

PRESENTATION ON STEAM BOILERS



WHAT IS A BOILER?

A boiler is usually a closed vessel made of steel. Its function is to transfer the heat produced by the combustion of fuel to water and ultimately to generate steam.

open vessels, generating steam at atmospheric pressure are not considered to be boiler.

The steam produced may be supplied to

- power generation
 - heating
 - space heating
 - hot water supply
- industrial processes
 - sugar mills
 - chemical industries

Essential of a good boilers

1. The boiler should be capable of generating steam at the required pressure and of the required quality quickly and with minimum fuel consumption.
2. The initial cost, installation cost and the maintenance cost of the boiler should not be too high.
3. The boiler should be light in weight, should need the least amount of brick work construction and should occupy small floor area.
4. The boiler should meet the fluctuating demands or steam supply without being overheated
5. The different parts of the boiler should be easily approachable for repairs.
6. There should be no deposition of mud and other foreign particles on the heated surfaces
7. The boiler should conform to the safety regulations as laid down in the "Boilers Act".

CLASSIFICATION OF BOILERS

➤ Relative position of hot gas and water

▪ Fire tube boiler

Hot gasses pass through the tubes that surrounded by water. Horizontal return tubular, vertical tubular, Lancashire, Cochran, Cornish, locomotive fire box, etc.

▪ Water tube boiler

The tubes contain water and the hot gases flow outside Babcock and Wilcox, Lamont boiler Wilcox, boiler, la-boiler, Benson boiler and Loffler boiler.

➤ **Method of firing**

- Internally fired boiler
Lancashire, Locomotive, and Scotch
- Externally fired boiler
Babcock and Wilcox

➤ **Pressure of steam**

- High pressure ($>80 \text{ kg/cm}^2$)
Babcock and Wilcox Lamont etc
- Low pressure ($<80 \text{ kg/cm}^2$)
Cochran, Cornish, Lancashire and Locomotive

➤ **According to the axis of shaft**

- Vertical tubular
- Horizontal tubular

➤ **Method of circulation of water**

- Natural circulation
- Forced circulation

➤ **Nature of service to be performed**

- Land boilers
- Portable boiler
- Mobile boilers

➤ **Heat source**

- Combustion of solid, liquid, or gas
- Electrical or nuclear energy
- Hot waste gases of other chemical reactions

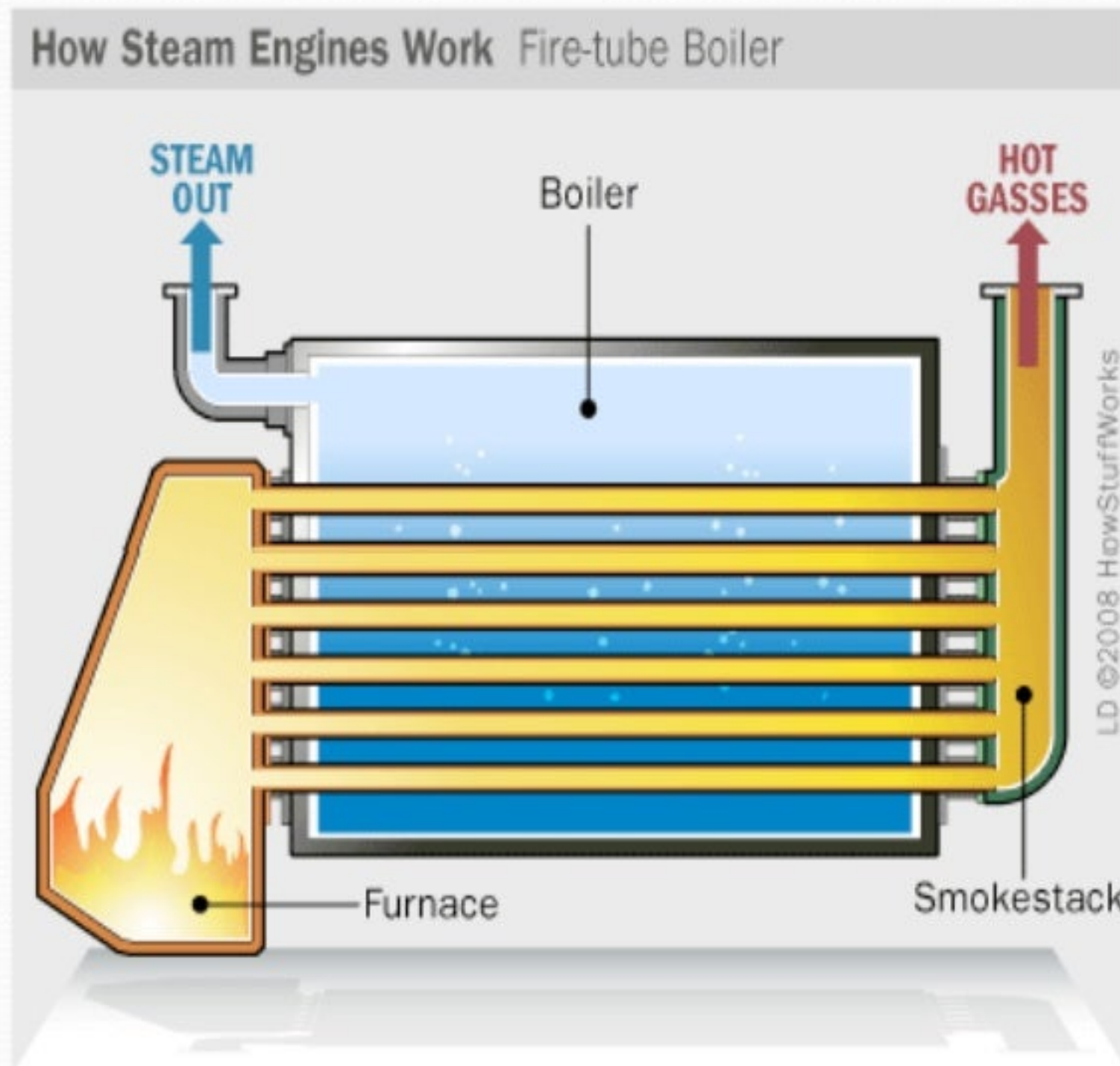
Fire Tube Boilers

A fire tube boiler is a type of boiler in which hot gases pass through one or more tubes running through a sealed container of water. The heat energy from the gases passes through the sides of the tubes by thermal conduction, heating the water and ultimately creating steam.

Types of Fire Tube Boiler

- Cochran boiler
- Lancashire boiler
- Scotch marine boiler
- Locomotive boiler etc

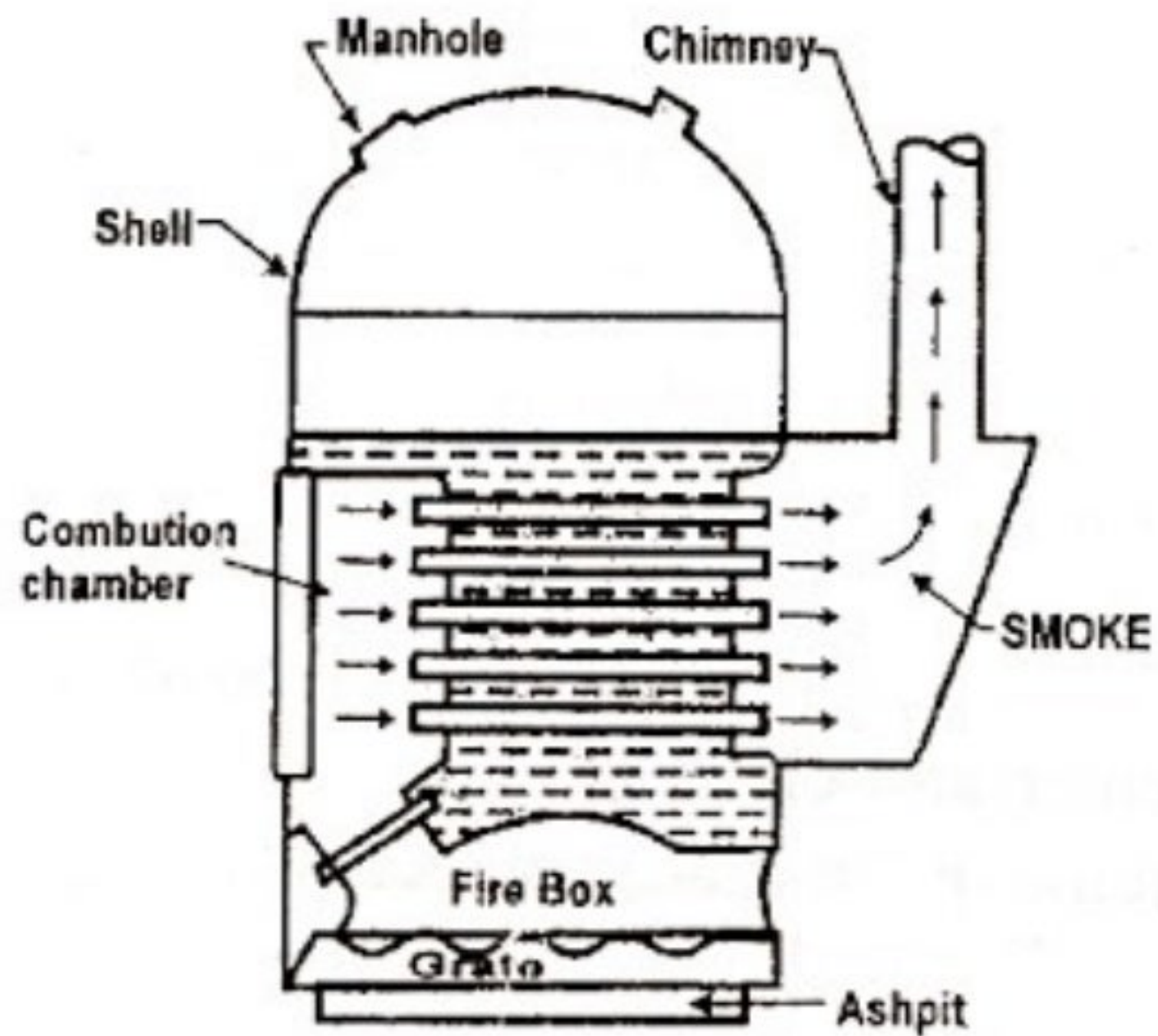
Fig.: Schematic Diagram of a Fire Tube Boiler



Fire Tube Boiler

Cochran Boiler

- Vertical
- Multi tubular
- Internally fired
- Natural circulation
- Favorable in small Plants
- Coal or oil burnt



Cochran Boiler (Elevation)

Water Tube Boiler

A water tube boiler is a type of boiler in which water circulates in tubes heated externally by the hot gases / flue gases. Water tube boilers are used for high-pressure boilers. Fuel is burned inside the furnace, creating hot gas which heats up water in the steam generating tubes.

Types of water tube boiler

- Babcock & Wilcox boiler,
- Sterling boiler etc.

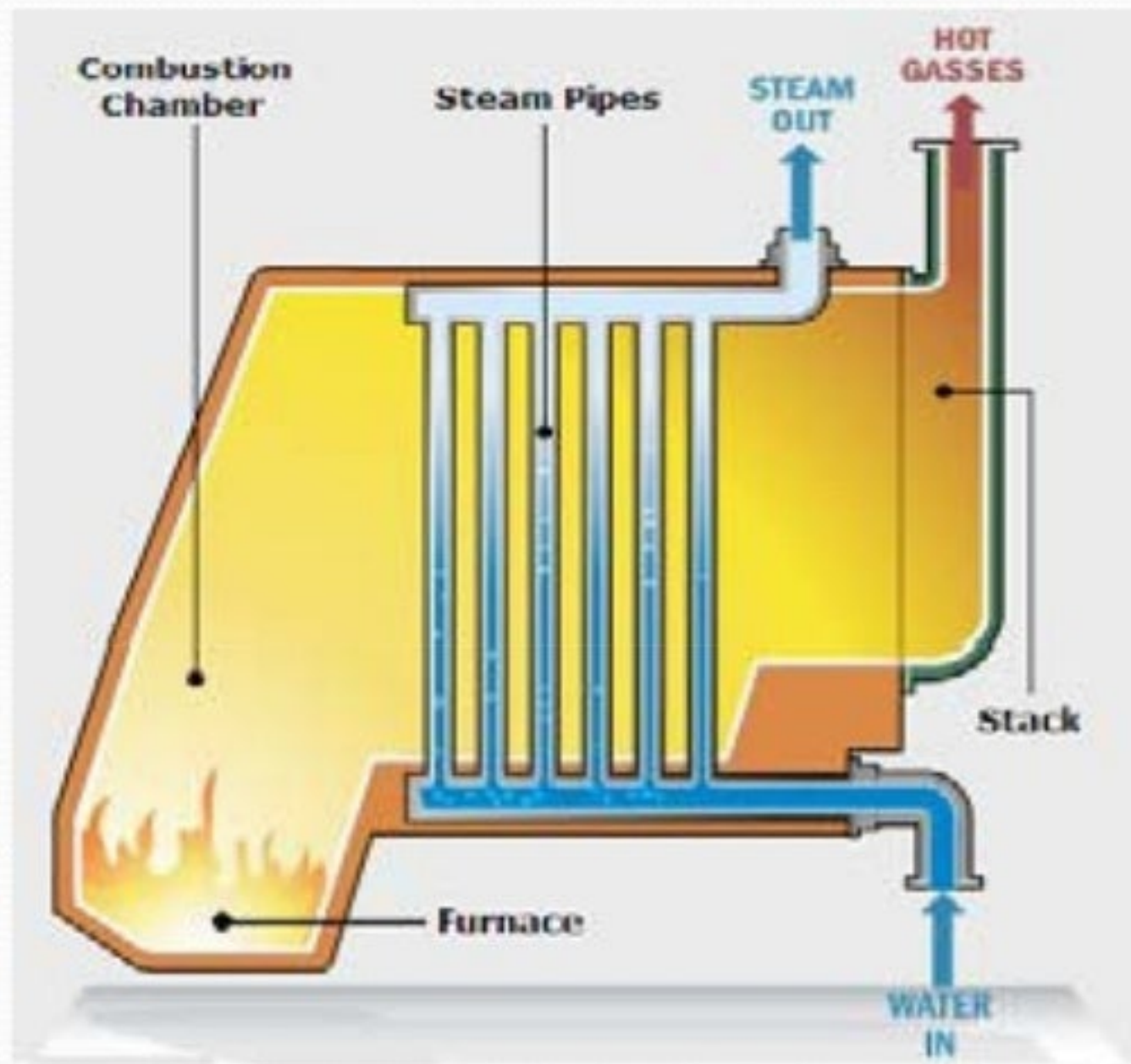
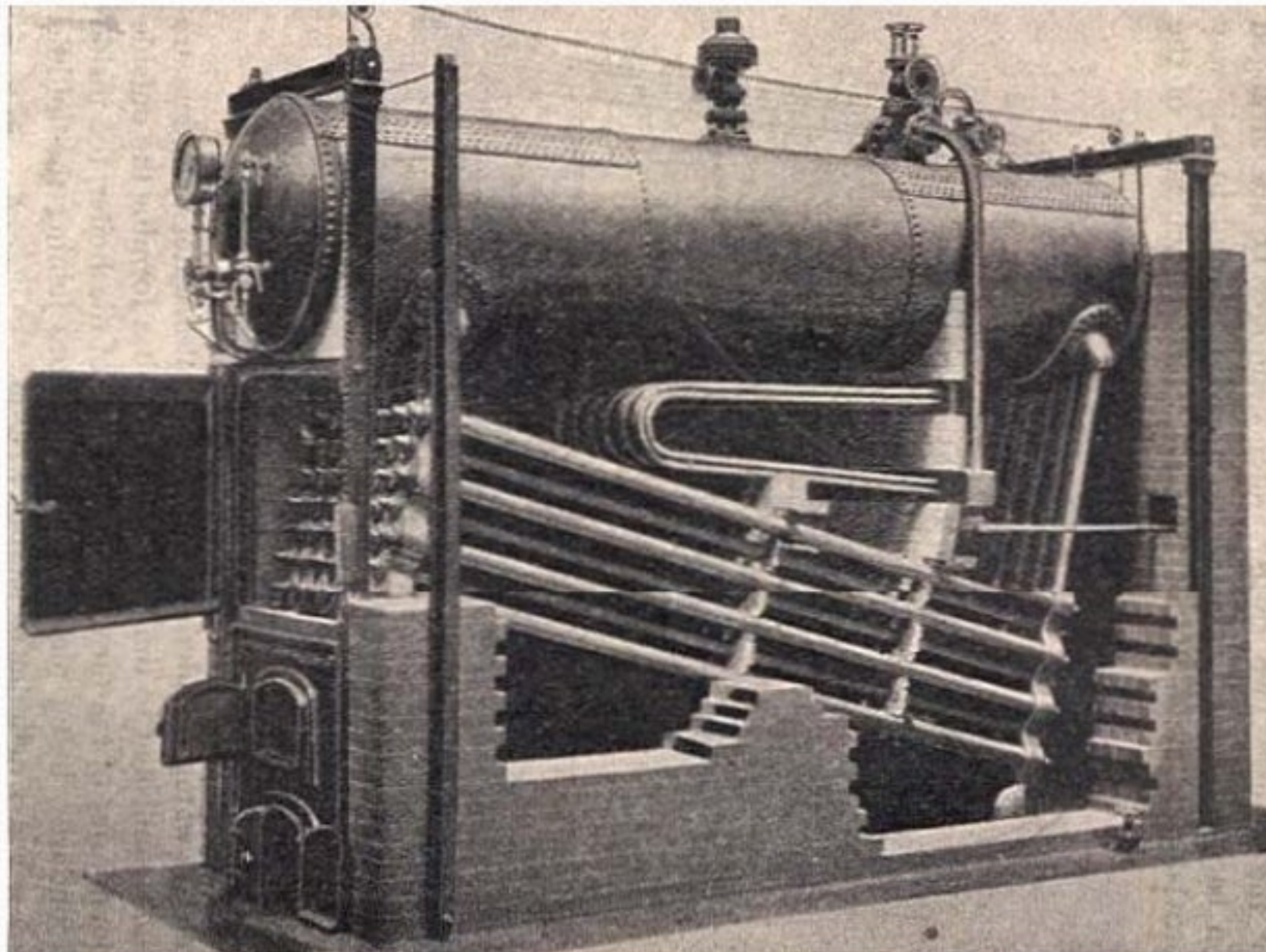


Fig.: Schematic Diagram
of a Water Tube Boiler

Water Tube Boiler

Babcock & Wilcox boiler



Comparison

Fire Tube Boiler	Water Tube Boiler
The hot gases from the furnace pass through the tubes which are surrounded by water in the shell	The water circulates inside the tubes which are surrounded by hot gases from the furnace
It cannot handle high pressure	It is a high pressure boiler
The rate of generation of steam is relatively low	The rate of generation of steam is high
Overall efficiency is up to 75%	Overall efficiency is up to 90%
It is not preferable for fluctuating loads for a longer time period	It is preferred for widely fluctuating loads
The operating cost is less	The operating cost is high
The bursting chances are less but bursting produces greater risk to the damage of the property	The bursting chances are higher but bursting doesn't produce any destruction to the whole boiler
It is generally used for supplying steam on a small scale and is not suitable for large power plants	It is used for large power plants

Boiler Mountings

Mountings are required for proper and safe functioning of the boiler which are generally mounted over the boiler shell.

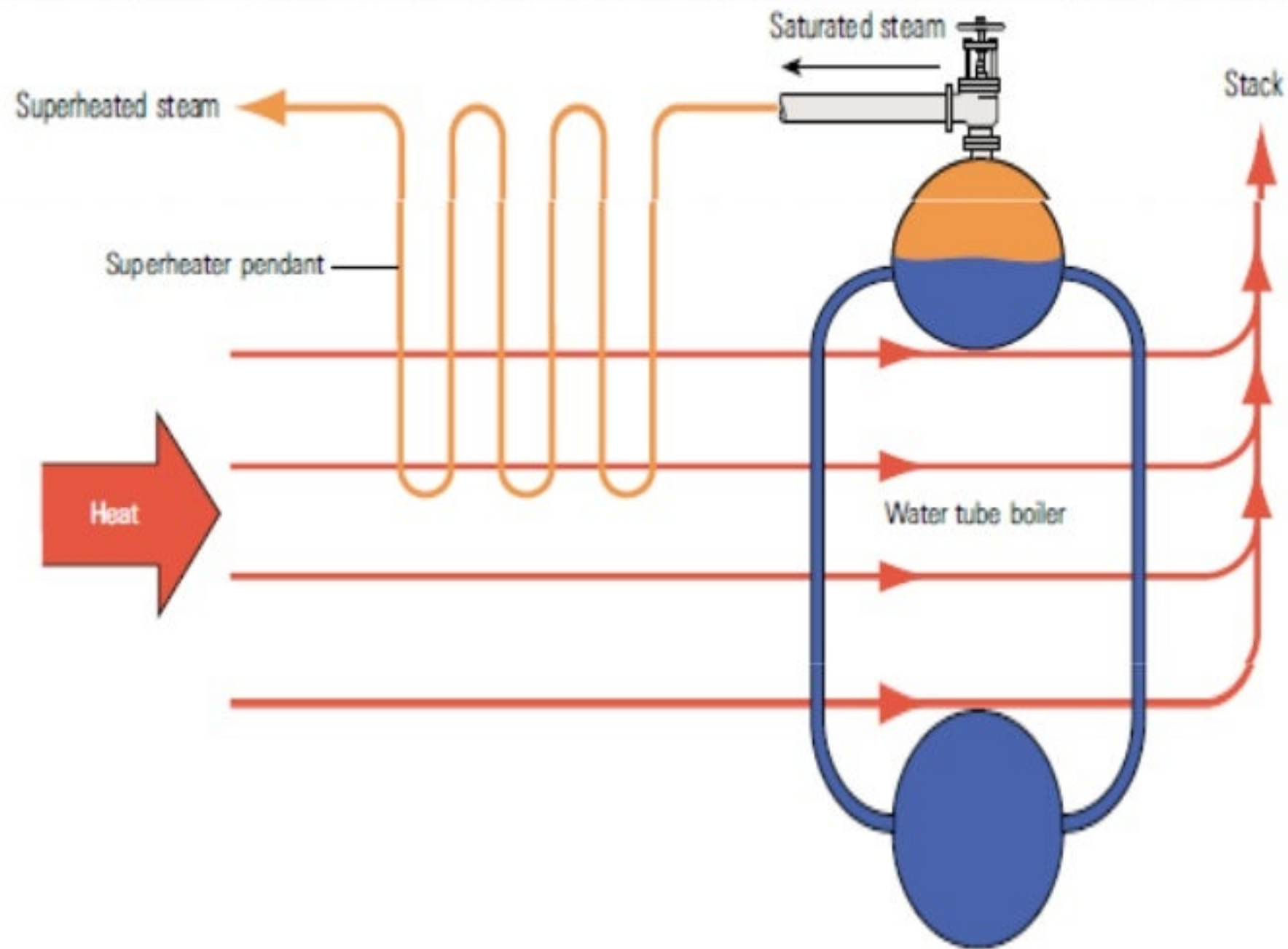
- Water Level Indicator
- Pressure gauge
- Safety valves
- Steam stop valve
- Blow off cock
- Fusible plug
- Feed Check valve

Boiler Accessories

Accessories are used for efficient running of the boiler

- Super heater
- Economizer
- Air preheated

Super heater



Economizer

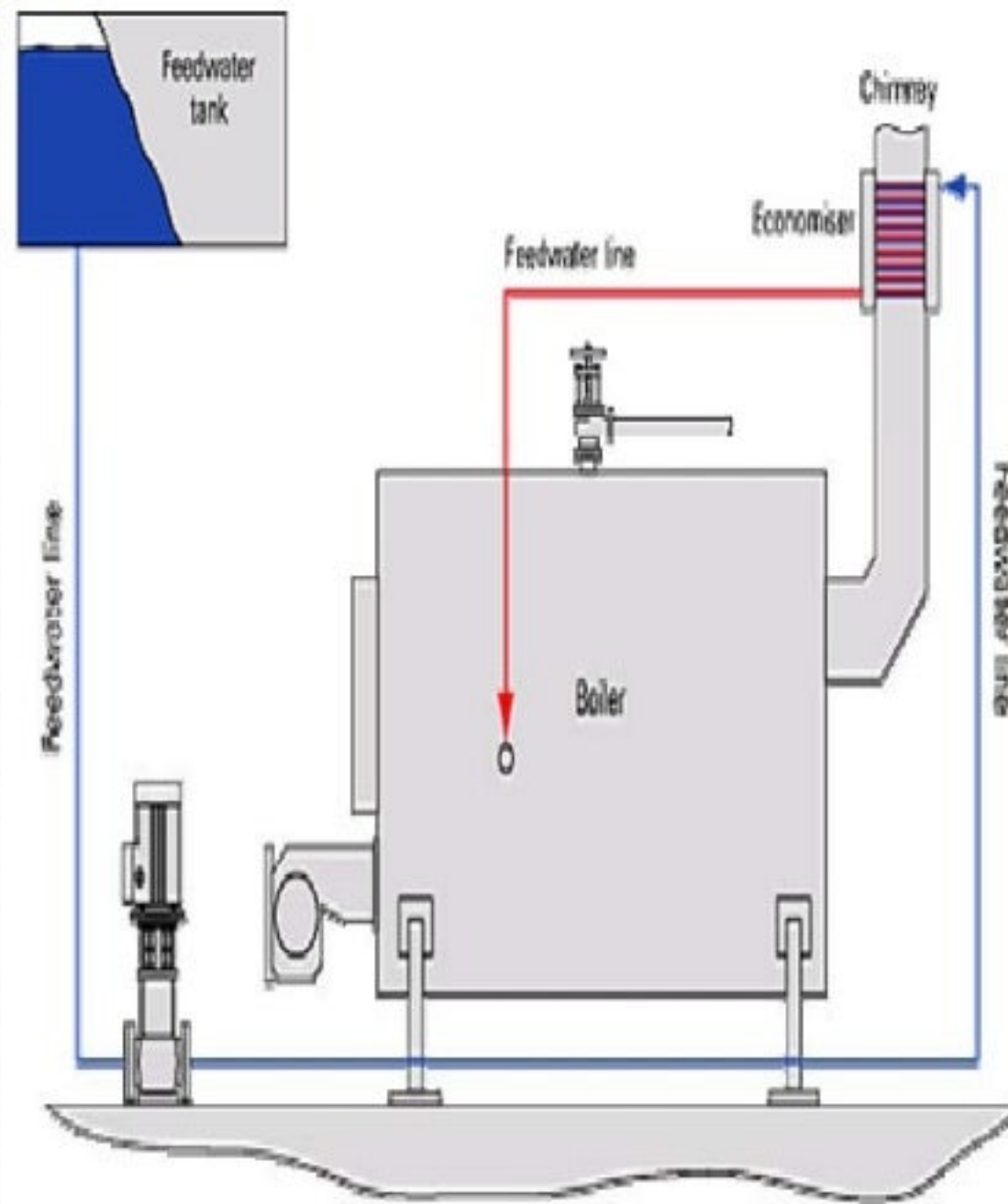


Fig.: An Economizer

Air Preheater

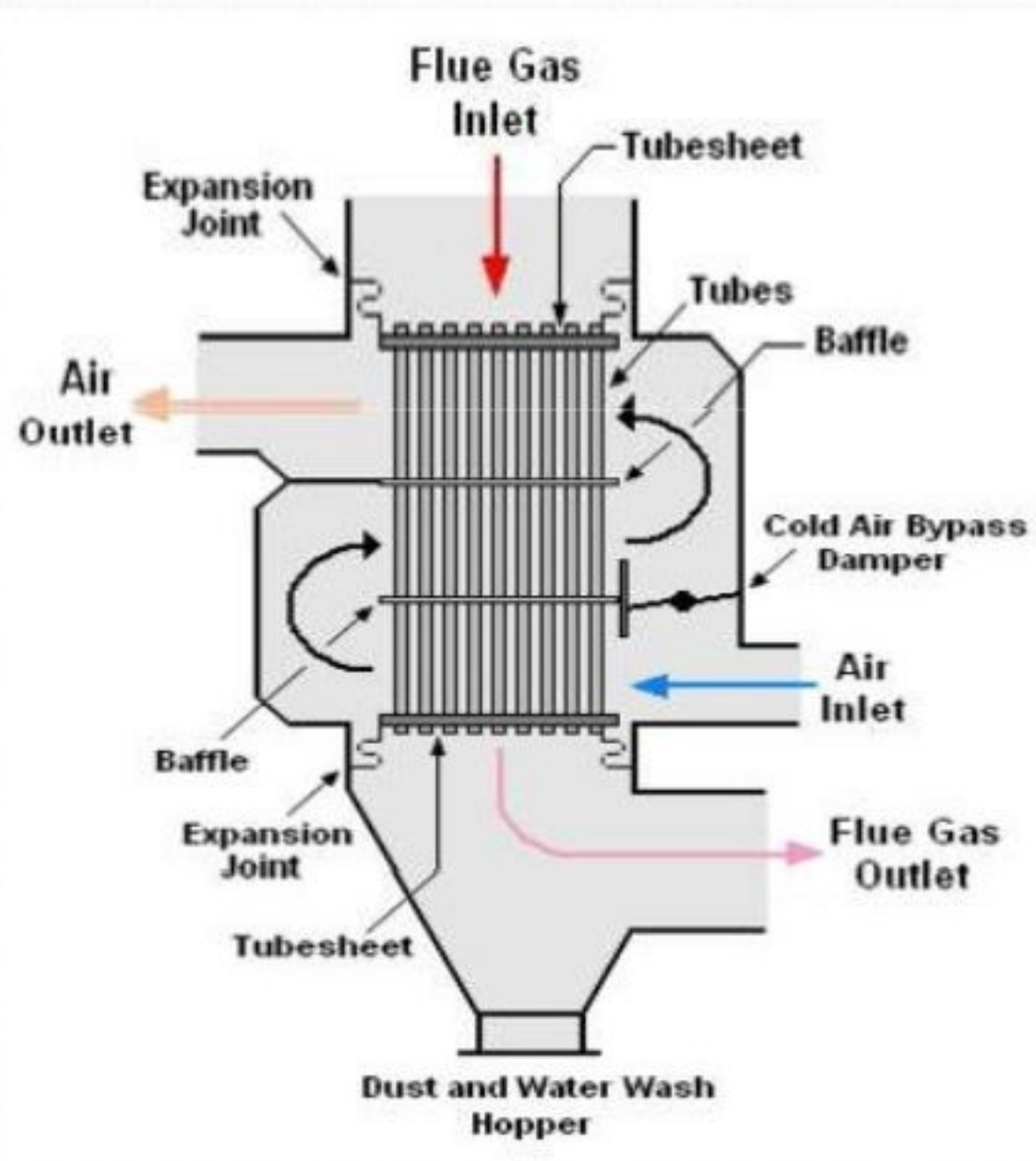


Fig.: Air Preheater

Boiler Capacity

- Evaporation or equivalent evaporation per hour may be taken as a measure of boiler capacity. It is generally measured in tons or kg per hour.

Boiler Efficiency

Efficiency of a boiler may be defined as the ratio of heat utilized for the generation of steam to heat supplied due to the burning of fuel.

Boiler efficiency,

$$\eta = \frac{\text{Energy utilize}}{\text{Energy supplied}} = \frac{m_s (h-h_o)}{m_f \cdot HV}$$

m_s be the mass of steam evaporated in a given time

m_f be the mass of fuel burnt at the same time

HV be the heating value of fuel per unit mass

h be the enthalpy per unit mass of steam

h_o be the enthalpy of feed water



Thank you....!