Daffodil international University

Department of Electrical & Electronic Engineering

Course Code: EEE 450

Course Title: Power Plant Engineering Lab

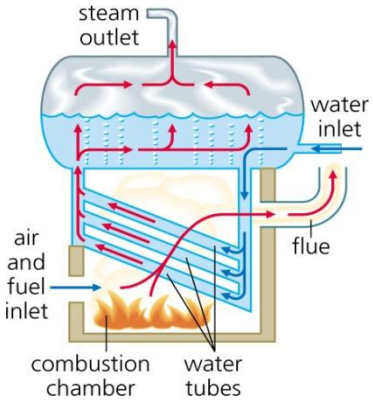
Experiment 01

Familiarization of various Steam Power Plant equipments

Objective:

To be familiar with the various apparatus or equipments of steam/thermal power plant.

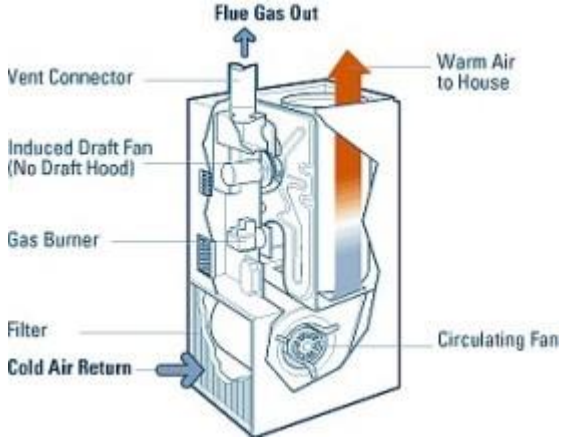
1. **Boiler:** A boiler is closed vessel in which water is converted into steam by utilizing the heat of coal combustion. Steam boilers are broadly classified into the following two types :
   Water tube boilers: water flows through the tubes and the hot gases of combustion flow over these tubes.
   Fire tube boilers: in a fire tube boiler, the hot products of combustion pass through the tubes surrounded by water.



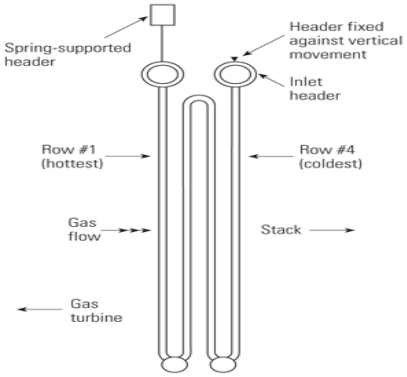
2. **Boiler Furnace:** A boiler furnace is a chamber in which fuel is burnt to liberate the heat energy. In addition, it provides support and enclosure for the combustion equipment *i.e., burners.* The boiler furnace walls are made of refractory materials such as fire clay, silica, kaolin etc. These materials have the property to resist change of shape, weight or physical properties at high temperatures. There are following three types of construction of furnace walls :
   (*a) Plain refractory walls:* suitable for small plants where the furnace temperature may not be high.
   (*b) Hollow refractory walls with an arrangement for air cooling:* In large plants, the furnace temperature is quite high and consequently, the refractory material may get

damaged. In such cases, refractory walls are made hollow and air is circulated through hollow space to keep the temperature of the furnace walls low.

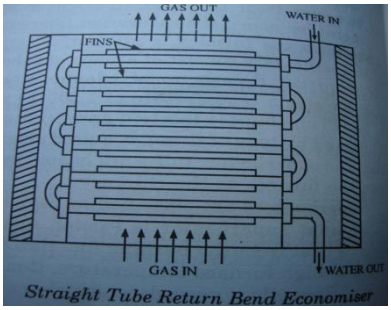
(*c) Water walls:* These consist of plain tubes arranged side by side and on the inner face of the refractory walls. The tubes are connected to the upper and lower headers of the boiler. The boiler water is made to circulate through these tubes. The water walls absorb the radiant heat in the furnace which would otherwise heat up the furnace walls.



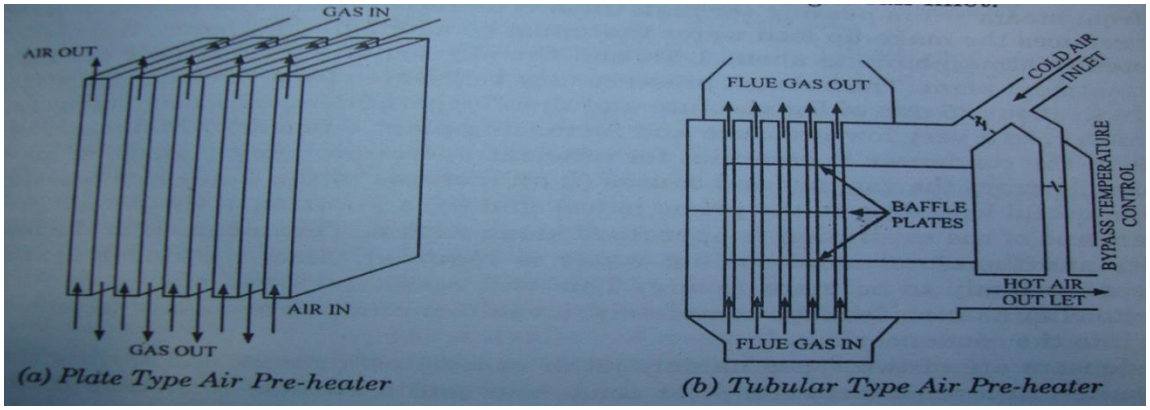
3. **Superheater:** A superheater is a device which superheats the steam *i.e., it raises the temperature* of steam above boiling point of water. This increases the overall efficiency of the plant. A superheater consists of a group of tubes made of special alloy steels such as chromium-molybdenum. These tubes are heated by the heat of flue gases during their journey from the furnace to the chimney. The steam produced in the boiler is led through the superheater where it is superheated by the heat of flue gases.



4. **Economizer:** It is a device which heats the feed water on its way to boiler by deriving heat from the flue gases. This results in raising boiler efficiency, saving in fuel and reduced stresses in the boiler due to higher temperature of feed water. An economizer consists of a large number of closely spaced parallel steel tubes connected by headers of drums. The feed water flows through these tubes and the flue gases flow outside. A part of the heat of flue gases is transferred to feed water, thus raising the temperature of the latter.



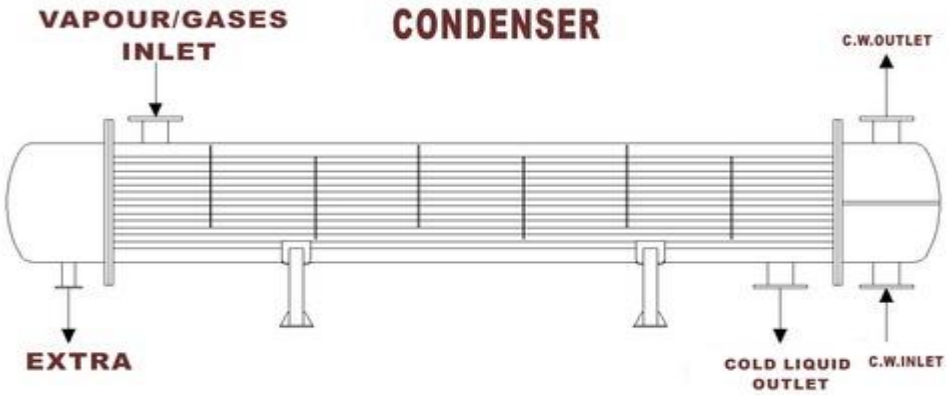
5. **Air Pre-heater:** An air pre-heater increases the temperature of the air supplied for coal burning by deriving heat from flue gases. Air is drawn from the atmosphere by a forced draught fan and is passed through air pre-heater before supplying to the boiler furnace. The air pre-heater extracts heat from flue gases and increases the temperature of air used for coal combustion.



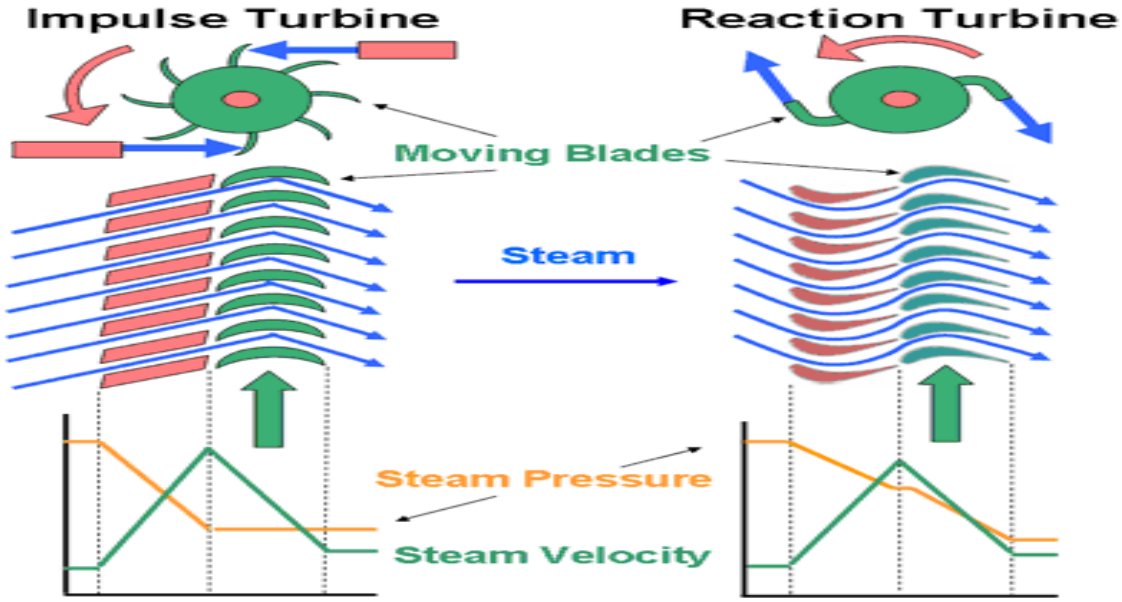
6. **Condenser:** A condenser is a device which condenses the steam at the exhaust of turbine. It serves two important functions.

   Firstly, it creates a very low pressure at the exhaust of turbine, thus permitting expansion of the steam in the prime mover to a very low pressure. This helps in converting heat energy of steam into mechanical energy in the prime mover.

   Secondly, the condensed steam can be used as feed water to the boiler.



7. **Impulse turbines:** the steam expands completely in the stationary nozzles (or fixed blades), the pressure over the moving blades remaining constant. In doing so, the steam attains a high velocity and impinges against the moving blades. This results in the impulsive force on the moving blades which sets the rotor rotating
8. **Reactions turbines:** the steam is partially expanded in the stationary nozzles; the remaining expansion takes place during its flow over the moving blades. The result is that the momentum of the steam causes a reaction force on the moving blades which sets the rotor in motion.



Result/ Observations: