A Review - Improving the Efficiency of IC Engine Fins by Varying its Material and Shape

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ABSTRACT

When the engine burns fuel, it generates heat. Additional heat is caused by friction between moving parts. Only about 30% of the energy emitted is converted into useful work, while the remaining 70% is removed from the engine to prevent the components from melting. In an air-cooled I.C engine, the outer periphery of the engine cylinder is provided with an extended surface, called a fin, to increase the heat transfer rate. So fin analysis is important to increase the heat transfer rate. The main purpose of this study is to study various studies that have been done in the past to improve the heat transfer rate of the cooling fins by changing the shape and material of the cylinder pins.

Keyword: - *Engine, Fins, Engine Performance, Efficiency*.

1. INTRODUCTION

An internal combustion engine is an engine in which combustion of fuel occurs in the combustion chamber together with an oxidant (generally air). In an internal combustion engine, the expansion of high temperature and high pressure gases produced by combustion exerts a direct force on some components of the engine, such as a piston, turbine blade or nozzle. This force moves the component away and generates useful mechanical energy. Most modern internal combustion engines are cooled by a closed circuit that carries the liquid coolant through a channel in the engine block where the refrigerant absorbs heat and through a heat exchanger or radiator in which the coolant releases heat into the air. Thus, they are ultimately cooled by air, whereas liquid-coolant circuits are known as water-cooled. In contrast, the heat generated by the air-cooled engine is emitted directly into the air. Normally this is promoted by a metal pin covering the outside of the cylinder which increases the surface area over which the air can act. Much of the heat generated by all combustion engines (about 44%) passes through the exhaust without passing through the liquid cooling system or the metal pins of the air-cooled engine (12%). Approximately 8% of the thermal energy enters the oil, which mainly means lubrication, but it also plays a role in heat dissipation through the cooler. Reference numbers must be indicated by square brackets [1]. However, the author name can be used with the reference number of the running text. The reference order of the running text must match the reference list at the end of the document.

There are three types of heat transfer. The first is evangelism. This is defined as heat transfer through the intervening material without bulk movement of the material. Solids have one surface at high temperature and one surface at low temperature. This type of heat conduction can occur, for example, through the turbine blades of a jet engine. The outer surface of the combustor exposed to gas is at a higher temperature than the inner surface of the cooling air adjacent to it. The second heat transfer process is convection or convection heat transfer. The fluid may be gas or liquid. Both have applications in aerospace technology. In convective heat transfer, heat is transferred through mass transfer of non-uniform temperature fluid. The third step is copying or transferring energy through space without the presence of the required material. Radiation is the only way for heat transfer in space. Interference can be important even in the presence of mediated media. A familiar example is the transfer of heat from shiny metal pieces or fire. Convective heat transfer can be increased by providing a thin metal strip between the surfaces and surrounding fluid called the fin. A pin is also known as an extended surface. The pins are used whenever an available surface is not suitable for delivering the required amount of heat. The pins are manufactured in various sizes and shapes depending on the application. The IC engine's air-cooling system is well known for air-cooled systems in which air acts as a medium. The heat generated in the cylinder is used in this system, where the conduction mode passes through the pin into the atmosphere or the expanded surface is integrated around the cylinder.

2. LITERATURE SURVEY

Pulkit Agarwal et al. [1] simulated the heat transfer in a motorcycle engine fan using CFD analysis. It is observed that the ambient temperature drops to a very low value. Resulting in excessive cooling and reduced efficiency of the engine. They concluded that supercooling also affects engine efficiency.

Take Magarajan. [16] studied the heat dissipation of a six-pin engine cylinder cooling fin with pitches of 10 mm and 20 mm and numerically calculated using an Ansys Fluent, a commercially available CFD tool. The engine was 150 C and the heat release from the cylinder was analyzed at a wind speed of 0 km / h. The CFD results were almost identical to the experimental results. So they concluded that they can modify the fin geometry and predict the outcome. Changes such as tapered fins can provide holes and holes in the fin geometry and optimize the dorsal fin.

A.K. Mishra et al. [17] initially performed a temporary numerical analysis with a wall cylinder temperature of 423 K, and the heat release from the cylinder was analyzed for zero wind speed. The heat release from the numerically calculated cylinder is verified with the experimental results. To increase cylinder cooling, the cylinder must have a larger number of pins. However, cylinder cooling can be reduced as the number of pins increases and the fin pitch becomes narrower.

G. Babu and M. Lavakumar [19] analyzed the thermal properties by varying the geometry, material and thickness of the cylinder fins. Models are created by changing the geometry, rectangle, circle, and curved pins and changing the thickness of the pins. The material of the cylinder pin body is aluminum alloy 204 with a thermal conductivity of 110-150 W / mk, aluminum alloy 6061 with high thermal conductivity and magnesium alloy. They conclude that by reducing the thickness and changing the shape of the pin into a curve shape, the efficiency of the pin body can be reduced by reducing the weight of the pin body. Using a magnesium alloy and a round pin reduces the weight of the pin body, increases the heat transfer rate, uses a circular pin, results in high heat loss, high efficiency and efficiency, so it is better to use aluminum alloy 6061 and 2.5mm thick material. more.

S. Chandrakant et al. [20] Experiments were performed on perpendicular and triangular pin profiles for air velocities ranging from 0 to 11 m / s. Experimental and CFD simulation results demonstrate that an annular pin with a rectangular pin profile is better suited for heat transfer enhancement than a triangular pin profile. The surface temperature of the triangular pin profile is higher than the rectangular pin profile at different air velocities. The heat transfer coefficient increases with increasing velocity in both profiles. In comparing two profile rectangular pin profiles, it has a higher heat transfer coefficient than the triangular fin profile.

3. BASIC PRINCIPALES

Cooling systems have many requirements. One key requirement is that the engine will fail if only one part is overheated. It is therefore important that the cooling system keep all components at a suitable low temperature. The liquid cooling engine can change the size of the passage through the engine block, allowing the coolant flow to meet the needs of each area. Locations with high peak temperatures (narrow islands around the combustion chamber) or high heat flow (around the exhaust port) may require sufficient cooling. This reduces the occurrence of hot spots, which are more difficult to avoid with air cooling. Air-cooled engines may use more closely spaced cooling fins in their area to change the cooling capacity, which can be difficult and costly to manufacture. Conductive heat transfer is proportional to the temperature difference between materials. If the engine metal is 250 ° C and the air is 20 ° C, there is a temperature difference of 230 ° C on cooling. The air-cooled engine uses all of these differences.

4. CONCLUSIONS

Here is a brief summary of the completed work and important conclusions derived from this survey.

- Models for three different types of pins were developed and the effects of wind speed and heat transfer coefficient values were investigated.
- The heat transfer rate increases after changing the fin shape.
- Because the geometry of the fin is not uniform, the turbulence of the flowing air increases, resulting in more heat transfer.

The shape and thickness together with the material play an important role in determining the amount of heat transfer from the pin. Oval shaped pins provide better results than rectangular and triangular shaped pins. In addition, the thickness of the pin plays an important role in heat transfer. When we reduce the thickness, the heat transfer rate is increasing to fit the defined shape and material. However, you should understand the strength of your fins until you can withstand the thickness of your fins while reducing the thickness.

5. REFERENCES

[1] Pudiri Madhu and N. Sateesh., An experimental investigation into the Modeling and Simulation of Fins for 150cc Engine, SAE paper (2015)R. Caves, Multinational Enterprise and Economic Analysis, Cambridge University Press, Cambridge, 1982.
[2] D. Merwin Rajesh and K Suresh Design and thermal analysis of cylinder fins by varying its geometry and material, IJME International Journal, ISSN NO: 2348- 4845 (2014)
[3] Thornhill D. and May A., An Experimental Investigation into the Cooling of Finned Metal Cylinders in a free Air Stream, SAE Paper 1999-01-3307 (1999)
[4] Gibson H., The Air Cooling of Petrol Engines, Proceedings of the Institute of Automobile Engineers, Vol.XIV, 243-275 (1920)
[5] Biermann E. and Pinkel B., Heat Transfer from Finned Metal Cylinders in an Air Stream, NACA Report No. 488 (1935)
[6] Masao Yoshida, Soichi Ishihara, Yoshio Murakami, Kohei Nakashima and Masago Yamamoto, Air-Cooling Effects of Fins on Motorcycle Engine, JSME International Journal, Series B, 49(3), (2006)
[7] Zakhirhusen, Memon K., Sundararajan T., Lakshminarasimhan V., Babu Y.R. and Harne Vinay, Parametric study of finned heat transfer for Air Cooled Motorcycle Engine, SAE Paper, 2005-26-361, (2005)
[8] Zakirhusen, Memon K. and Sundararajan T., Indian Institute of Technology Madras, V. Lakshminarasimhan, Y.R. Babu and Vinay Harne, TVS Motor Company Limited, Simulation and Experimental Evaluation of Air Cooling for Motorcycle Engine, 2006-32-0099 / 20066599 (2006)
[9] Pathak Sunil, Turbo charging and oil techniques inlight motor vehicles, Res.J. Recent Sci, 1(1), 60-65 (2012)
[10] Dev Nikhil, Attri Rajesh, Mittal Vijay, Kumar Sandeep, Mohit, Satyapal, Kumar pardeep, Thermodynamic analysis of a combined heat and power system, Res.J. Recent Sci, 1(3), 76-79 (2012)
[11] G.Raju, et al. (2012). "Optimal Design of an I.C. Engine Cylinder Fin Arrays Using a Binary Coded Genetic Algorithms." International Journal of Modern Engineering Research (IJMER) 2(6): 4516-4520
[12] U. Magarajan, et al. (2012). "Numerical Study on Heat Transfer of Internal Combustion Engine Cooling by Extended Fins Using CFD." International Science Congress Association 1(6): 32-37.
[13] A. Mishra, et al. (2012). "Heat Transfer Augmentation of Air Cooled Internal Combustion Engine Using Fins through Numerical Techniques." Research Journal of Engineering Sciences ISSN 2278:9472
[14] J.A. Paul, et al. (2012). "Experimental and Parametric Study of Extended Fins in the Optimization of Internal Combustion Engine Cooling Using CFD." International Journal of Applied Research in Mechanical Engineering (IJARME) 2(1).
[15] G. Babu and M. Lavakumar (2013). "Heat Transfer Analysis and Optimization of Engine Cylinder Fins of Varying Geometry and Material." IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 7(4): 24-29.
[16] S.S.Chandrakant, et al. (2013). "Numerical and Experimental Analysis of Heat Transfer through Various Types of Fin Profiles by Forced Convection." International Journal of Engineering Research & Technology (IJERT) 2(7).
[17] A.R. Kumar, et al. (2013). "Heat Transfer Analysis in the Cylinder Head of a Four-Stroke SI Engine." International Journal of Engineering Research & Technology (IJERT) 2(5).
[18] R.P. Patil and P. H. M. Dange (2013). "Experimental and Computational Fluid Dynamics Heat Transfer Analysis on Elliptical Fin by Forced Convection." International Journal of Engineering Research & Technology (IJERT) 2(8).

[19] N.P.R. Rao and T. V. Vardhan (2013). "Thermal Analysis of Engine Cylinder Fins By Varying Its Geometry and Material." International Journal of Engineering 2(8).
[20] S. Wange and R. Metkar (2013). "Computational Analysis of Inverted Notched Fin Arrays Dissipating Heat by Natural Convection." International Journal of Engineering and Innovative Technology (IJEIT) 2(11)
[21] V. GANESAN, (2008). I C Engines, McGraw-Hill Education (India) PVT Limited