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TO STUDY OF DIFFERENT TYPE COOLING IN AUTOMOBILE & CARS

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ABSTRACT: Most internal combustion engines are fluid cooled using either air (a gaseous fluid) or a liquid coolant run through a heat exchanger (radiator) cooled by air .Now a day the air conditioning system of cars is mainly uses "Vapour Compression Refrigerant System" (VCRS) which absorbs and removes heat from the interior of the car that is the space to be cooled and rejects the heat to atmosphere. In vapour compression refrigerant system, the system utilizes power from engine shaft as the input power to drive the compressor of the refrigeration system, hence the engine has to produce extra work to run the compressor of the refrigerating system utilizing extra amount of fuel. Many countries are facing problems where the temperature is too hot in the car when they park their cars under the scorching sun. Various problems will arise caused by this situation. For comparison, the temperature inside the car can achieve up to 80°C without the proposed system. This will make the driver and passenger uncomfortable while entering the car. Portable car cooling system is really necessary so that the hot air inside the car shall be dissipate/remove and the temperature is reduced.

Keyword: Refrigeration, heat, Portable, radiator, atmosphere.

I. INTRODUCTION

Refrigeration is the process of removing heat from an enclosed or controlled space, or from a substance, and moving it to a place where it is unobjectionable. The primary purpose of refrigeration is lowering the temperature of the enclosed space or substance and then maintaining that lower temperature as compare to surroundings. Cold is the absence of heat, hence in order to decrease a temperature, one "removes heat", rather than "adding cold." [1] In vapour absorption refrigeration system, a physiochemical process replaces the mechanical process of the vapour compression system by using energy in the form of heat rather than mechanical work. The main advantage of this system lies in possibility of utilizing energy from exhaust a so vehicle and also using an eco-friendly refrigerant such as water. The vapour absorption system has many favourable characteristics; typically a much smaller electrical input is required to drive the solution pump as compared to the power requirement of the compressor in the vapour compression system. Automotive A/C systems present challenges not normally encountered in stationary A/C systems, such as those used in building A/C systems. In general air conditioning is defined as the simultaneous control of temperature, humidity, cleanliness and air motion. Depending upon the requirement, air conditioning is divided into the summer air conditioning and the winter air conditioning. The former uses a refrigeration system and a dehumidifier against a heat pump In addition, air conditioning is also sub divided into the comfort and industrial air conditioning. We know that in case of Internal Combustion engines, combustion of air and fuel takes place inside the engine cylinder and hot gases are generated. The temperature of gases will be around 2300-2500°C. This is a very high temperature and may result into burning of oil film between the moving parts and may result into seizing or welding of the same. So, this temperature must be reduced to about 150-200°C at which the engine will work most efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency. So, the object of cooling system is to keep the engine running at its most efficient operating temperature.[2]

II. ALTERNATIVE WAY OF REDUCING CAR CABIN TEMPERATURE

The car ventilation fan as shown in fig 2 is using solar system and it can easily found in the market. This product was created for the purpose to keep car cool whenever it is overheated by the sunlight or hot surrounding, but there are differences between this product and portable car cooling system proposed in this paper in terms of the product functions, structure of the product, system used, durability and many more. The car ventilator fan shown in Fig uses a solar panel and battery as a source of energy to run the ventilation fan, while portable car cooling system, uses rechargeable cell as its source of energy. Besides that, the drawback of the car ventilator is it can be placed only if the window's glass is slightly opened and this action can actually cause the things that are not desired to happen such as car theft. [3]

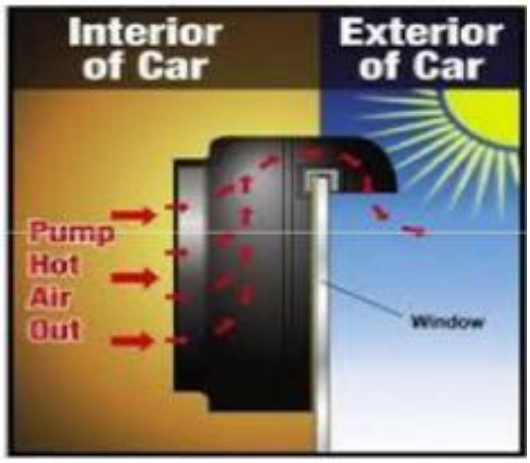

Fig 1: Ventilation System

III. VAPOUR ABSORPTION REFRIGERATION SYSTEM.

In vapour absorption refrigeration system as shown in FIG1, the compressor is replaced by an absorber, a pump, a generator and pressure reducing valve. These components in the system perform the same function as that of compressor in VCR system. The vapour refrigerated from evaporator is drawn into the absorber where it is absorbed by the weak solution of refrigerant forming a strong solution. This strong solution is pumped to the generator where it is heated utilizing exhaust heat of vehicle. During the heating process the vapour refrigerant is driven off by the solution and enters into the condenser where it is liquefied. The liquid refrigerants then flows into the evaporators and the cycle is completed. [4]

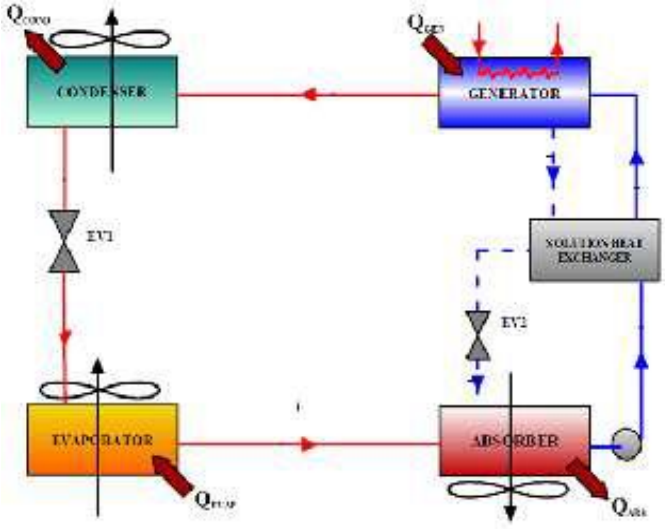

Fig.2. The essential components of the air-cooled absorption system.

IV. REFRIGERANT USED FOR THE ABSORPTION REFRIGERATION SYSTEMS

A fundamental requirement of absorbent/refrigerant combination is that, in liquid phase, they must have a margin of miscibility within the operating temperature range of the cycle. The mixture should also be chemically stable, non-toxic, and non-explosive. In addition to these requirements, the following are desirable

- Refrigerant should have high heat of vaporization and high concentration within the absorbent in order to maintain low circulation rate between the generator and the absorber per unit of the cooling capacity.
- Transport properties that influence heat and mass transfer, e.g., viscosity, thermal conductivity, and diffusion coefficient should be favourable.

The main properties are:

- Ammonia (refrigerant) and water (absorbent) are highly stable for a wide range of operating temperature and pressure.
- Ammonia has a high latent heat of vaporization, which is necessary for efficient performance of the system. Its latent heat of vaporization at -15℃ is 1315kJ/Kg. c.Its boiling point at atmospheric pressure is -33.3 ℃& freezing point is -77 ℃ .
- It has highest refrigerating effect per Kg of refrigerant.
- The leakage of this refrigerant may be quickly & easily detected by the use of burning sulphur candle which in the presence of ammonia will form white fumes of ammonium sulphite.
- It is environmental friendly. [5]

V. WATER COOLING SYSTEM

In this method, cooling water jackets are provided around the cylinder, cylinder head, valve seats etc. The water when circulated through the jackets, it absorbs heat of combustion. This hot water will then be cooling in the radiator partially by a fan and partially by the flow developed by the forward motion of the vehicle. The cooled water is again recirculated through the water jackets.[4]

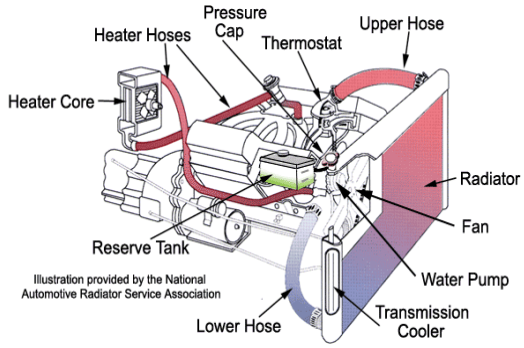

Fig3. Water cooling system

Rate of heat transfer over the surface of radiator is given by;

$Q = U \times A \times \Theta m$

$\Theta m = T_{Havg} - T_{Cavg}$

$UA = 1 / R_{toalt}$,

Where;

U =Overall heat transfer coefficient between two fluids

Θm =AMTD (arithmetic mean temperature difference) and

R_{toalt}, =Total thermal resistance between water and air.

$R_{total} = R_{in} + R_{f,\,in} + R_{cond} + R_{out} + R_{f,\,out}$

$R_{in} = 1/ (h_{in} \times A_{total,\,in})$

Nu = Nusselt number,

K_{air}= Thermal conductivity of air, Re as Reynolds number and Pr as Prandtl number.

$Re = (\rho \times v \times L_c) / \mu$

$Pr = (\mu \times cp) / k$

$Nu = 3.66 + [(0.668 (D/W) \times Re \times Pr) / (1 + 0.04 ((D/W) \times Re \times Pr)^{2/3}]$

$Nu = (h_{in} \times L_c) / k$

Where;

L_c = Characteristic length.

R_{in}= Convective resistance between the water & the inner surface of the tube,

$R_{f,in=}$ Fouling resistance that occurs on the internal surface of the tube,

R_{cond} = Resistance to conduction through tube wall,
R_{out}= Resistance between the air and the surface of the fins and the outer tube surface
R_{fout} = Fouling resistance that occurs on the outer surface of the tubes.

$R_{f, in} = R''_{f, in} / A_{total\ in}$
$R_{f, out} = R''_{f, out} / A_{total\ out}$

Where;
$R''_{f, in}$ = Fouling factor for inside,
$R''_{f, out}$= Fouling factor for outside,
V = Velocity of air flow,
υ = Kinematic viscosity of air
$A_{s\ fin\ total}$ = Total fin surface area,
$A_{s\ unfin}$ = Total un-finned surface area

$R_{cond} = t_h / [\ k_{tube} \times A_{total\ in}]$
$R_{out} = 1 / (\ \eta_o \times h_{out} \times A_{total,out}\ )$
$\eta_o = 1 - [(\ A_{s\ fin\ tot} / A_{tot})(1-\eta_{fin})]$
$Re = (\rho \times v \times L_{out}) / \mu$
$Pr = (\mu \times c_p) / k_{air}$
$Nu = 0.036 \times (Re)^{4/5} \times (Pr)^{1/3}$
$Nu = (h_{out} \times L_{out}) / k_{air}$

Therefore, the rate of heat transfer for the radiator is Q is calculated And the difference in heat rate,
$\Delta Q = Q_{req} - Q_{act}$[6]

VI. PORTABLE CAR COOLING SYSTEM

The hot air will be sucked into the portable cooling system due to low air pressure in the system.

- This is caused by the high velocity of the propeller blades rotation.
- The pump circulates the water and sprays the same on cloth.
- Then, the hot air will hit the cloth that is wet and cold. Thus, the hot air is eliminated and the air with vapours of cold water is discharged into the car cabin.
- The heating or cooling load in a passenger bus may be estimated by summing the heat flux from the following loads:
- Solid walls(side panels, roof, floor)
- Glass(Slide, front and rear windows)
- Passengers
- Engine and Ventilation
- Evaporator fan motor [7]

VII. CONCLUSION

The main objective of the research is to propose a cooling system that able to control and maintain temperature inside the car. The radiator material in the design shows an increased rate of heat transfer which is much greater than the required value. The developed portable car cooling system is in a medium size and the design is suitable for good features, high performance with simple and effective way in reducing the car's cabin temperature. It is possible to design an automobile air conditioning system using engine heat based on Vapour Absorption Refrigeration System. Also from the Environmental point of view this system is Eco-friendly as it involves the use of Ammonia as a refrigerant which is a natural gas and is not responsible for OZONE layer Depletion. In this way we can concluded, technically, that Out of the total heat supplied to the engine in the form of fuel, approximately, 30 to 40% is converted into useful mechanical work; the remaining heat is expelled to the environment through exhaust gases and engine cooling systems, resulting in to entropy rise and serious environmental pollution, so it is required to utilized waste heat into useful work.

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