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A two stage air compressor with perfect intercooling takes in air at 1 bar pressure and 27 °C

) The minimum work for two stage air compressor

$$W = \frac{2n}{n-1}\,\frac{P_1V_1}{mRT_1}\left[\left(\frac{P_3}{P_1}\right)^{\frac{n-1}{2n}} - 1\right]$$

$$= \frac{2\times1.3}{1.3-1}\times 1\times 0.287\times 300\left[\left(\frac{9}{1}\right)^{\frac{1.3-1}{1.3\times2}} - 1\right]$$

$$= 8.667\times 86.1\times(0.2886)$$

$$= 215.36\ \text{KJ/kg}$$

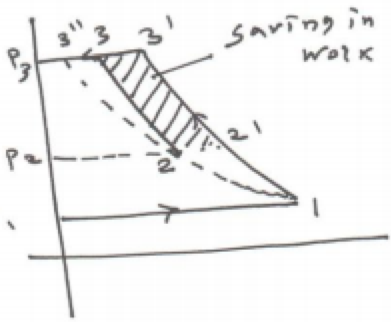
$$PV^n = C$$

Conside process 1-2'

$$\frac{T_2'}{T_1} = \left(\frac{P_2}{P_1}\right)^{n-1/n}$$

$$\frac{T_2'}{300} = \left(\frac{3}{1}\right)^{\frac{1.3-1}{1.3}}$$

$$T_2' = 386.56\ ^\circ K$$



Heat Rejected to intercooler $= mC_p(T_2' - T_1)$

$$= 1.005\,(386 - 300)$$

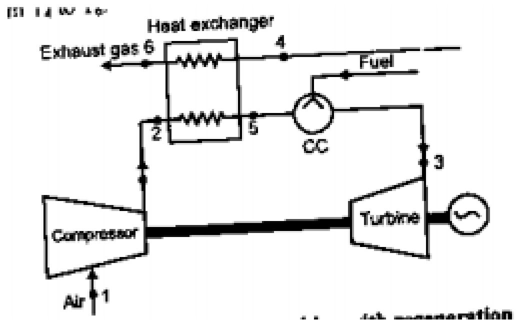
$$= 86.99\ \text{KJ/kg}$$

State four assumptions made for air standard cycle.

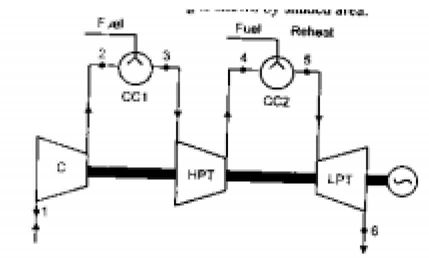
Assumption made in air standard cycle Following assumption made in actual cycle to analysis as air standard cycle. 1. The working fluid is perfect gas. 2. There is no change in mass of the working medium. 3. All the process that constitutes the cycle is reversible. 4. Heat is assumed to be supplied from a constant high temperature source and not from chemical reaction during the cycle. 5. There are no heat losses. 6. The working medium has constant specific heats throughout the cycle.

State the different methods used to improve thermal

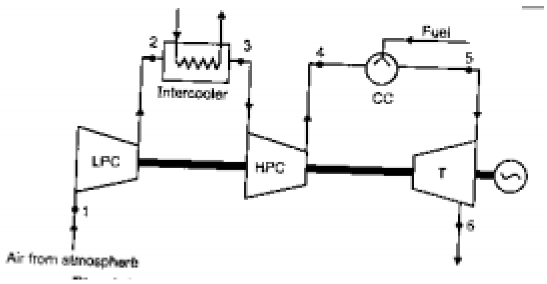
Methods to improve thermal efficiency of gas turbine 1) Regeneration – This is done by preheating the compressed air before entering to the combustion chamber with the turbine exhaust in a heat exchanger, thus saving fuel consumption.



(a) Reheating : The whole expansion in the turbine is achieved in two or more stages &reheating is done after each stage.



(a) Intercooling



<u>Compare, closed cycle and open cycle gas turbine…..</u>

Sr.no	Factors	Open cycle gas turbine	Closed cycle gas turbine
1.	**Pressure**	Lesser pressure	Higher pressure
2.	**Size of the plant for given**	Larger size	Reduced size
3.	**Output**	Lesser output	Greater output
4.	**Corrosion of turbine**	Corrosion takes place due to	No corrosion since there is
5.	**Working medium**	Loss of working medium	No loss of working medium.
6.	**Filtration of incoming air**	It may cause severe problem.	No filtration of air is required.
7.	**Part load efficiency**	Less part load efficiency	More part load efficiency
8.	**Thermal efficiency**	Less thermal efficiency	More thermal efficiency
9.	**Requirement of cooling**	No Requirement of cooling water	Larger amount of cooling
10.	**Weight of system for**	Less	More
11.	**Response to the changing**	Good response	Poor response
12.	**Fluid friction**	More Fluid friction	Less Fluid friction

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Give classification of air conditioning system……

Air conditioning systems are classified as 1) Classification as to major function- i) Comfort air-conditioning - air conditioning in hotels, homes, offices etc. ii) Commercial air-conditioning- air conditioning for malls, super market etc ii) Industrial air-conditioning – air conditioning for processing, laboratories etc

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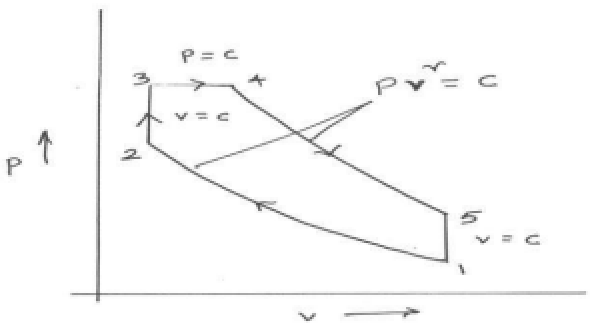
Draw P-V and T-S diagram for dual cycle. Name the processes involved in it…..



Process 1-2 : Isentropic compression

Process 2-3: Partial Heat addition at constant volume

Process 3-4 : Partial Heat addition at constant pressure

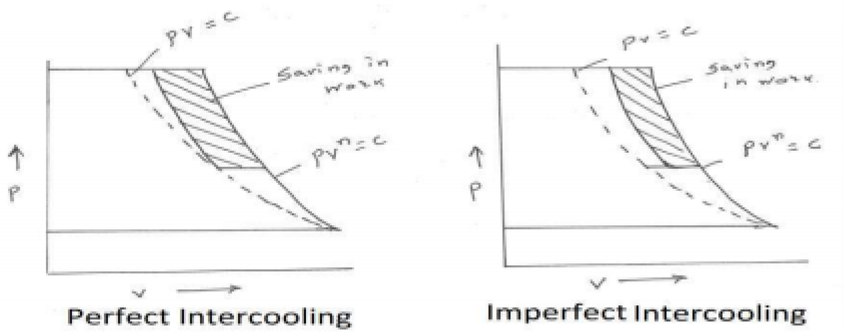
Process 4-5 : Isentropic expansion

Process 5-1: Heat rejection at constant volume

Define perfect and imperfect inter-cooling in air compressor and show it by graph also….

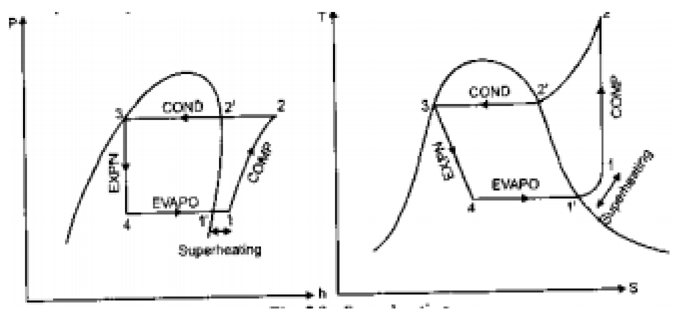
Perfect cooling: In this process the temperature of air after passing out of intercooler is same as that of temperature of air before compression in LP cylinder. The respective figure is shown.

Imperfect cooling: In this process the temperature of air after passing out of intercooler is between the temperature of air before & after compression in LP cylinder. The respective figure is shown.

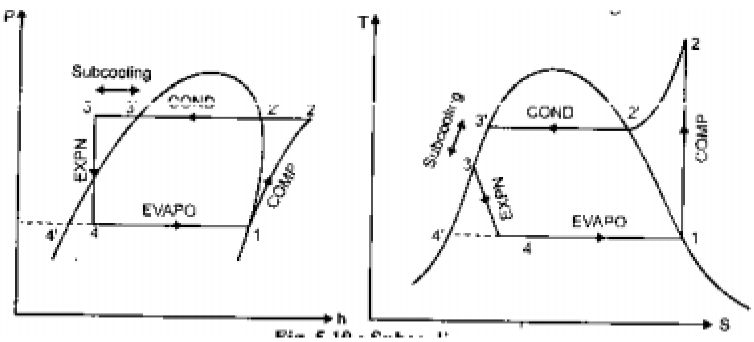


Represent subcooling and superheating on P-h and T-S diagram….

Superheating

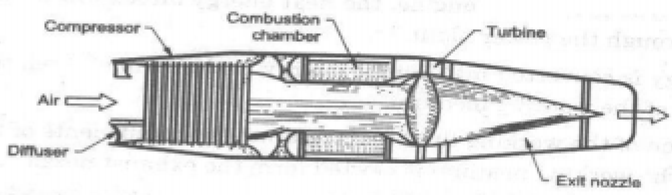


Due to superheating suction temperature of compressor increases , increasing compressor power but it also increases the refrigerating effect therefore COP of system remains more or less constant. The superheating is not done to increase the refrigerating effect or COP but it is done to increase the life of compressor.



Explain construction and working of turbojet with neat labelled sketch.

Turbo-Jet Engine :



Turbo-jet engine

The turbojet engine consists of an open cycle gas turbine engine (compressor, combustion chamber and turbine) with an entrance air diffuser added in front of the compressor and an exit nozzle added rear end or aft of the turbine.

In this unit no propeller is provided. The diffuser of a turbojet engine must provide the greatest possible pressure rise by slowing the incoming air and converting its kinetic energy into pressure.

The shape, area and location of the actual air inlet in an aeroplane is highly important. Variable area entrance diffusers are being developed for new aircraft in order to maintain high diffuser efficiency for both high and low speed operation. The atmospheric air enters the compressor through the front opening.

The compressor compresses the air to the required pressure and discharges it into combustion chamber. The fuel is injected into the combustion chamber at constant pressure.

The gases leaving the combustion chamber expand in turbine, which produces sufficient power to run the compressor and exhaust to atmospheric through nozzle, which produces propulsive thrust to drive the unit.

The major advantages of the use of axial flow compressor is capable of multistaging and small frontal area, out weight its sensitivity and fragility. Therefore it is the current choice for use in turbojet engine of high thrust output.

Describe the method to measure indicated power of I.C.

engine.

Method to measure Indicated power :

Indicated Power :

The power developed inside the engine cylinder is known as indicated power and denoted by I.P.

Measurement of indicated power :

Indicated power of engine at a particular speed can be calculated with the help of indicator. The indicator is fitted to the engine cylinder.

The strength of the spring to be used in the indicator must be carefully chosen.

The ratio of maximum pressure in the engine cylinder to the mean pressure during the cycle in an I.C. engine is much greater than that of any other heat engine.

The variation of pressure inside the engine cylinder is obtained an a diagram called as indicator diagram as shown in Fig.

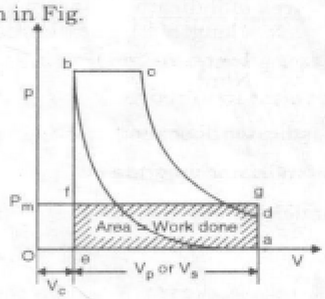


Fig. 2.1

The diagram obtained is a curved abcd the area under the curve is workdone as shown in P-V diagram work obtained = A (a – b – c – d).

Area (a b c d) into rectangle of length equal to stroke volume as shown in Fig. 2.1.

$$A(a-b-c-d) = A(a-e-f-g)$$

Consider height of rectangle as mean-effective pressure (P_m)

∴ Average variation of pressure inside engine cylinder equal to P_m

$$\text{work/cycle} = A(a-b-c-d) = A(a-e-f-g) = P_m V_s$$

$$= P_m A \times L$$

$$= P_m \times \frac{\pi}{4} d^2 L$$

$$\text{Indicated power} = \text{workdone/cycle} \times N$$

$$= P_m A L N$$

Where N is speed of engine then N number of power stroke or explosion.

a) For two stroke engine

$$I.P. = P_m A L N$$

b) For four stroke engine

$$I.P. = P_m A L \times \frac{N}{2}$$

$$N = \frac{N}{2}$$

because one power stroke is completed in two revolution of crankshaft. Indicated mean effective pressure can be calculated as,

$$P_m = \frac{\text{Area of indicator diagram} \times \text{spring index}}{\text{length of indicator diagram}}$$

$$= \frac{a \times s}{l} \text{ N/m}^2$$

where a = Area of indicator diagram

l = length of indicator diagram

s = spring index in N/m^2 per meter.

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