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State any four industrial uses of compressed air.

1) To drive air motors in coal mines. 2) To inject fuel in air injection diesel engines. 3) To operate pneumatic drills, hammers, hoists, sand blasters. 4) For cleaning purposes. 5) To cool large buildings. 6) In the processing of food and farm maintenance. 7) For spray painting in paint industry. 8) In automobile & railway braking systems. 9) To operate air tools like air guns. 10) To hold & index cutting tools on machines like milling / cnc machines.

An engine of diameter 250 mm and 375 mm stroke works on otto cycle..........

$$V_s = \frac{\pi}{4} d^2 l = \frac{\pi}{4}(0.25)^2 \times 0.375$$

$$= \underline{\underline{0.01841 m^3}} \quad \text{— (1 mark)}$$

$$\text{Compression Ratio } (r_c) = 1 + \frac{V_s}{V_c}$$

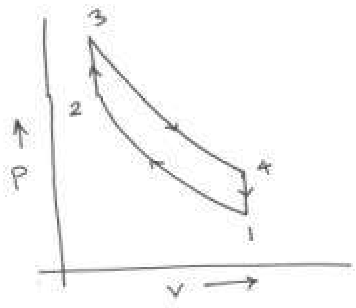
$$= 1 + \frac{0.01841}{0.00263}$$

$$= \underline{\underline{8}} \quad \text{- (1 mark)}$$

$$\eta_{air\ std.} = 1 - \frac{1}{r_c^{\gamma - 1}}$$

$$= 1 - \frac{1}{(8)^{1.4-1}}$$

$$= \underline{\underline{56.47\%}} \quad \text{— (1 mark)}$$



OTTO CYCLE

(1 mark)

In gas turbine plants, Brayton cycle is more suitable than otto cycle…

In gas turbine plant – it works on brayton cycle where the heat added & heat rejected at constant pressure. It consists of compressor, combustion chamber & a turbine. The efficiency of Brayton cycle rotor cycle is same for but efficiency is of gas it temperature & pressure is increasing. High temperature & pressure require for ignition & fuel consumption for bray ton cycle. It is not possible in Oto cycle because the heat added & rejected at constant volume so bray ton cycle is most suitable than Otto cycle for gas turbine plant.

Distinguish between central A/C and unitary A/C systems with respect to following parameters….

Parameter	Central A/C	Unitary A/C
1. Vibration	Vibration is more	Vibration is less
2. Noise	Noise of A/C unit is more	Noise of A/C unit is less
3. Power consumption	More air flow rate therefore power consumption is more	Power consumption is less
4. Operating cost	For central A/C operating cost is high	For unitary A/C operating cost is less
5. Duct	It require duct design & installation	No duct design & installation
6. Failure problem	If there is failure or fault in A/C plant all rooms air conditioning affects	If there is failure particular rooms affected
7. Initial cost	Initial cost is high	Initial cost is less
8. Maintenance cost	Maintenance cost is higher	Maintenance cost is low

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An engine working on otto cycle has,….

c) Given data:- d = 150 mm = 0.15 m

L = 225 mm = 0.225 m

$V_C = 1.25 \times 10^{-3}\ m^3 = 0.00125\ m^3$

Swept volume $= \pi/4\ d^2 l = \pi/4 (0.15)^2 \times 0.225$

$Vs = 0.00398\ m^3$

Compression ratio $= \frac{Vc+Vs}{Vc} = \frac{0.00125+0.00398}{0.00125}$

$r = \frac{0.00523}{0.00125} = 4.18$

$r = 4.18$

$A.S.E = 1 - \frac{1}{(r)^{\gamma-1}} = 1 - \frac{1}{(4.18)^{1.4-1}} = 1 - \frac{1}{(4.18)^{0.4}}$

$= 1 - \frac{1}{1.77} = 1 - 0.564$

$A.S.E = 436\%$ A.S.E. = 43.6 %

Define displacement of compressor for two stage compressor…

Displacement is the product of piston displacement and working stroke per minute is bared on low pressure only and the amount air passing through the other cylinder for two stage compressor. When free air wave from low pressure cylinder to high pressure cylinder through intercooler there is reduction of volume of air because of perfect cooling so free air delivered is less than displacement of compressor. (Pl check)

Which is more effective way to increse the C.O.P. of refrigerator,……

$$\text{COP (R)} = \frac{T_1}{T_2 - T_1}$$

Where $T_1 = lower\ Temperature$

$T_2 = Higher\ Temperature$

C.O.P. $_{\text{Refr.}}$ = $T_2 / T_2 - T_1$

To improve or more effective way to increase the cop of refrigerator by.

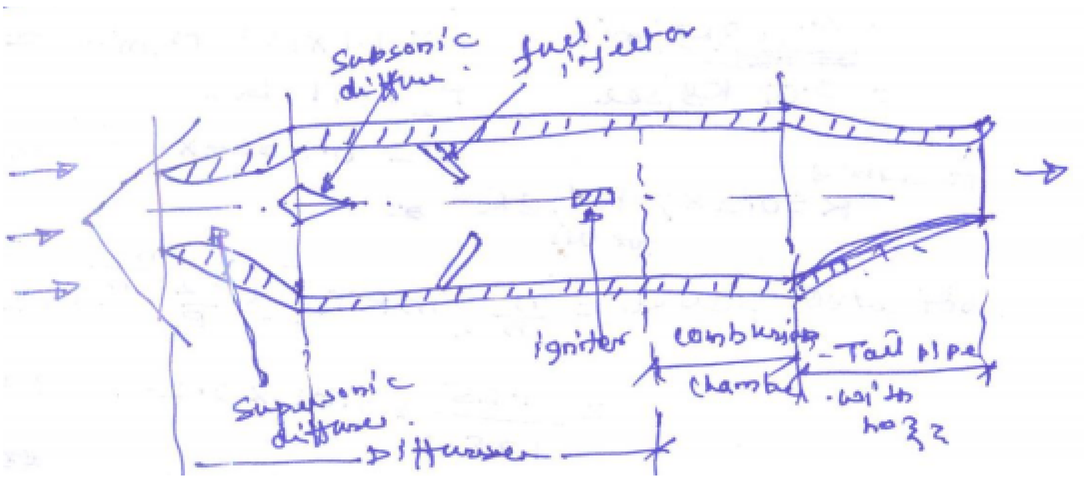
1. Decreasing the higher temperature (i.e. Temp. of hot body T_2)
2. Increasing the lower temperature (i.e. Temp. of cold body T_1)

It is not possible to increase the cop by

a. Increasing T_2 keeping T_1 constant, because T_2 is temperature of cooling water or air available for rejection of heat & lower temperature (T_1) is the temperature to maintain in refrigerator.
b. Decreases T_1 keeping T_2 constant – it is not possible after during T_2 is will be heat the temp. at T_2.

Explain the construction and working of Ram jet with the

help of neat labelled schematic diagram. State its limitations (any two).



A single stage single acting air compressor delivers 0.6 kg of air per minute at 6.1 bar...

$m = 0.6\ kg/min$

$= \frac{0.6}{60} kg/min$

=0.01 kg/sec.

$P_1 = 1.1\ bar$

$=1.1 \times 10^5$ N/m^2

$T_1 = 28 + 273$

$= 301\ ^0k$

1. Assume R = 0.287 kJ/kgk for air

$$\text{Indicated power} = \frac{n}{n-1} mRT_1 \left[\left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} - 1 \right]$$

$$= \frac{1.25}{1.25-1} \times 0.01 \times 0.287 \times 301 \left[\left(\frac{6.1}{1.1}\right)^{\frac{1.25-1}{1.25}} - 1 \right]$$

$$= 5 \times 0.01 \times 0.287 \times 301[(5.5)^{0.2} - 1]$$

$= 5 \times 0.01 \times 0.287 \times 301[1.41 - 1]$

$= 5 \times 0.01 \times 0.287 \times 301[0.41]$

$IP = 1.77 \frac{kJ}{g}$ 02 kw 02 $1770 \frac{J}{g}$ 02 w

If the mechanical efficiency is 85⁰/0

Power required $= \frac{1.77}{0.85}$

Power required = 2.08 kW. It is not affected by clearance volume.

2. $IP = \frac{n}{n-1} P_1 r_1 \left[\left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} - 1 \right] \times N/60$

$$1770 = \frac{1.25}{1.25 - 1} \times 1.1 \times 10^5 \times 0.00118 \left[\left(\frac{6.1}{1.1} \right)^{\frac{1.25-1}{1.25}} - 1 \right] \times \frac{N}{60}$$

$1770 = 5 \times 1.1 \times 10^5 \times 0.00118[(5.55)^{0.2} - 1]N/60$

$= 5 \times 1.1 \times 10^5 \times 0.0018[0.41] \times N/60$

$= 406 \times N/60$

$$N = \frac{1770 \times 60}{406}$$

$$N = 262\ r.p.m.$$

$r_1 = \frac{\pi}{4} d_1^2 l$

$= \frac{\pi}{4} \times (0.1)^2 \times 0.15$

$= 0.00118\ m^3$

3. Clearance volume =0.03 v_s

$\therefore$ volumetric efficiency $= 1 - \frac{VC}{VS} \left[\left(\frac{P_2}{P_1} \right)^{\frac{1}{1.25}} - 1 \right]$

$= 1 - \frac{0.03\ VS}{VS} \left[\left(\frac{6.1}{1.1} \right)^{\frac{1}{1.25}} - 1 \right]$

$= 1 - 0.03[(5.55)^{0.8} - 1]$

$= 1 - 0.03[3.93 - 1]$

$= 1 - 0.088$

$volumetric = 0.91 = 91\%$

A vapour compression machine is used to maintain a temperature of –23°C in a refrigerated space. The ambient temperature is 37°C.....

Since a minimum temperature of 10^0c is required in evaporator condenser, therefore evaporator temperature would be.

$T_1 = T_4 = -23 - 10 = -33^0 c = -33 + 273 = 240k$ and condenser

$T_2^1 = T_3 = 37 + 10 = 47^0 = 47 + 273 = 320k$

1. Capacity of refrigeration per minute

$$= mg(h_1 - h + 3) = 1$$

$= 1(336.630 - 245.715)$

$= 90.915$

$\therefore$ Capacity of refrigeration $= \frac{90.915}{210} = 0.43\ TR$

Capacity of system $= 0.43\ TR$

2. Power required - work done during compression of refrigeration $= mg(h_2 - h_1)$

Enthalpy of super head vapour - $h_2 = h_2^1 + cp(T_2 - T_2^1)$

To find T_2 entropy at point 2

$S_2 = S_2^2 + 2.3\ cp\ log\left(\frac{T_2}{320}\right)$

$1.5668 = 1.5386 + 2.3 \times 0.64\ log\left(\frac{T_2}{320}\right)$

$log\left(\frac{T_2}{320}\right) = \frac{1.5668 - 1.5386}{2.3 \times 0.64} = \frac{0.0282}{1.472}$

$= 0.01916$

$\frac{T_2}{320} = 1.01936$

$T_2 = 326\ k$

$h_2 = h_2^1 + cp(T_2 - T_2^1)$

$= 369.48 + 0.64(326 - 320)$

$= 369.48 + 3.84$

$h_2 = 372.96\ kJ/kg$

$\therefore$ power required $= mg(h_2 - h_1)$

$= mg(372.96 - 336.776)$

$= 1(36.184)$

$= 36.20\ kJ/min$

$= \frac{36.18}{60}$

Power required =0.60 kJ/g

3. Cop of cycle $= \frac{h_1 - h_{f3}}{h_2 - h_1} = \frac{336.776 - 245.715}{372.96 - 336.776}$

$$= \frac{91.061}{36.18} = 2.5$$

Cop of cycle = 2.5

4. Carnot cop $= \frac{T_1}{T_2 - T_1}$

$$= \frac{240}{320 - 240}$$

$$= \frac{240}{80} = 3$$

$Carnot\ cop = 3$

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