Design Modification & Analysis of Air-Cooled Engine Fins

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Abstract: ***The Engine cylinder is one of the primary elements of the engine, which is subjected to excessive variation in temperature and thermal stresses. Fins are placed on the surface of the cylinder to enhance the amount of heat transfer by convection. The cooling mechanism of an air-cooled engine is mostly dependent on the fin design of the cylinder head and block. Cooling fins are used to increase the heat transfer rate of a specified surface. The main aim of the project is to study and compare with 100cc hero motorcycle fin and analyze the thermal properties by varying geometry, material and thickness. Presently material used for manufacturing the models is aluminum alloy 6063 which has a thermal conductivity of 200 W/mK. We are changing the material of fins aluminum alloy 6101 which has a thermal conductivity of 218 W/mK. Engine fins and atmospheric air between have force convection occurs. So that using this material we get more heat dissipation from the fin. Also, get more effectiveness of fin than old material. We are considering fin without insulating at the tip. The boundary condition for fin at 1000 °C thermal temp. And 30 °C atmospheric temp.***

Indexed Terms: ***Engine fin, Heat transfer, Engine cylinder, Heat exchanger***

I. INTRODUCTION

Best fin design should have higher benefits with a lower amount of material. Using aluminum alloy and carbon steel as materials, we will analyze which material makes a better heat transfer. The spacing between the fins and so the number of fins in a specified area must be optimized. Hence, we planned to analysis design parameter which helps to improve the performance of air-cooled engine fins. Parameters such as Geometry, Thickness, Materials & Thermal Conductivity.

Now a day, automobile industries getting a common complaint from a customer of overheating an engine in bikes. This overheating of an engine mainly due to insufficient heat dissipation. Due to the overheating of the engine, it reduces the life of the engine. Also, it damages of an engine part. Insufficient heat dissipation from engine its produce thermal stress on engine parts. To overcome the above problem, we are replacing fin material for increasing heat dissipation. Due to this change, we can also increase engine life.

II. HEAT TRANSFER

Heat transfer is the transfer of thermal energy from a heated body to a colder body. Exchange of heat occurs till body and the surroundings reach the same temperature. According to the second law of thermodynamics, 'Where there is a temperature difference between objects in proximity, heat transfer between them can never be stopped'; it can only be slowed down. Heat is the energy in transit between systems which occurs by virtue of their temperature difference when they communicate. Obviously, conditions of temperature disparity and communication must be fulfilled simultaneously for heat interaction between systems to occur. The finite temperature difference existing between the systems makes the process of heat exchange irreversible, i.e. flow of heat cannot be reversed.

Modes of Heat transfer:
Heat transfer usually includes three separate methods of heat transmission: conduction, convection and radiation. These three modes are similar in that a temperature difference must exist and the heat conversation is in the direction of reducing temperature.

Conduction:
Thermal conduction is a process of heat transmission from a section of higher temperature to a section of low temperature with a medium (solid, liquid, or gases) or between several mediums in direct physical contact. Conduction does not include any transfer of macroscopic portions of matter relative

to one another. The thermal energy may be transmitted by means of electrons which are free to move by the lattice structure of the material.

Convection:

The thermal convection is a process of energy, transference affected from the motion or mixing of a fluid medium. Convection is performing only in a fluid medium and is at once linked to the motion of medium itself. Macroscopic particles of a fluid movement in space cause the heat exchange, and for this reason convection constitutes the macroform of the heat transfer. The effectiveness of heat transfer through convection based largely upon the mixing movement of the fluid. With respect to the origin, types of convection are distinguished; forced and natural convection.

Radiation:

Radiation is the energy transfer in the form of waves through space without any medium other than conduction and convection. Conduction and convection require a medium like solid or gas but radiation only happen in space through electromagnetic waves. The velocity of radiation which can be emitted from an outside at an absolute temperature T is governed by the Stefan- Boltzmann law as $Q = \sigma AT^4$

Where, σ =5.670 ×10 -8 W/m 2 is the Stefan

Boltzmann constant.The black body is ideal surface for emits radiation at Maximum rate, and the radiation transferred by a black body is called black body radiation. Absorptivity α is another important property of a plane, is explained as the division of the radiation energy incident on a surface that is received by the surface. The entire radiation incident on it is absorbed by black body. That is, a blackbody is a perfect absorber (α=1) of radiation.

III. LITERATURE REVIEW

Wankhade S.R (2017): They have design and analysis of cooling fin by study and comparing with100 cc Hero Honda Motorcycle fins and analyze the thermal properties by varying geometry, material, and thickness. Parametric models of a cylinder with fins have been developed to predict the transient thermal behavior. The models were created by varying the geometry like rectangular, circular shaped fins and also by varying thickness of the fins 3mm and 2.5mm. The 3D modeling software used is Pro/Engineer. The analysis is done using ANSYS. Presently Material used for manufacturing the models is grey cast iron which has a thermal conductivity of 53.3 W/mK and aluminum alloy 6063 which has a thermal conductivity of 200W/mK.

Charan et. al. (2018): Analysed extended surfaces, which are commonly used to enhance convection heat transfer in a wide range of engineering applications. The conception of introducing perforations on the lateral surface of fin is to enhance heat transfer rate effectively. From the research, it is evident that tip temperature is minimum for aluminum triangularly perforated with three perforations in it and heat transfer is maximum for triangularly perforated with three perforations of aluminum material. From research study, it shows that Nusselt number increases for perforated fin when
Compared with non- perforated fin. Therefore it is concluded that a three triangle laterally perforated aluminum is most Suitable for the fin applications.

Rajesh et. al. (2017): Analysed the thermal properties by varying geometry, material (Cu and Al alloy 6082), distance between the fins and thickness of cylinder fins. The Fins models are created by varying the geometry circular and also by varying thickness of the fins for both geometries. The 3D modelling software Pro/Engineer &UniGraphics were used. Thermal analysis was done on the cylinder fins to determine variation temperature distribution over time. The Analysis was done using ANSYS. By doing thermal analysis on the engine cylinder fins, it has been concluded that it is helpful to know the heat dissipation inside the cylinder.

Hemant S. Farkade (2012): The main purpose of extended surfaces called fins to increase the heat transfer rate. Fins offer an economical and trouble free solution in many situations demanding natural convection heat transfer. Heat sinks in the form of fin arrays on horizontal and vertical surfaces used in variety of engineering applications, studies of heat

transfer and fluid flow associated with such arrays are of considerable engineering significance. The main controlling variable generally available to designer is geometry of fin arrays. Considering the above fact, natural convection heat transfer from vertical rectangular fin arrays with and without notch at the center have been investigated experimentally and theoretically. Moreover notches of different geometrical shapes have also been analyzed for the project.

Mogaji et. al. (2017): Performed numerical analysis of heat flow through fin of a rectangular profile surface with and without considering radiation heat loss. The effects of physical parameters which include: length, L, thickness, t, fin metal type and emissivity, å, on the fin thermal performance have been comparatively studied. It was observed that heat dissipation rate for the fin with thermal radiation was higher than those without thermal radiation independently of the fin type metal considered in the study. For studying the effect of increasing the fin material emissivity subjected to the cases of considering radiation, heat loss, and appreciable enhancement of the fin thermal performance was observed for Aluminium and copper materials compared to stainless steel material.

IV. CONCLUSION

- We have designed a rectangular fin which used in a 100cc hero Honda motorbike.
- We had replaced the material of aluminium alloy 6063 to the aluminium alloy 6101.
- Hence, we get a better heat transfer rate as compared to aluminium alloy 6063.
- Also, the increase in the effectiveness and efficiency of the fin.
- Maximum work is done on tall fin which is generally used for experimental purpose only.
- Also we can develop a model for the values of total heat flux and temperature distribution by using ANSYS.

REFERENCES

[1] Baljit Ubhi, Pardeep Singh “Design and Analysis for Heat Transfer through Fin with Extension” Research paper in international journal of advanced engineering research and studies in March 2014.

[2] Kuang Yuan Kung, Shih- Chinglo “Transient Analysis of Two Dimensional Fin with Various Surface Heat Effects” International journal of innovative research in science engineering and technology.

[3] G.Angel, N. Sambasiva Rao “Design and Analysis of Cooling Fins” Research paper in national journal of emerging technology and advanced technology.

[4] Ankit Mayank, Ashok Yadav “Design and Analysis of Extended Surface with Different Thermal Conductivity “research paper from the international conference on automotive engineering.

[5] Kiran Beldar, AvinashPatil, “Design and Analysis of cylinder having longitudinal fins with rectangular Notches", International Journal of Scientific Development and Research (IJSDR), 2017.