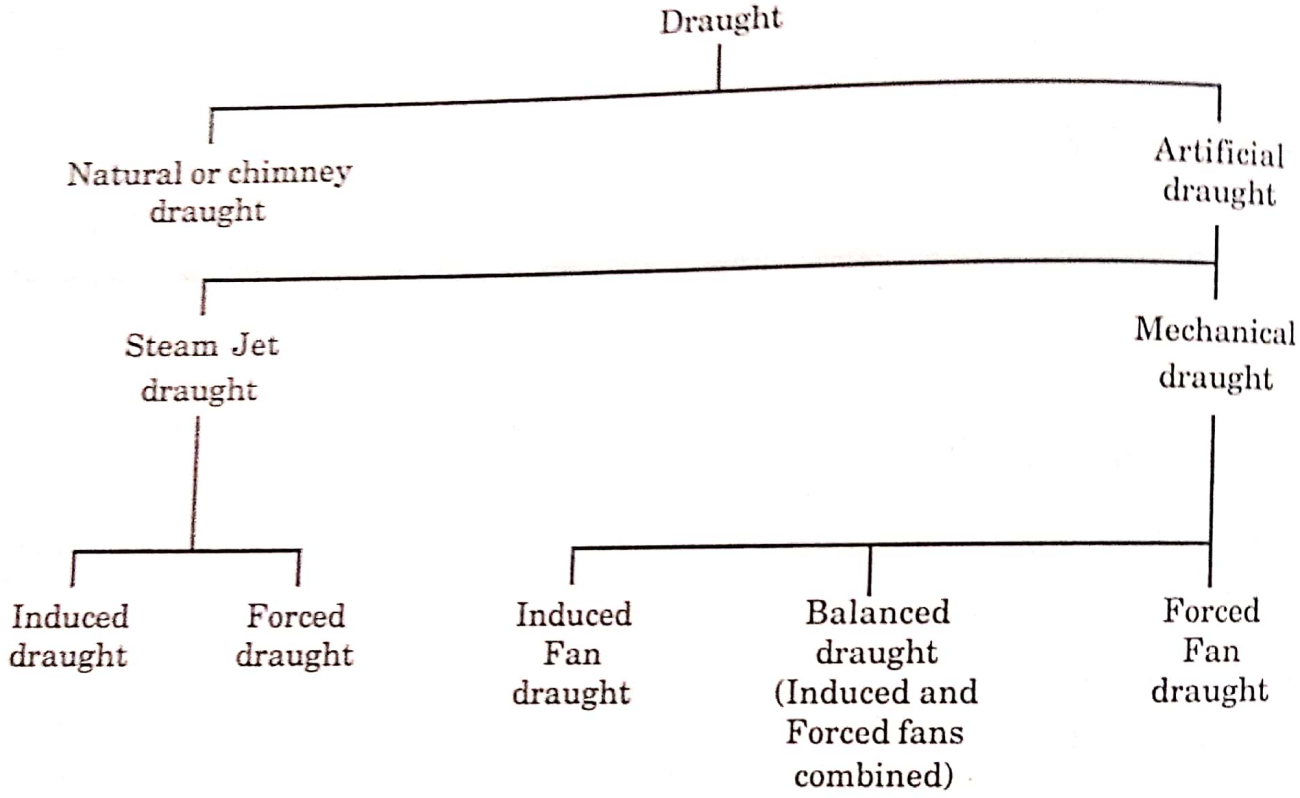
...boiler is shown in Fig. 13.10. The feed water passes

13.1 INTRODUCTION

In order to maintain the continuous flow of fresh air into the combustion chamber, it is necessary to exhaust the products of combustion from the combustion chambers of the boilers. A pressure difference has to be maintained to accelerate the products of combustion to their final velocity and to overcome the pressure losses in the flow system. This pressure difference so maintained is known as "draught".

13.2 CLASSIFICATION OF DRAUGHT

The method of producing the draught is generally classified as :



13.3 NATURAL DRAUGHT

Natural draught is obtained by the use of a chimney. A chimney is a vertical tubular structure of brick, masonry, steel or reinforced concrete or even reinforced plastic, built for the purpose of enclosing a column of hot gas, to produce the draught. The life of brick or concrete chimney may be as high as 50 years. The effective draught is reduced in a brick chimney due to the leakage through the cracks and imperfect bonding of bricks. This leakage loss can be eliminated by the use of a concrete or steel chimney. Steel chimney also requires less space and has less weight and is less costly, but the life of the steel chimney is only about 15 years. Lining of the steel chimney can increase its life. The concrete chimney is costlier and takes longer time to install but it has long life as compared to other types of chimneys.

The draught produced by the chimney is due to the density difference between the column of hot gases inside the chimney and the cold air outside.

A diagrammatic ... is shown

13.6 ARTIFICIAL DRAUGHT (FORCED AND INDUCED DRAUGHTS)

In most of the modern power plants, the draught used must be independent of atmospheric conditions, and it must have a greater flexibility (control) to take the fluctuating loads on the plant.

It would be impossible to run today's large steam power plants requiring tens of thousands of tons of steam per hour without the aid of draught fans. A chimney of any reasonable height would be incapable of developing enough draft to move the tremendous volume of gases (400×10^3 cu. m. to 800×10^3 cu. m. per minute).

The draught required in actual power plant is high (300 mm of water) and to meet this high draught requirements, artificial draught system should be used. The artificial draught is more economical when the required draught is above 40 mm of water. The artificial draught may be of mechanical type or of steam jet type. If the draught is produced by a fan, it is known as fan (mechanical) draught and if the draught is produced by a steam jet, the draught is known as steam jet draught.

Steam jet draught is used for small installations like locomotives while mechanical draught is invariably used in central power stations.

13.7 FORCED DRAUGHT

In a forced draught system, a blower is installed near the base of the boiler and air is forced to pass through the furnace, flues, economiser, air-preheater, and to the stack. This draught system is known as positive draught system or forced draught system because the pressure of air throughout the system is above atmospheric pressure and air is forced to flow through the system. The arrangement of the system is shown in Fig. 13.3. A stack or chimney is also used in this system as shown in figure but its function is to discharge gases high into the atmosphere for better dispersion of ash particles and pollutants. As it is not designed for producing draught, the height of the chimney may not be large.

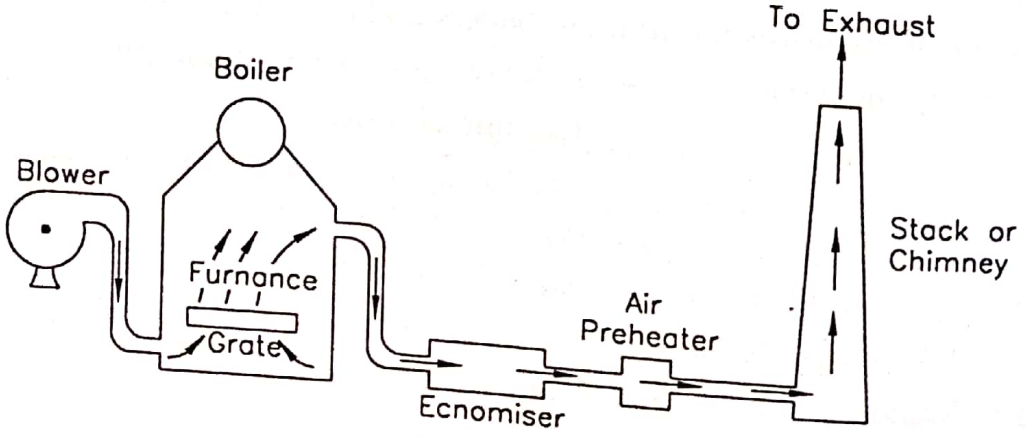


Fig. 13.3. Forced draught.

13.8 INDUCED DRAUGHT

In this system, the blower is located near the base of the chimney. The air is sucked into the system by reducing the pressure through the system below the atmospheric pressure. The induced draught fan sucks the gases from the furnace and the pressure inside the furnace is reduced below that of the atmospheric thus inducing the atmospheric air to flow through the furnace. The action of the induced draught is similar to the action of the chimney. As the

draught produced is independent of the temperature of the hot gases, the gases may be discharged as cold as possible after recovering as much as possible heat in the economiser and the air preheater.

This draught is used generally when an economiser and an air preheater are incorporated in the system. The fan should be located at such a place that the temperature of the gas handled by the fan is lowest. The chimney is also used in this system and its function is similar to that in forced draught but total draught produced in induced draught system is the sum of the draughts produced by the fan and the chimney. The arrangement of the system is shown in Fig. 13.4.

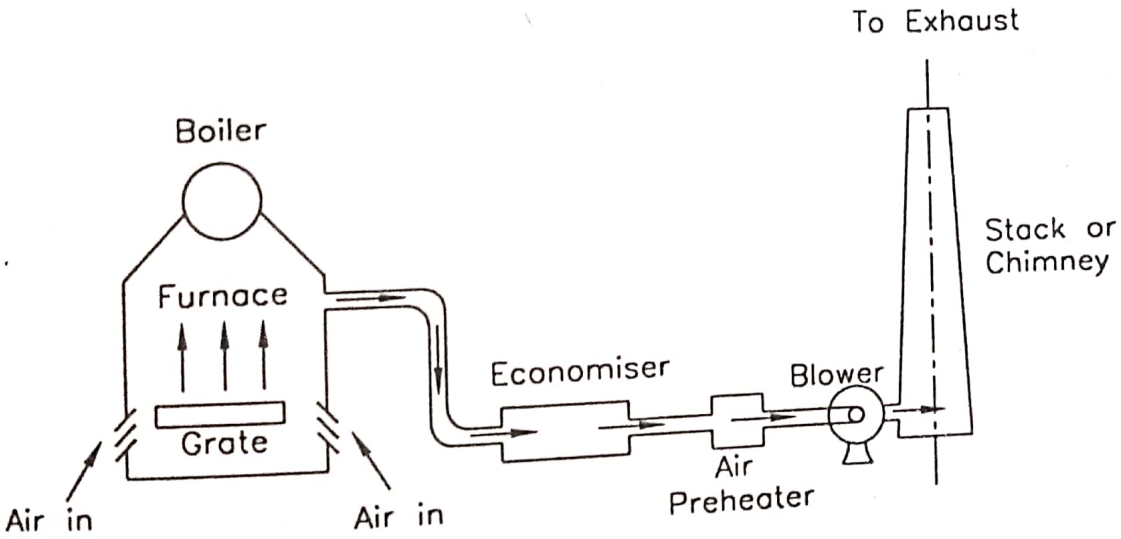


Fig. 13.4. Induced draught.

13.9 COMPARISON OF FORCED AND INDUCED DRAUGHTS

The advantages of forced draught system over the induced system are listed below.

1. The power required by the induced draught fan is more than that required by the forced draught fan because the induced draught fan handles more gases (air + fuel) and at elevated temperature. The volume of the gas handled by induced draught fan is much larger than the volume handled by forced draught fan due to the high temperature of the gases, therefore the size of induced draught fan is about 1.3 times the size of forced draught fan.
2. Water cooled bearings are required for induced draught fan to withstand the high temperature of the flue gases.
3. There is no chance of air leakage into the furnace with forced draught as the pressure inside the furnace is above atmospheric, therefore, the chances of blowout are more if the doors are opened for fitting or inspection. There is continuous leakage of air into the furnace with induced draught as the pressure inside the furnace is less. This dilutes the combustion gases and leads to losses.
4. The flow of air through the gate and furnace is more uniform and it penetrates better into the fuel bed when forced draught is used. The better penetration of air through the fuel bed and uniform flow improves the rate of burning.
5. When the doors are opened for firing in case of induced draught fan, there will be rush of cold air into the furnace and this reduces the draught through the system and reduces the heat transmission efficiency of the surfaces.
6. The induced draught fan blades are quickly eroded.