

# ME 170

## MODEL LAB

***Lecture 1***  
***Study of Boilers and Steam Turbine***

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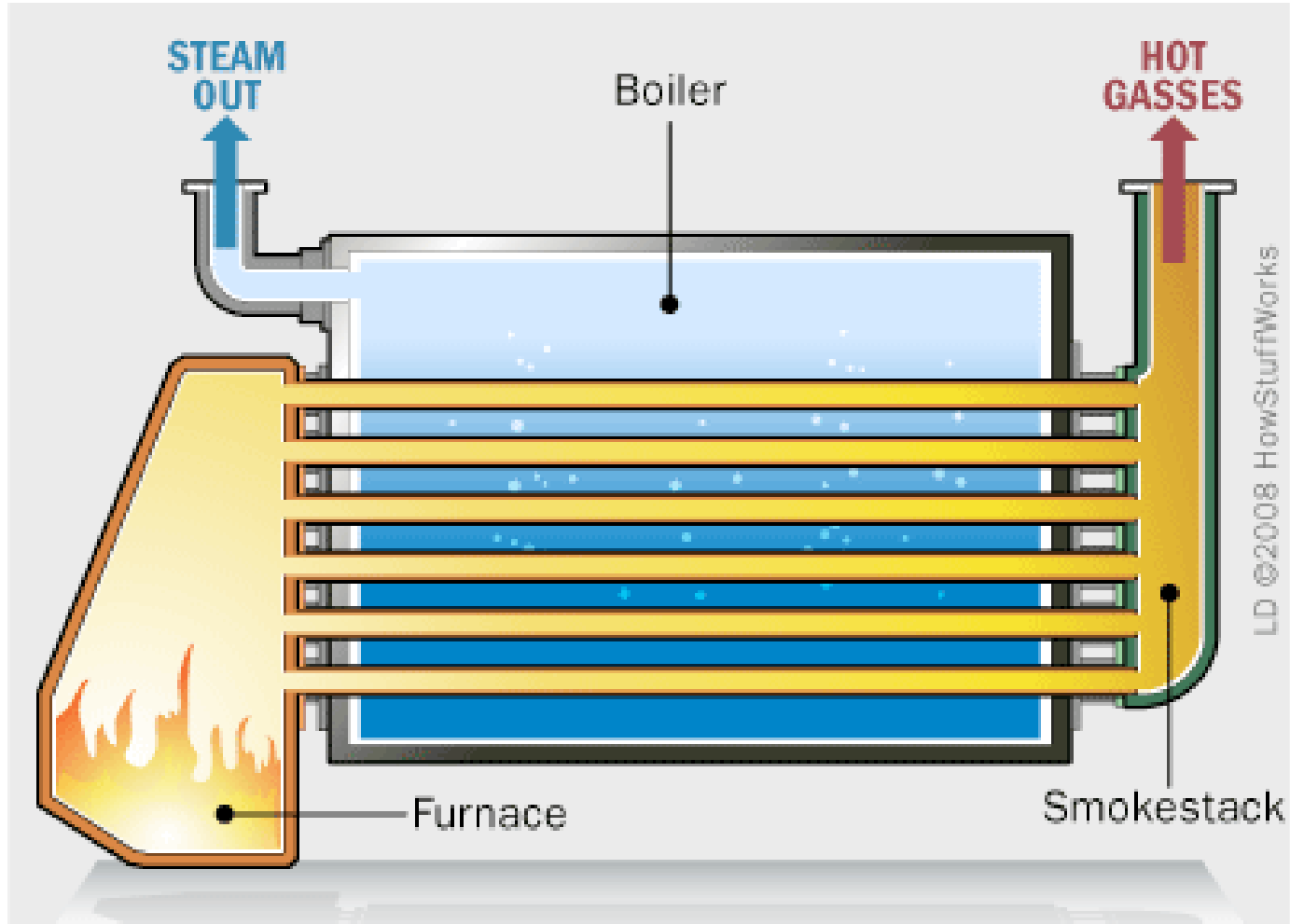
**BUET, Dhaka-1000**

**<http://teacher.buet.ac.bd/aashiquear>**

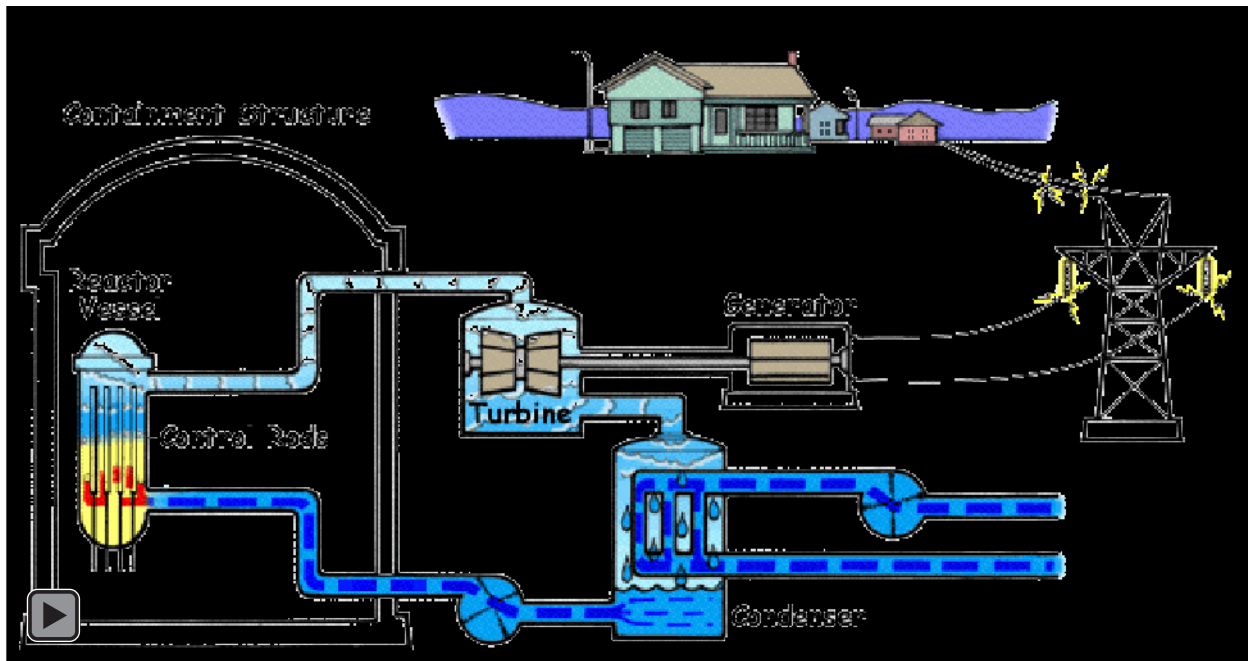
## STEAM GENERATOR: BOILER



# STEAM GENERATOR: BOILER

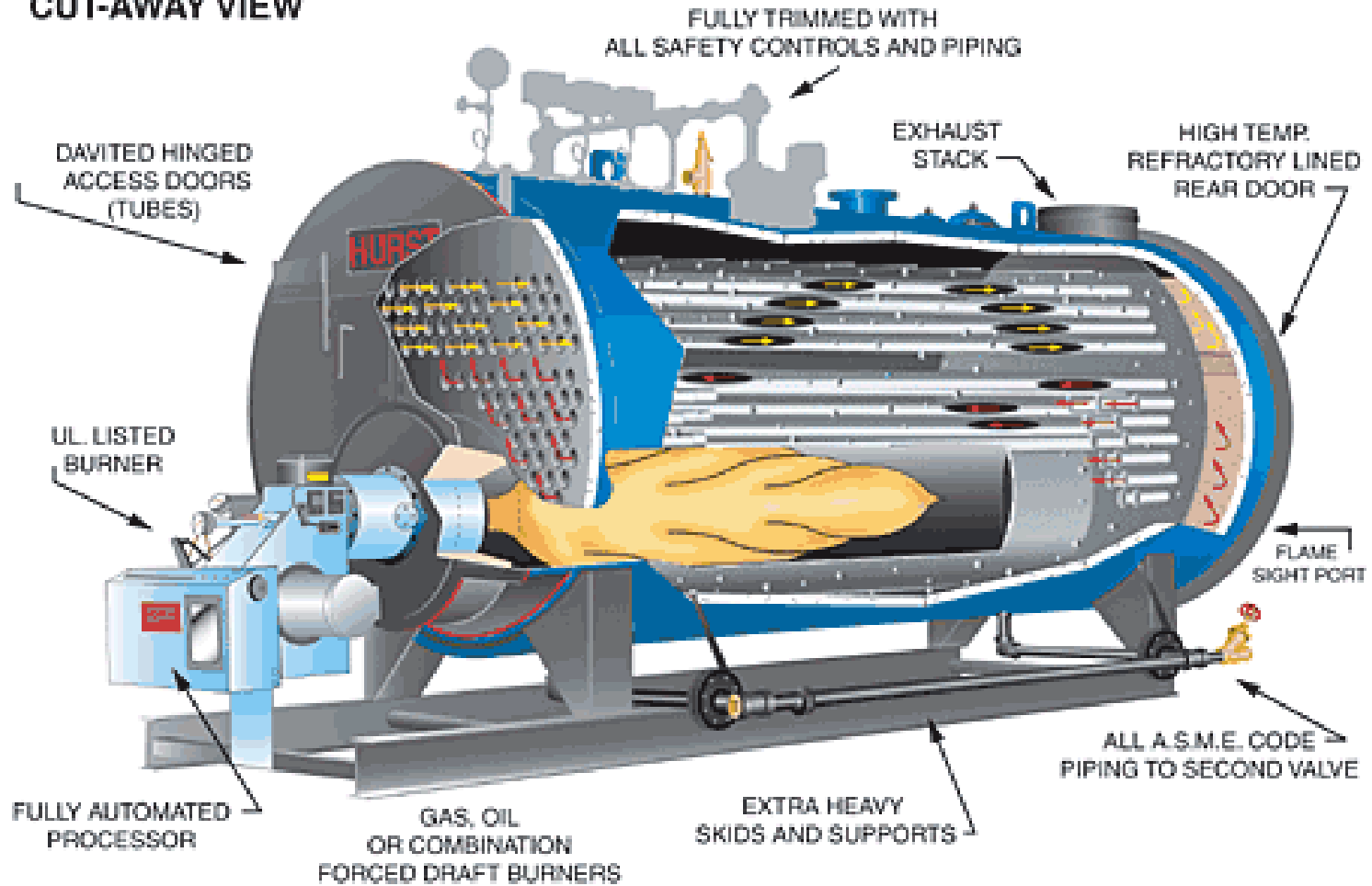


# STEAM GENERATOR: BOILER SCHEMATIC OF NUCLEAR POWER PLANT



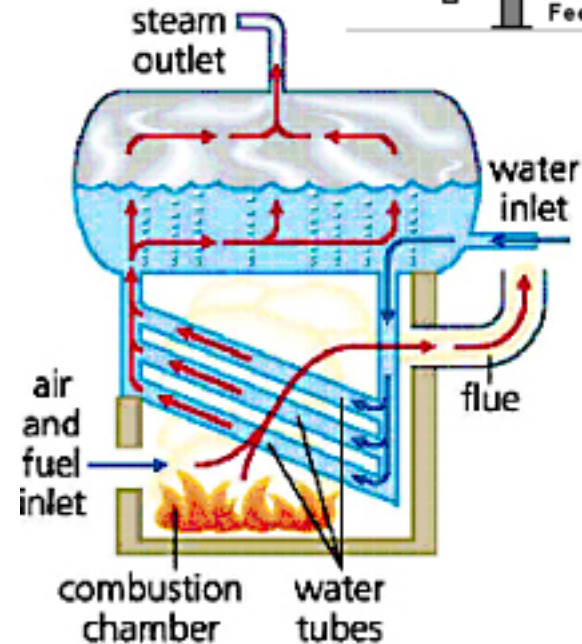
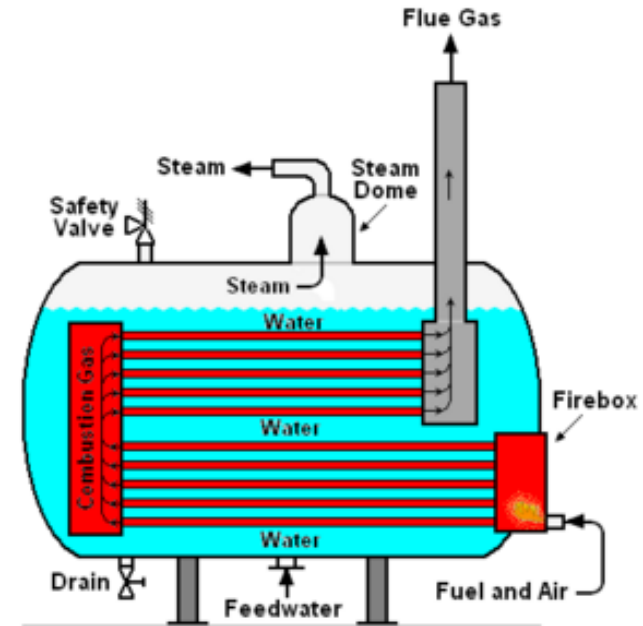
## MODERN PACKAGE BOILER

### CUT-AWAY VIEW



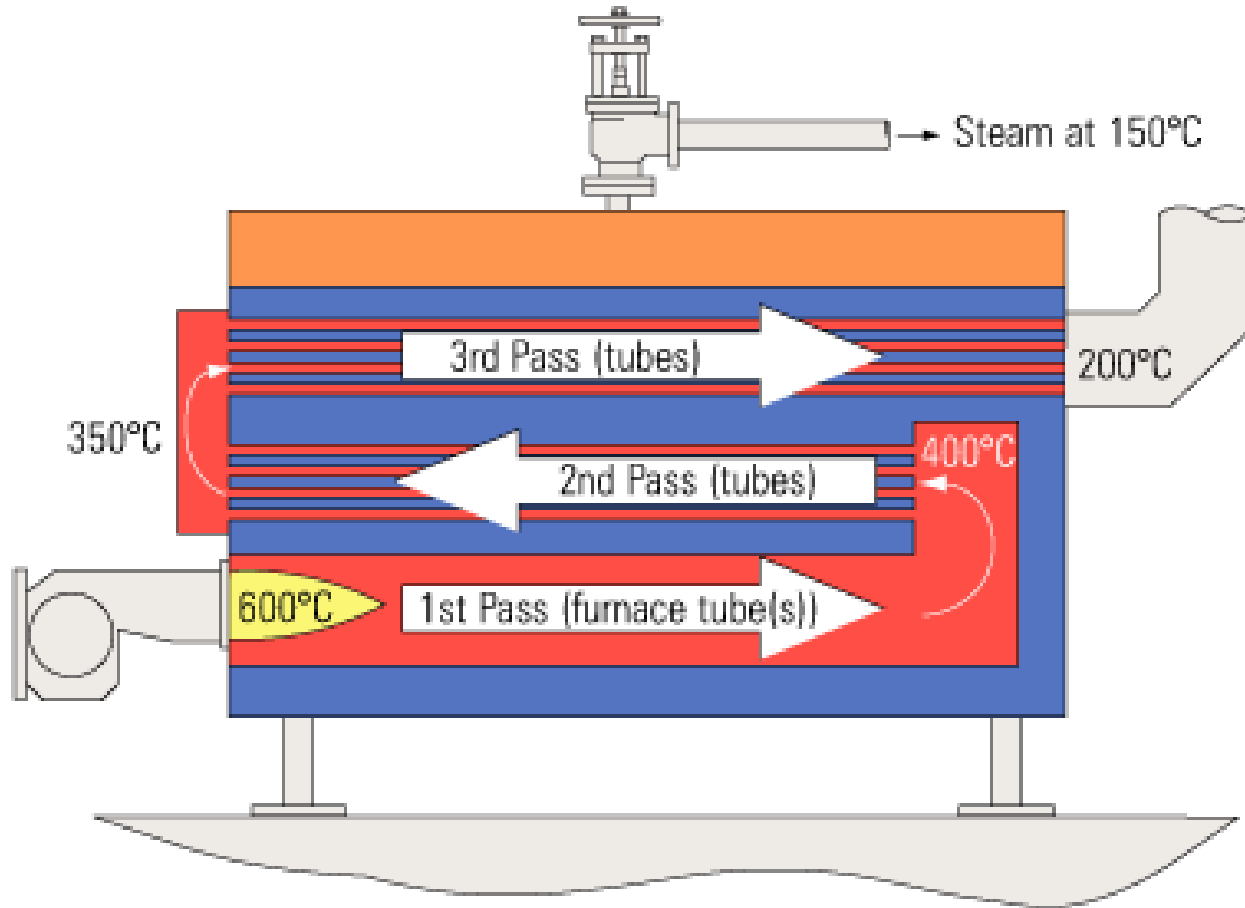
## CLASSIFICATION OF BOILER:

1. Based on containing material in tube
  - a. Fire tube boiler
  - b. Water tube boiler
2. Based on working pressure
  - a. High pressure boiler
  - b. Low pressure boiler
3. Based on installation
  - a. Stationary boiler
  - b. Mobile boiler
4. .Based on axis of boiler
  - a. Horizontal axis boiler
  - b. Vertical axis boiler



# MODERN PACKAGE BOILER

## THREE PASS BOILER



## Boiler Mountings

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

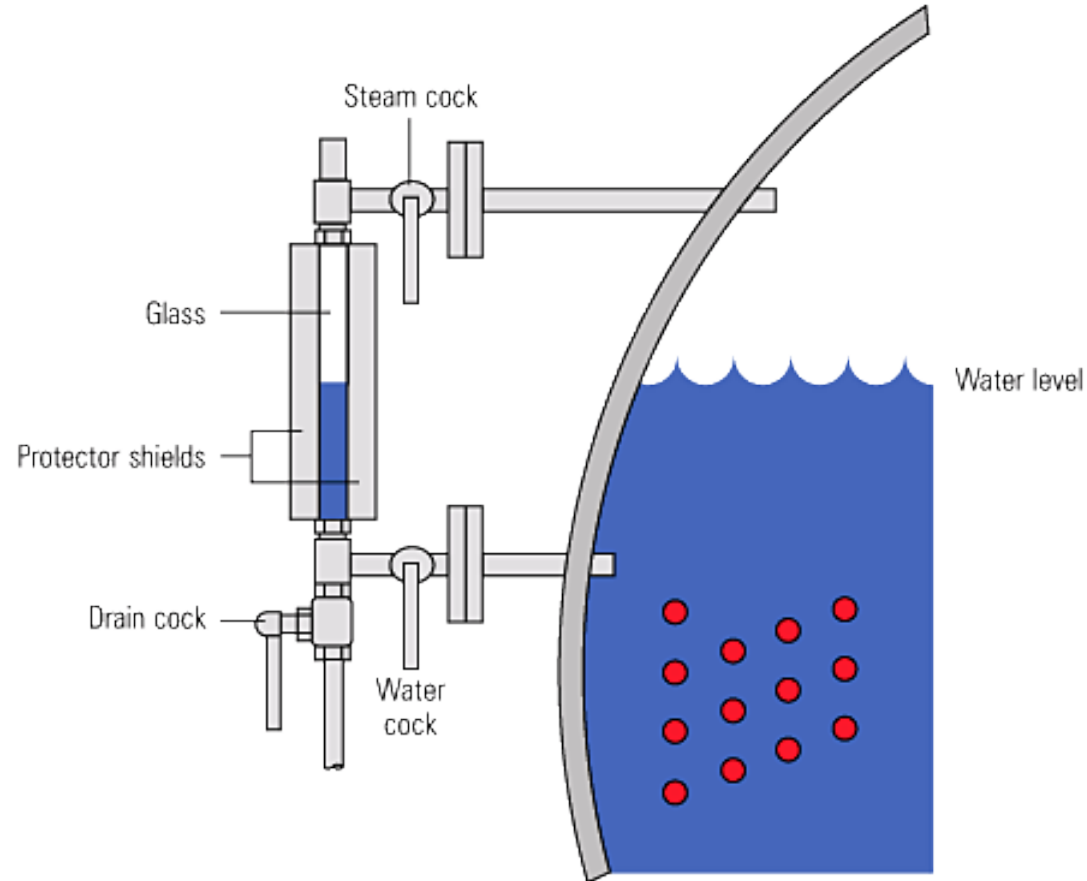
- Water Level Indicator
- Pressure gauge
- Safety valves
- Steam stop valve
- Blow off cock
- Fusible plug
- Feed Check valve



## Boiler Mountings

### Water Level Indicator

- The water level indicator is needed to ascertain the water level of a boiler.
- Two water level indicators should be fitted for each boiler in such a place that the water level can be constantly seen.



## Pressure Gage

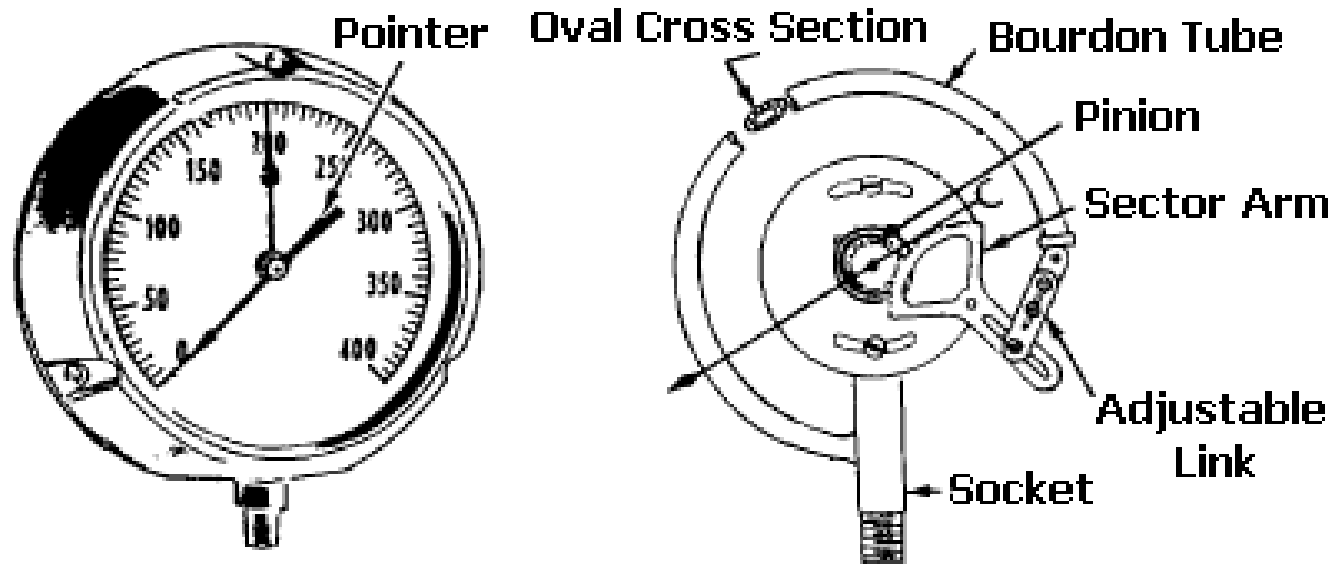


Fig.: A Bourdon Tube Pressure Gage

- A pressure gauge is an instrument by means of which the pressure exerted inside a vessel can be measured.
- There are two types of pressure gauges, one is *Bourdon tube pressure gauge* and the other is *diaphragm type gauge*.

## Safety Valve

- The safety valve (pressure relief valve) is used in a boiler to relieve the pressure of steam when it is above the working pressure.
- Its function is to discharge a portion of the steam from the boiler automatically when the steam pressure exceeds the normal limit. It is mounted on the top of the shell.
- As per boiler regulation two safety valves are required to be fitted in each boiler.

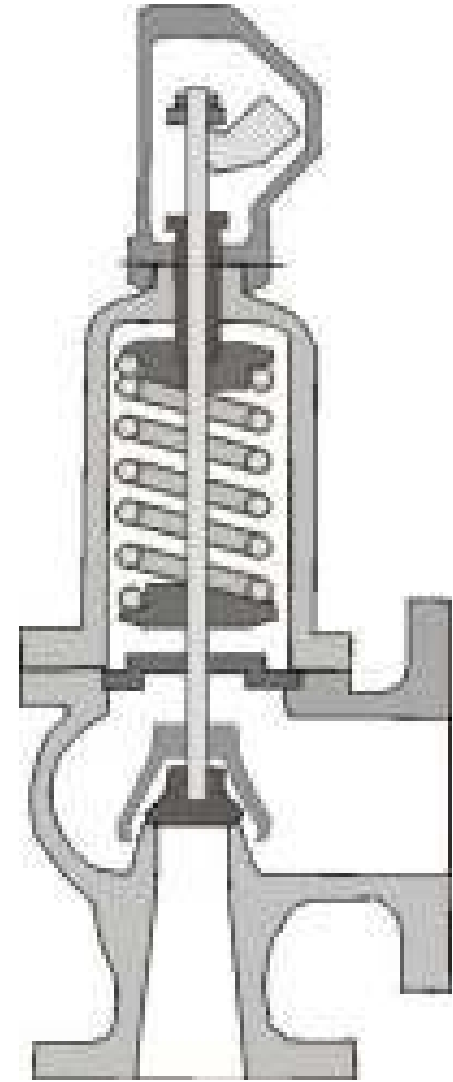
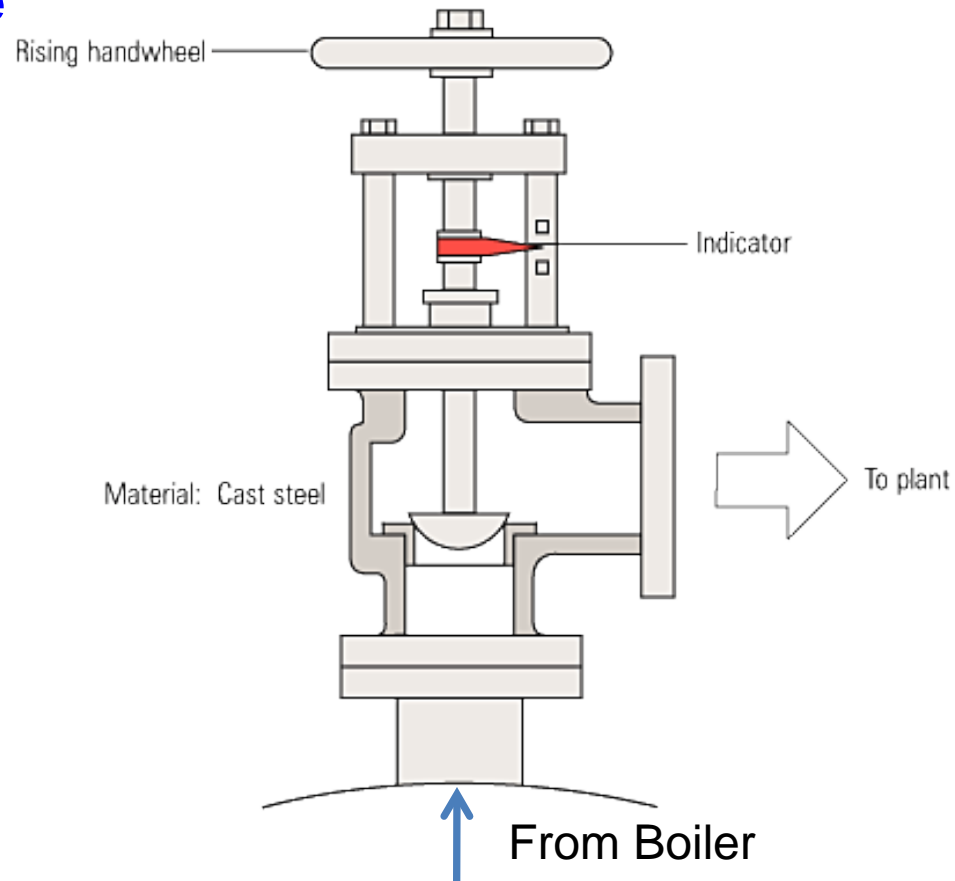


Fig.: A Spring Loaded Safety Valve

## Steam Stop Valve



- The function of the stop valve or junction valve is to regulate the flow of steam from the boiler to the main steam pipe.
- To shut off the steam completely when required.

## Fusible Plug

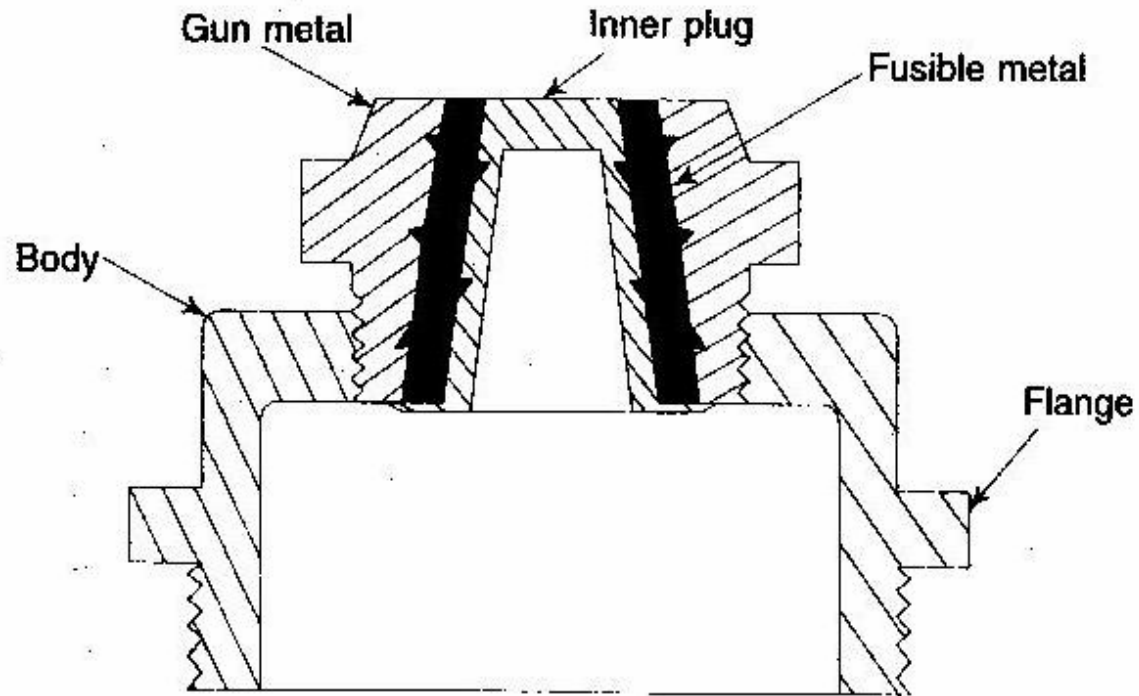


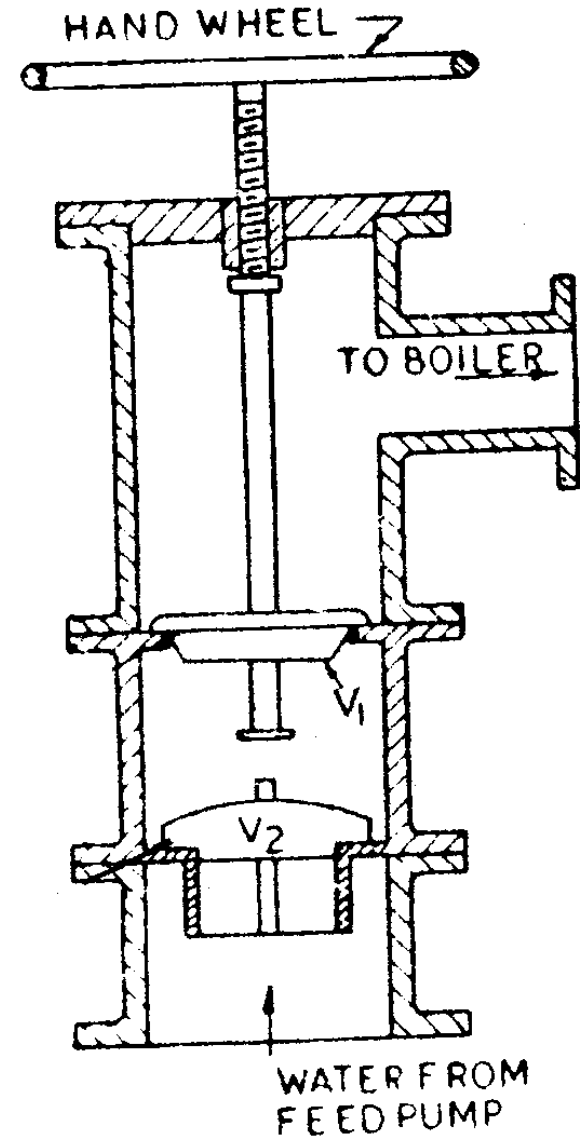
Fig.: A Fusible Plug

The function is to extinguish the fire in the event of water level in the boiler shell falling below a certain specified limit

## Feed check valve

The feed check valve is used to control the supply of water to the boiler and to prevent the escaping of water from the boiler when the pump pressure is less or the pump is stopped.

It is fitted over the shell slightly below the normal water level of the boiler.

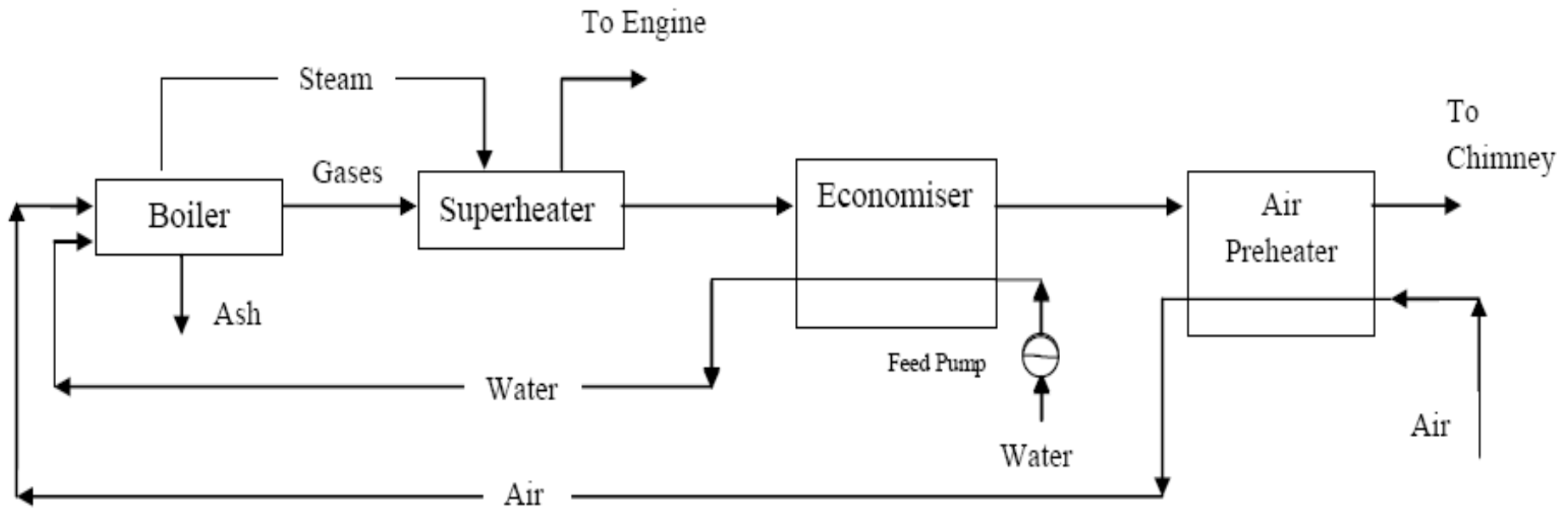


## Boiler Accessories

Accessories are used for efficient running of the boiler

- Superheater
- Economiser
- Air preheater
- Reheater

## Schematic of a Boiler Plant



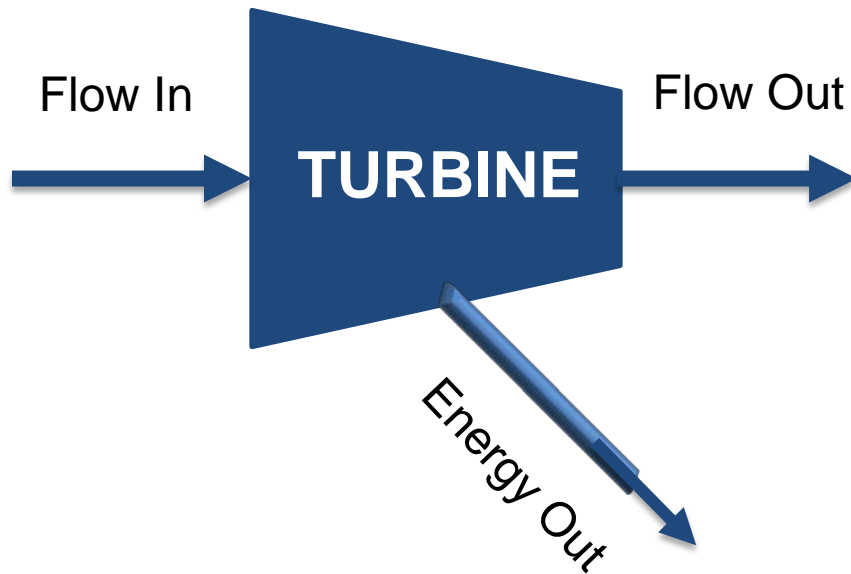




## Boiler Specification

|                          |                                       |
|--------------------------|---------------------------------------|
| BRAND NAME               | Philipp Loos GmbH                     |
| Model                    | 12 D-57629 Norken                     |
| Country of Made          | Germany                               |
| Capacity                 | 1600 kg/hr                            |
| Maximum working pressure | 16 bar                                |
| Type of Burner           | Dual Fuel Burner (Natural Gas/Diesel) |
| Fuel used                | Natural Gas                           |

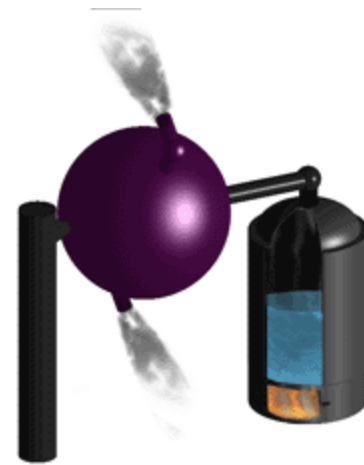
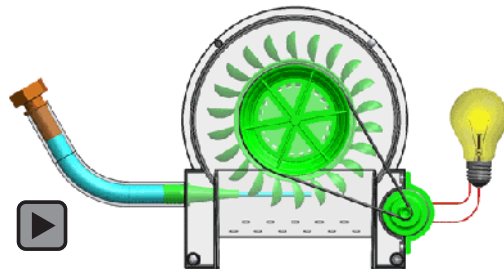
## STEAM TURBINE



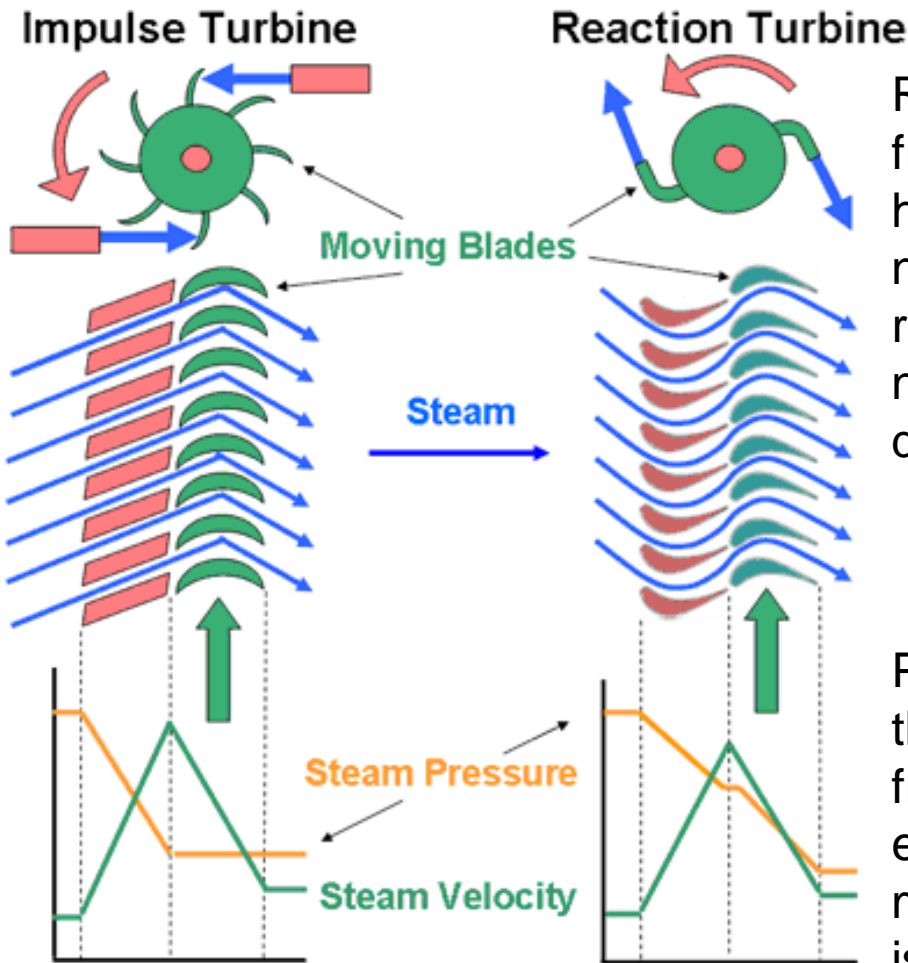
A steam turbine is a device that extracts *thermal energy* from pressurized steam and uses it to do mechanical work on a rotating output shaft.

## CLASSIFICATION

- Turbines are mainly of two types:
  - Impulse Turbine
  - Reaction Turbine
- Most steam turbines use a mixture of the reaction and impulse designs. Typically, higher pressure sections are impulse type and lower pressure stages are reaction type.



# Steam Generator & Steam Turbine



Impulse Steam Turbine stage consists as usual from stator which known as the nozzle and rotor or moving blades

Impulse Turbine are characterized by the that most or all enthalpy and hence pressure drop occurs in the nozzle

Reaction effect results from issuing a fluid at very high velocity from a nozzle. This results in a reaction which moves the nozzle in opposite direction.

$$F = mV$$

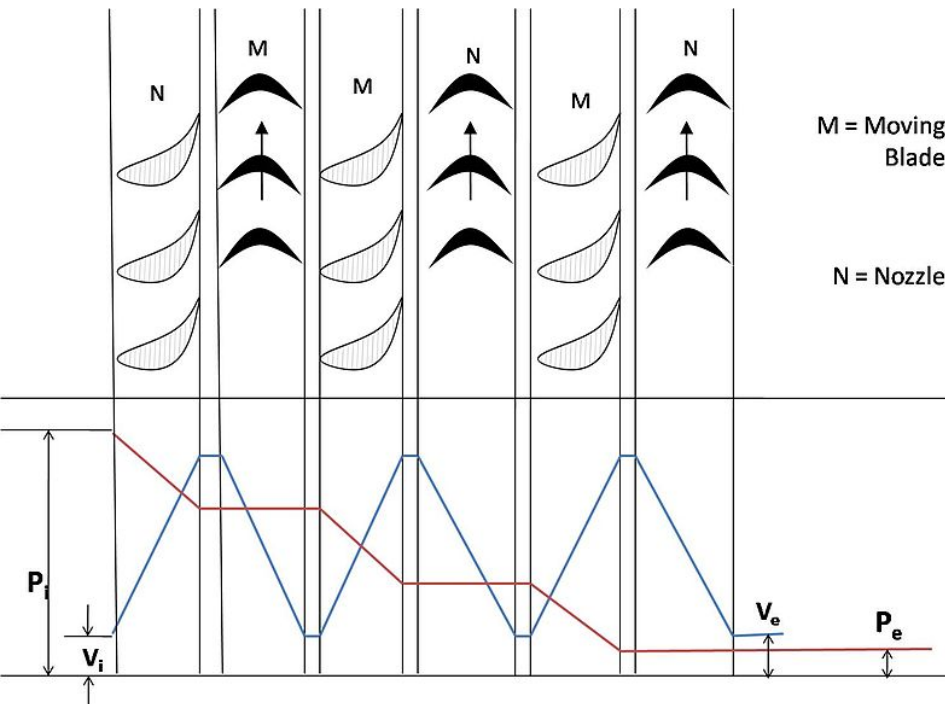
Pure reaction happens if the flow is accelerated from zero velocity to its exist velocity in the moving blades Since this is not the case in turbines, thus there are no pure reaction turbine but a mix between impulse and reaction.

## COMPOUNDING OF IMPULSE TURBINE

- This is done to reduce the rotational speed of the impulse turbine to practical limits. (A rotor speed of 30,000 rpm is possible, which is pretty high for practical uses.)
- Compounding is achieved by using more than one set of nozzles, blades, rotors, in a series, keyed to a common shaft; so that either the steam pressure or the jet velocity is absorbed by the turbine in stages.
- Three main types of compounded impulse turbines are:
  - Pressure compounded
  - velocity compounded and
  - pressure and velocity compounded impulse turbines.

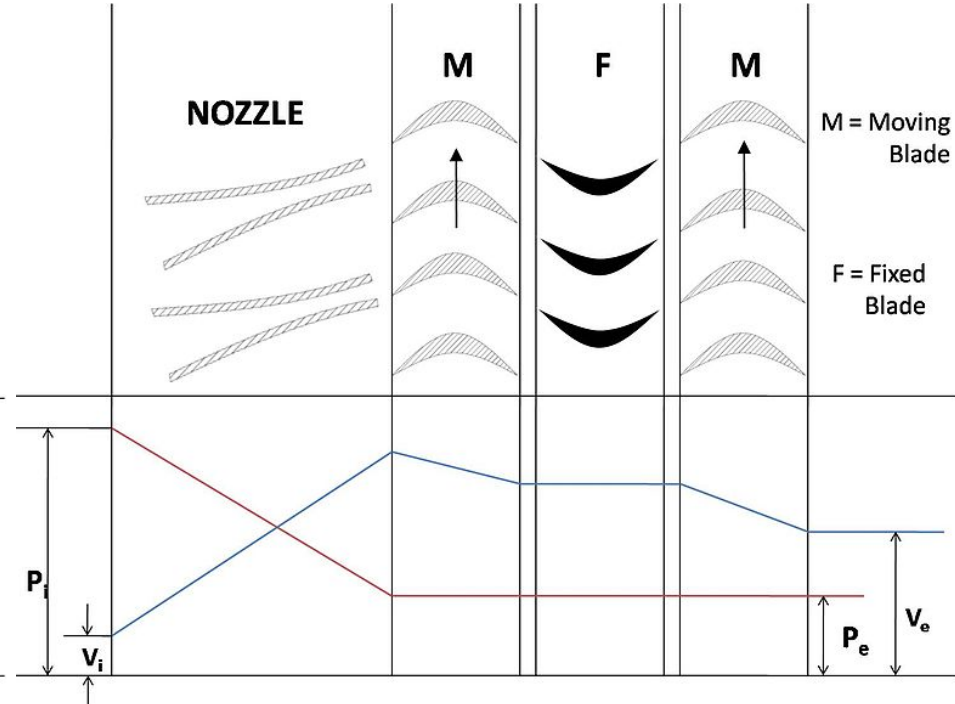
## Pressure Compounded Impulse Turbine

This involves splitting up of the whole pressure drop from the steam chest pressure to the condenser pressure into a series of smaller pressure drops across several stages of impulse turbine.

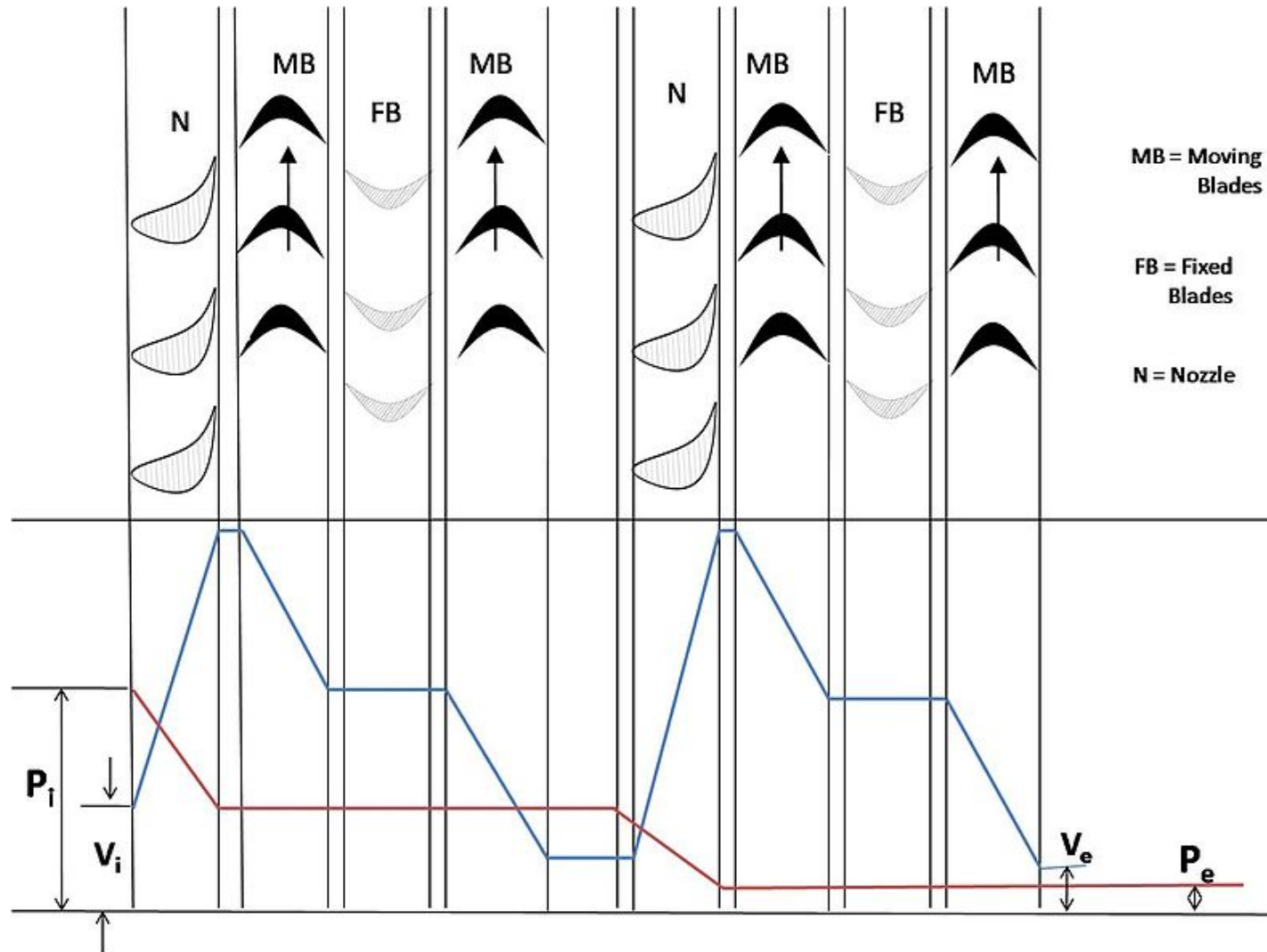


## Velocity Compounded Impulse Turbine

Velocity drop is arranged in many small drops through many moving rows of blades instead of a single row of moving blades.



# Pressure-Velocity Compounded Impulse Turbine



That's All for Today