Increasing the Efficiency of Engine Cooling System

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Abstract— Engine produces high amount of heat while running. This can raise the engine temperature to very high level and can damage or seize the engine components. Hence for the safety of engine components, it needs to run at much lower temperature, which is called engine working temperature. Radiator plays a vital role in engine cooling system. When increasing the cooling efficiency of radiator causes increase the life time of engine. The efficiency of the radiator can be increased by changing the surface area or dimension of the tube or increasing the number of fins/tubes. The heat transfer rate for the existing radiator could be analyzed. After analyzing the existing radiator, the new radiator has been designed. Two flat plates are placing inside the tube which acts as the nozzle. Hence, nozzle velocity increases and pressure decreases. Pressure is directly proportional to temperature. Thus, the temperature of coolant inside the radiator decreases. As a result efficiency of the proposed radiator is increased 5.37% when comparing with existing method.

Keywords: Radiato, Efficiency, Fins, Tubes, Nozzles

I. Introduction

The majority of I.C. engines have cooled by air or liquor coolant passing via air or radiator. The majority of the liquor-cooled I.C. engines using coolant oil which has been combination of water as well as chemical like anti-freeze and rust inhibitors. The industry word of antifreeze mixture is coolant oil for engine cooling system. Coolant oil-based cooling system minimizes the happening of hot spot that difficult to avoid when applying air cool. The rate of heat transfer when using coolant oil is 47 percentage higher than the clean water. There is a continuing effort to develop fluid flow simulation capability coupled with heat transfer calculations for the analysis of cooling airflows. It is of course important to get an accurate cooling flow simulation, that the aerodynamics is well modeled. The mathematical learn in favor of heating absence of experimental correlation when considering flow as wick. Transitory act in smooth heat tube for cooling various electronics apparatus by calculate the liquid flow in vapor core as well as wick area by passing 2D hydrodynamic method. When added the alumina particle causes linear increment of thermal conductivity in aqueous fluids. The importance of particle size and viscosity of fluid in respect of thermal conductivity enrichment relation of them. The heat transfer performance in super hydrophilic copper to fabricate post wicks in silicon substrates for depositing as well as controlling oxidation.

The Radiator System used for experimental purpose is Piaggio Porter Vehicle. We are going to increase the overall efficiency of the system by bringing the following changes in the mentioned cooling system. We are going to change the design of cooling fan and also we are going to make some changes in the radiator. The company at this instant is using the radiator which consists of semi-metallic fins, here we will use some natural material and grass which we use in coolers, that will help in increasing the efficiency of the cooling system. In present system they cannot control the speed, we are making some changes by which the customers or users can control the speed of the fan. Sensors such as Temperature Switch, Thermal Switch will be the part of our cooling system.

The rest of the paper is arranged as follows. Section 2 depicts component selection and design.

II. Component Selection and Design

A. List of components

Sr.no	Table		
	Component	Specifications	Quantity
1	Radiator Assembly	Aluminium	1
2	Fan	Hub=108mm Fan=230mm	1
3	Temperature Switch	12V	1
4	Thermal Switch	12V	1
5	Temperature Sensor	8mm	1
6	Wiring	Length=2m	2
7	Temperature Meter	Only Temperature display type	1
8	ASPEN Sheets	2Kg	N.A
9	Bracket	Length=4m Breadth=3m	1
10	Switches	12V	1
11	Grade Wire	10s11c	1
12	Belt	3pk 0660	1
13	Push buttons	10Amp	1
14	Radiator Bushings	Plastic, Rubber	2

Table 1: List of components

B. Design details

1) Cylinder design

Sr.no	Table		
	Description	Symbol	Values
1	Diameter of Hub	d	108mm
2	Diameter of Fan	D	230mm
3	Thickness of Hub	T	22mm
4	Width of Blade	B	30mm
5	Length of Blade	L	61mm
6	Number of Blade	N	10

Table 2: Fan specifications

Operational Speed,

Fan Speed = 1.3 * engine rpm(assumed)
= 1.3 * 1650
= 2145 rpm

At hub α = Φ = 1.5deg & β = θ = 53deg
At mid α = Φ = 2.2deg & β = θ = 54.6deg
At tip α = Φ = 3deg & β = θ = 56deg

For each design method, two materials will be used: steel with density of 7860 kg/m3 and aluminium with density of 2710 kg/m3.

Overall Process

The generic working process involves the following:

1) Open/Create a project.
2) Create/Manipulate the geometry.
3) Create the mesh.
4) Check/Edit the mesh.
5) Generate the input for the solver.
6) Post-process the results

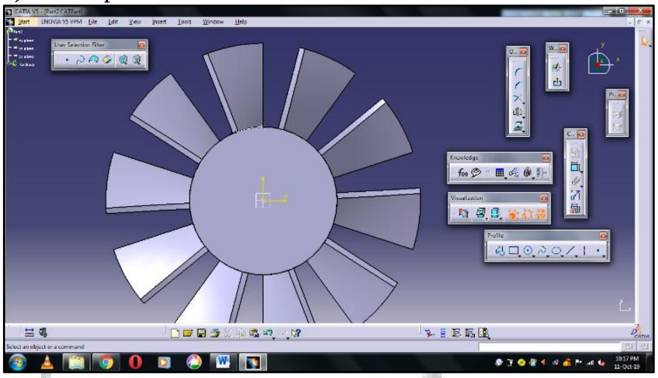

Fig. 1: Fan CATIA Model

2) Temperature Switch

Sensing of the temperature is achieved through the use of temperature sensors, and temperature regulators which process the signals they receive from sensors. From a thermodynamics perspective, temperature changes as a function of the average energy of molecular movement. As heat is added to a system, molecular motion increases and the system experiences an increase in temperature.

Fig 2: Temperature Switch

3) Thermal Switch

Temperature is a measure of the average heat or thermal energy of the particles in a substance. Since it is an average measurement, it does not depend on the number of particles in an object or the object's size. The major difference between bimetals lies in the internal resistance of each given type. Under a heat load, each type of bimetal will exhibit a different internal resistive level. It is commonly referred to as the resistivity of the bimetal.

Fig. 3: Thermal Switch

III. Working of the System

A cooling system works by sending a liquid coolant through passages in the engine block and heads. As the coolant flows through these passages, it picks up heat from the engine. The heated fluid then makes its way through a rubber hose to the radiator in the front of the car.

Though the present factor has a forced circulation system, it is still worthwhile to get acquainted with the other three systems. Non-Return Water Cooling System This is suitable for large installations and where plenty of water is available. The water from a storage tank is directly supplied to the engine cylinder. The hot water is not cooled for reuse but simply discharges. The low H.P. engine, coupled with the irrigation pump is an example. Thermo-Syphone Water Cooling System works on the principle that hot water being lighter rises up and the cold water being heavier goes down. In this system the radiator is placed at a higher level than the engine for the easy flow of water towards the engine. Heat is conducted to the water jackets from where it is taken away due to convection by the circulating water. As the water jacket becomes hot, it rises to the top of the radiator. Cold water from the radiator takes the place of the rising hot water and in this way a circulation of water is set up m the system. This helps in keeping the engine at working temperature.

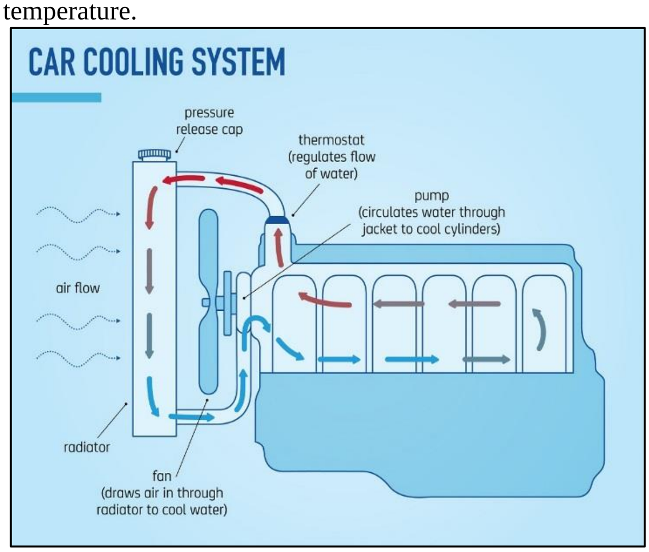

Fig. 4: Working of Cooling System

Fig. shows the It serves two purposes in the working of an engine:

1. It takes away the excessive heat generated in the engine and saves it from over-heating.
2. It keeps the engine at working temperature for efficient and economical working. This cooling system has four types of systems:
   - Direct or non-return system,
   - Thermo-Syphone system,
   - Hopper system,
   - Pump / Forced circulation system.

IV. RESULTS AND DISCUSSIONS

After replacing the metallic fins by Aspen sheets, the cooling efficiency will increase in a minor amount. This will reduce the cost of the system because the cost of the metallic fins are more as compared to the Aspen material. The changes which we are making in the shape and size of the fan will increase the flow rate and the cooling will be more efficient as compared to the existing cooling system. The temperature sensors will automatically sense the temperature and the working will be carried out automatically. Here as we are using the temperature switch, so it will display the temperature directly on the temperature meter which does not exist in nowadays cooling system. As per the above represented seminar the total cost of the cooling system will be reduced due to use of Aspen material whose cost is less as compared to the metallic fins used in existing cooling system. Also, as per the changes made by us in the design of fan, the flow rate of the should increase. As we are using the temperature switch and thermal switch which are the temperature sensors, the system will operate automatically when the temperature of the engine increases.

Conclusion

Hence, in this way we are going to manufacture the cooling system for automobiles, by changing the shape and size of the fan and using the ASPEN cooling pads instead of aluminium fins, which would increase the efficiency and reduce the cost. Also, we are trying to control the fan speed, which is not inculcated in any automobile till now.

REFERENCES

[1] Ramanjeet Singh et al. (2016) Reverse engineering and Design optimization.
[2] Dwivedi et al. (2016) Design optimization of Radiator fan.
[3] Jain et al. (2017) Heat Transfer. International Journal.
[4] Ambedkar et al. (2017) Heat Transfer. International Journal.
[5] G. Suresh Babu (2013) Circulation of Coolant. Heat Transfer in Radiator Journal of Masterscience.
[6] Trivedi et al. (2012) Design of Radiator in cooling System of Automobile.
[7] Singh et al. (2011) Design of Fan in cooling system in Automobile. International Journal of Science.
[8] Kumawat et al. (2014) Design of blades shape and size of fan in automobile cooling system. Real Science Journal.
[9] Sai et al. (2014) Nanofluids in car Radiator. National Journal of cooling System.