STEAM CONDENSERS:

Thermal efficiency of a closed cycle power developing system using steam as working fluid and working on Carnot cycle is given by an expression $(T_1 - T_2)/T_1$. This expression of efficiency shows that the efficiency increases with an increase in temperature T_1 and decrease in temperature T2. The maximum temperature T_1 of the steam supplied to a steam prime mover is limited by material considerations. The temperature T_2 (temperature at which heat is rejected) can be reduced to the atmospheric temperature if the exhaust of the steam takes place below atmospheric pressure. If the exhaust is at atmospheric pressure, the heat rejection is at 100°C.

Low exhaust pressure is necessary to obtain low exhaust temperature. But the steam cannot be exhausted to the atmosphere if it is expanded in the engine or turbine to a pressure lower than the atmospheric pressure. Under this condition, the steam is exhausted into a vessel known as condenser where the pressure is maintained below the atmosphere by continuously condensing the steam by means of circulating cold water at atmospheric temperature.

A closed vessel in which steam is condensed by abstracting the heat and where the pressure is maintained below atmospheric pressure is known as a condenser. The efficiency of the steam plant is considerably increased by the use of a condenser. In large turbine plants, the condensate recovery becomes very important and this is also made possible by the use of condenser. The steam condenser is one of the essential components of all modern steam power plants.

Steam condenser are of two types:

1. Surface condenser. 2. Jet condensers

SURFACE CONDENSERS:

In surface condensers there is no direct contact between the steam and cooling water and the condensate can be re-used in the boiler: In such condenser even impure water can be used for cooling purpose whereas the cooling water must be pure in jet condensers. Although the capital cost and the space needed is more in surface condensers but it is justified by the saving in running cost and increase in efficiency of plant achieved by using this condenser. Depending upon the position of condensate

extraction pump, flow of condensate and arrangement of tubes the surface condensers may be classified as follows:

(*i*) **Down flow type:** Fig. (1-a) shows a sectional view of dawn flow condenser. Steam enters at the top and flows downward. The water flowing through the tubes in one direction lower half comes out in the opposite direction in the upper half Fig.(1-b) shows a longitudinal section of a two pass down-flowcondenser.

(*ii*) **Central flow condenser:** Fig.(2) shows a central flow condenser. In this condenser the steam passages are all around the periphery of the shell. Air is pumped away from the centre of the condenser. The condensate moves radially towards the centre of tube nest. Some of the exhaust steams while moving towards the centre meets the undercooled condensate and pre-heats it thus reducing undercooling.

ADVANTAGES AND DISADVANTAGES OF A SURFACE CONDENSER:

The various advantages of a surface condenser are as follows:

1. The condensate can be used as boiler feed water.
2. Cooling water of even poor quality can be used because the cooling water does not come in direct contact with steam.
3. High vacuum (about 73.5 cm of Hg) can be obtained in the surface condenser. This increases the thermal efficiency of the plant.

The various disadvantages of' the surface condenser are as follows:

1. The capital cost is more.
2. The maintenance cost and running cost of this condenser is high.
3. It is bulky and requires more space.

TYPES OF JET CONDENSERS:

1. Low level jet condensers (Parallel flow type): In this condenser (Fig. 4) water is sprayed through jets and it mixes with steam. The air is removed at the top by an air pump. In counter flow type of condenser the cooling water flows in the downward direction and the steam to be condensed moves upward.

Fig.4 Fig. 5

2. <u>High level or Barometric condenser</u>: Fig.(5) shows a high-level jet condenser. The condenser shell is placed at a height of 10.33 m (barometric height) above the hot well. As compared to low level jet condenser. This condenser does not flood the engine if the water extraction pump fails. A separate air pump is used to remove the air.