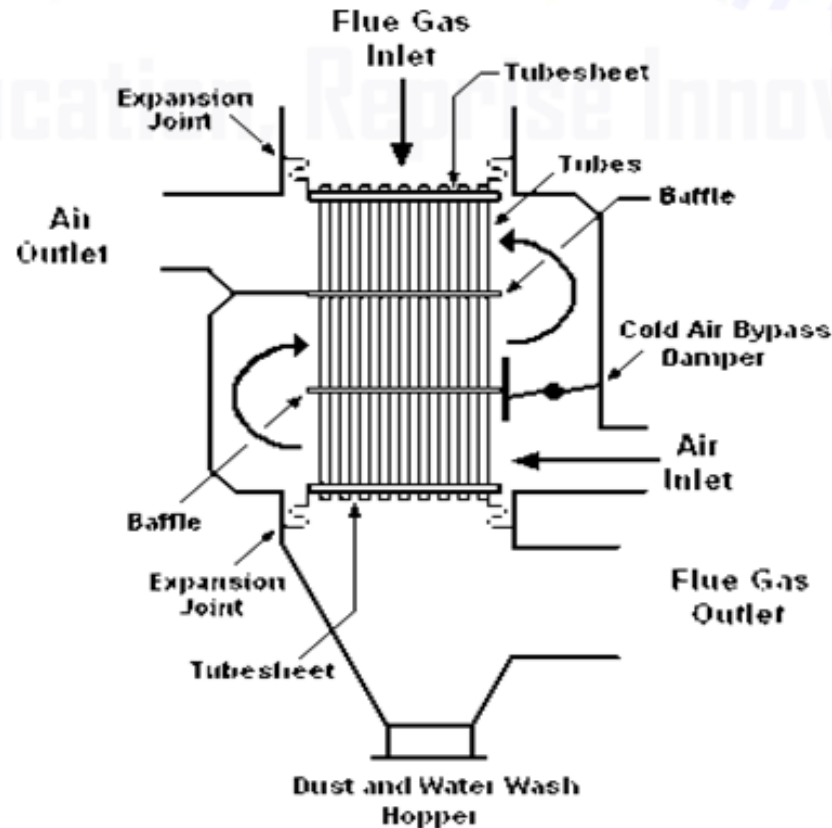


Ambient air is forced by a fan through ducting at one end of the pre heater tubes and at other end the heated air from inside of the tubes emerges into another set of ducting, which carries it to the boiler furnace for combustion.



Regenerative air pre- heaters

There are two types of regenerative air pre-heaters:

- The rotating-plate regenerative air pre-heaters (RAPH) and
- The stationary-plate regenerative air pre-heaters.

Rotating-plate regenerative air pre- heater

The rotating-plate design (RAPH) consists of a central rotating-plate element installed within a casing that is divided into two (bi-sector type), three (tri-sector type) or four (quad-sector type) sectors containing seals around the element. The seals allow the element to rotate through all the sectors, but keep gas leakage between sectors to a minimum while providing separate gas air and flue gas paths through each sector.

Stationary-plate regenerative air pre heater:

The heating plate elements in this type of regenerative air pre heater are also installed in a casing, but the heating plate elements are stationary rather than rotating. Instead the air ducts in the pre heater are rotated so as to alternatively expose sections of the heating plate elements to the up flowing cool air.

As indicated in the adjacent drawing, there are rotating inlet air ducts at the bottom of the stationary plates similar to the rotating outlet air ducts at the top of the stationary plates.

Superheaters and Reheaters

Superheaters are one of the most important accessories of boiler that improve the thermal efficiency.

In superheaters there should not be any fins as it increases the thermal stresses and care should be taken when choosing the super-heater material that is stand for high temp and corrosion resistance.

Super-heater types

1. Convection super-heater: it is the earliest type of super-heater and it is located above or behind banks of water tubes to protect them from direct flame or fire

Parameters that increase the convection

- a. Increasing the fuel-and air flow (combustion gas flow).
- b. Increasing the mass flow rate of the steam.

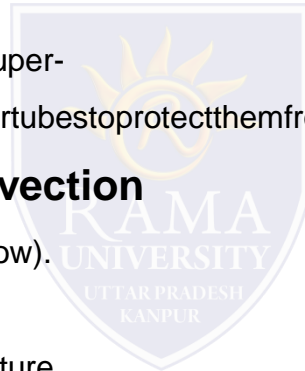
Convection super-heaters are used for low temperature.

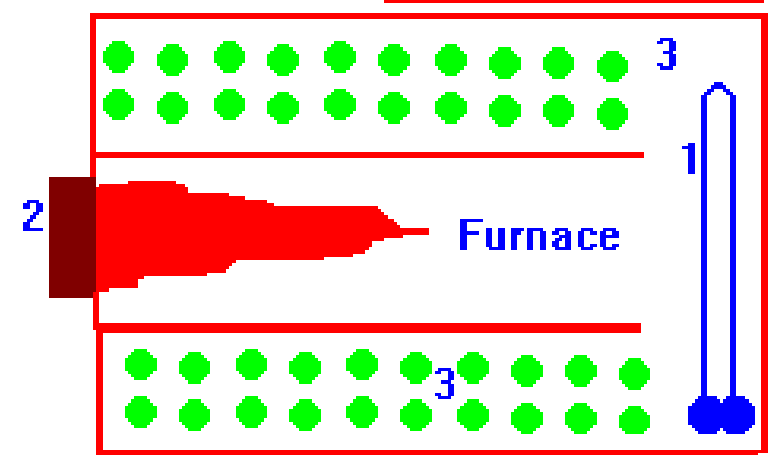
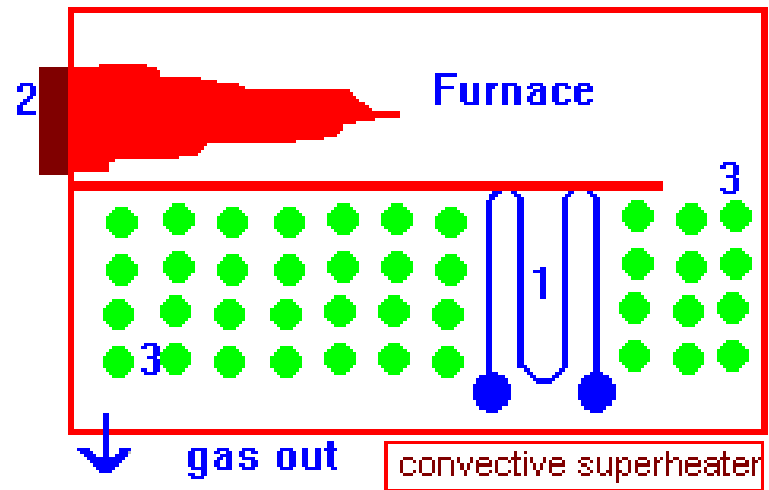
Radiant Super heater

They are placed exposed to the heat source which requires the improvement of metal temperatures.

Radiation is proportional to $T_f^4 -$

T_w^4 where T_f and T_w are the flame and tube wall absolute temperature. T_f is greater than T_w so radiation is mainly dependent on the flame temperature. As the steam flow rate increases the exit temperature becomes lower as T_w goes up.





1.superheater 2.burner 3.screen/evaporator

radiant superheater

Re-heaters

They are the same as the super-heaters but as their exit temperature is a little bite less than super-heaters and their pressure is 20%-25% less than the super-heater, they can stand less quality material alloys.

Economizers

- The economizer is the heat exchanger that raises the temperature of the water leaving the highest-pressure feed-water heater to the saturation temperature corresponding to the boiler pressure, which is done by the gases leaving the last super-heater or re-heater that still have enough heat to transfer before it leaves to the stack, that is why it is called economizer.
- Economizer tubes are commonly 1.75-2.75 inch in OD and made in vertical sections of continuous tubes, between inlet to outlet headers, with each section formed into several horizontal paths connected by 180° bend for proper drainage.
- Sections are placed side by side on 1.1 inch. The spacing depends on the fuel type, as the smaller and the cleaner the fuels such as the natural gas Economizer are come plain or with extended surfaces to enhance heat transfer.
- Economizers are generally placed between the last super heater re-heater and the air pre-heater.
- Economizers functions better with feed-water heater, as without them cold water is entering the economizer, which results in condensation and corrosion at the outer surfaces.
- Using the deaerating (DA) feedwater heater is considered beneficial for the economizer as it releases most of the oxygen that may react and cause fouling.
- Chemical and water washing when cleaning the economizer in the shut down time of the station



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