Analysis of Parametric Study of Longitudinal Fins

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Abstract

The extended surface is known as a fin, which is used to enhance the rate of heat transfer from a surface or structures. The fin is used where heat transfer coefficient is low. In fin, heat transfer takes place by means of conduction and convection. The major heat transfer to the surface of fin takes place by conduction and by convection heat transfer from the surface of the fin to the surrounding. In current scenario the heat transfer is very important for any industry; we required better fins, which dissipate more and more heat from the primary surface. Now a day’s fins are mostly used in the electronics industry to avoid the damaging effects of burning or overheating like normal computer or laptop used everything can be placed in small space. The design and selection of any particular type of fin are very important in engineering application, we choose those fins which give maximum heat transfer rate and it depends on the shape or geometry of fin and it is less difficult in manufacturing. The fin should be low cost and lightweight and volume. In this paper we provide a parametric study of longitudinal fins with all above provided parameters.

Keywords: Fins, heat transfer rate

Introduction:

As the fossil fuel reserves are depleting day by day, increasing fuel price raising the technology towards new inventions and research, who provides engines highly efficient and produces high specific power. To increase the thermal efficiency so the IC engine should be maintained at a higher level during heat generation. To prevent the thermal damage it must be required to heat should remove from the engine. Here the area is varied by air velocity. By this area decreases and velocity increases. By semi laminar turbulent there is more heat.

A fin is an extended surface in any object mainly to increase the heat transfer rate for the maximum heat dissipation by convection. Conduction convection defines the rate of heat transfer through fins. Any object which takes parts in heat transfer is done by basically conduction convection or radiation. It is not that much feasible or comfortable to increases the temperature difference between an object and between environment or increases in convective heat transfer coefficient or maybe increases the surface area of the object according to the heat transfer formulation. As first two option is not that much economical and feasible hence the last option can be applied. It would be the best economical solution according to increase the surface area of fins. As in refrigerator and vehicles or motorcycle engines, fins are mainly attached to the cylinder arrangement to increase the heat transfer directly.

Combustion of fuel in presence of air is done on the combustion chamber which takes place inside the engine cylinder. The temperature of gases will be around 2300-2500°C. this is high temperature and may result in the burning of oil film between the moving part and may result in or welding of same. So, this temperature must be reduced to about 150-200°C at which the engine determination work most efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency. so, the object of the cooling system is to keep the engine organization at its most efficient operating temperature.

It is to be noted object of cooling that the engine is quite inefficient when it is cold and hence the cooling system is designed in such a way that it prevents cooling when the engine is heating up and till it attains to maximum resourceful operating temperature then it starting cooling. Fin (or rib) are influential projection provide on the surface of a cylinder block and cylinder head. They incense the external contact area between a cylinder and the air. Fins are generally cast integrally, cast integrally with the cylinder.

In recent years there has been great demand for high performance, lightweight, compact, and economical test transfer components the fin are recognized as one of the most effective means of increasing the heat he dissipated the engine criteria of the find are different for various applications, but the primary concern is weight and cost. Therefore it is highly desirable to optimize the size of fins. The optimum dimensions are those for which maximum heat is dissipated for a given weight or mass of the fin. The most effective heat transfer enhancement can be achieved by using fins as an element for heat transfer surface area expansion the purpose of this study is to establish the most constructive dimensions and shapes for rectangular longitudinal fins any cylindrical pin fins by including transverse heat conduction.

Radiators and heat rejection devices moreover find are also utilizing in cooling of big heat flux electronic devices as well as in cooling of gas turbine blades fins are also used in thermal storage heat exchanger systems including phase change materials. On the other hand, fin design can be difficult such as spiral fin. In adding, fans can have a simple system as in finned tube heat exchangers.

Literature review:

M.G. Sobamowo"***Analysis of convective Longitudinal Fin with temperature-dependent thermal conductivity and internal heat generation***", Alexandria Engineering, Journal Received 10 December 2015; revised 7 March 2016; accepted 12 April 2016 Available online 22 September 2016.

This paper has done the use of finite difference method and to analysis of internal heat generation and heat transfer in longitudinal fin with temperature dependent. The using of finite difference scheme were solved with the aid of Matlab solve by the non-linear equation. The different kind of technique in study of fin are Homotopy Perturbation Meth is helpto calculated the effectiveness of straight fins, Homotype Analysis Method is help tocalculate the effectiveness of straight fins, Variational Iteration Method is help to calculate convective straight & radial fins, Adomian Decomposition Method, In Finite Difference Method any composite body can break into small area, and a lot of more are there for doing analysis on fins. With the help of this paper thermal geometric, thermal conductivity and convective heat transfer parameter when dimensionless temperature distribution falls monotonically. The thermo geometric stricture M, for huge value more the heat convected from the fin through its length and the extra thermal energy is efficiently transfer into the surroundings from side to side the fin length. In insignificant temperature defeat from the fin tip (insulated tip) to the surrounding temperature of fin, the temperature decrease when length of the fin is increase, and the temperature decreasing. In the bottom area the temperature of the fin is decrease. After gone through the reading of this research paper we get the finite difference method to calculate the efficiency and effectiveness of the fin. for further analysis of fin FDM method is used.

Ashish J. Modi,Hardil D Rathor, Prof. (Dr.) Pravin P. Rathod "***Effect of Different Variables on Heat Transfer Rate of Four-Stroke SI Engine Fins- Review Study***", International Journal Of Mechanical Engineering And Technology (IJMET), Volume 4, Issue 2, March - April (2013), pp. 328-333

In this paper for best geometry of fin the analysis of the geometry of fin is required. They do analysis and plan the graph using Microsoft Excel. They show the following effect which will raise the temperature transmit rate. These are the subsequent effect to be measured while designing the fins:-

1). EFFCT OF NUMBER AND THICKNESS OF FINS ON THE HEAT TRANSFER RATE:

Temperature liberate starting the cylinder did not get better when the cylinder have the extra fins and also narrow a fin pitch at inferior blustery weather velocities, for the reason that it is hard for the atmosphere to surge in to the narrower gap among the fins, so the heat between them greater than before. The appearance has been resulting for the fin of the air cooled cylinder. The end was that the optimized fin pitch with the most efficient cooling area at 20mm for non-moving and 8mm for moving.

The difference of the heat Transfer with respect to speed. The temperature move was calculated openly from the fluent software. At nothing velocity it is seen that the

When the speed is increased it can be seen that the temperature express is increased with due to forced convection and also due to the spin generated between two fins which induces turbulences and therefore higher heat transmit. For a better fin thickness, the resultant fin spacing is reasonably small. As a result, the Generated swirled flow may blend with the major flow and result in a higher heat transfer concert.

The heat reassign from 6mm fins is found to be the higher at high velocities. For high speed vehicle thicker fins present better efficiency. When fin thickness was improved, the reduced gap between the fins resulted in swirls being created which helped in increasing the heat transfer. huge number of fins with fewer thickness can be selected in high velocity vehicles than wide fins with fewer numbers as it helps propose better turbulence.

2). EFFECT OF PERFORATIONS, NOTCHES AND CHANGABLE GEOMETRY ON HEAT TRANSMITT RATE OF FINS:

The study by ANSYS shows that thermal flux is additional for the fins with perforation as compared to fin with no perforations. Thus we can say that the heat transfer improves with the calculation of perforations. It is also experiential that the thermal flux increases with increase in puncture aspect in raised up to certain dimension, then yet again it decreases. The analysis is also done for special materials of subjective thermal conductivities, such as Mild steel & stainless steel. Outcome exposed are like to that of Aluminum fin. They show that as thermal Conductivity increases thermal flux raise. As the thermal flux is extra the rate of heat transfer would be more for the fins.

It is experiential that heat transfer speed increases with perforations as compared to fins of related size with no perforations. It is renowned that in case of triangular perforations best heat transfer is achieved. It is also finished that heat transfer rate is different for different resources or heat transfer rate changes with change in thermal conductivity. The perforation of fins raises the heat dissipation rates and at the same time decreases the overheads for fin materials also. From this paper we are acquisitive the optimal thickness of fins and the optimal pitch of fin in our research.

Mr. Maniralam, Asst. Prof. "***Design and Analysis of fins of varying geometry and material***", International journal of computer engineering in research trends (IJCERT),Volume 3, Issue 2. Feb 2016

In this paper research - fin is one of the major components, which is subjected to high temperature variations and thermal stresses. In order to cool the cylinder, fins are provided on the cylinder to increase the rate of heat transfer. By doing thermal analysis on the longitudinal fins it is helpful to know the heat dissipation inside the fins.

The principle implemented in this project is to increase the heat dissipation rate by using the invisible working fluid, nothing but air. We be acquainted with that, heat dissipation rate are increased because of surface area are increased, so designing such a big compound engine is extremely hard. The cooling of the cylinder of fin by using air and the cast iron is used for manufacturing a fin. In this thesis, the materials are used as Copper and Aluminum alloy 6082 by changing geometries, distance between the fins and thickness of the fins for the actual model of the cylinder fin body by using all three materials.

Problem identification

As according to the fins study following questions are arises when ever designing of fin and material is done. Two-dimensional numerical investigations of the fluid flow and heat transfer have been carried out for the laminar flow of the fin, designed to work as an air-source . The transferred heat and the pressure drop predicted by simulation have been compared with the corresponding experimental data taken from the literature. Two dimensional analyses of the fins with varying geometry have been conducted. Simulations have been performed for different geometries with varying louver pitch, louver angle and different louver blade number. Constant inlet air temperature and varying velocity ranging from 2 to 8 m/s was assumed in the numerical experiments. The air-side performance is evaluated by calculating the temperature and the pressure drop ratio. Efficiency curves are obtained that can be used to select optimum louver geometry for the selected inlet parameters. Different cases of various fin geometry for different air velocities were investigated. The maximum heat transfer improvement interpreted in terms of the maximum efficiency has been obtained for fin . The presented results indicate that varying geometry might be a convenient way of enhancing performance of fins.

Methodology

Three fin materials namely aluminum, copper and steel were considered to study the effect of pin fin thermal conductivity on the performance of the . Heat transfer from pin fin arrays was assumed while considering the effect of the fin material. The characteristics of the convective heat transfer from pin arrays can be understood from the temperature contours in fluid and solid parts of the computational domain . It is seen that the fluid adjacent to the fin attain the maximum temperature. Heat is transferred from the bottom heated plate to the fin by conduction and from fin to the air by turbulent convection. The temperature difference between the fin and the air decreases in the downstream direction. The air takes heat from the fin and hence the temperature of the air increases. It was observed that for the aluminum fin the exit temperature of the air is the maximum and for steel fin it is the minimum . The temperature difference between the fin and the surrounding air decreases along the computational domain . The global Nusselt number is more for aluminum fin compared to that for the other two fin . It was also observed that as the inlet velocity increases, the outlet bulk temperature decreases for all cases due to large convective heat transfer at high inlet velocity. The principle implemented in the project is to increase the heat dissipation rate by using the working fluid , nothing but air . We know that by increasing the surface area we can increase the heat dissipation rate. The main purpose of using these cooling fins is to cool the component by air. The main aim is to analyze the thermal properties by varying geometry, material and thickness of fins. Transient thermal analysis determines temperature and other thermal quantities that vary over time. The variation of temperature distribution over time is of interest in many application such as in cooling. The accurate thermal simulation could permit critical parameters to be identified for improved life.

Material Study for Fin

Material	Density Kg/m^3	thermal diffusivity m^2/s	Specific Heat J/Kg K	Thermal Conductivity W/m K	Melting Point (Celsius)	Ultimate Tensile Strength MPa	Young's Modulus GPa	Cost INR/Kg
1. Aluminum	2707	84.18X10^{-6}	896	204.2	659	483	70	147
2. Copper	8954	112.3X10^{-6}	383	386	1083	220	117	467
3. Iron	7897	20.34X10^{-6}	452	72.7	1482	350	211	200
4. Nickel	8906	22.66X10^{-6}	446	90	1452	150	170	847
5. Silver	10524	170X10^{-6}	234	419	951	170	83	41552
6. Tin	7304	38X10^{-6}	226	64.1	231.9	200	47	1365
7. Brass	8522	34.12X10^{-6}	385	110.7	927	500	97	319
8. Steel	7854	17.7X10^{-6}	434	60.5	1371	270	290	60
9. Mild steel	7753	9.7X10^{-6}	486	36.3	1350	841	200	50

10. Cast iron	7272	$17X10^{-6}$	420	52	1204	200	130	70

Different alloys of aluminum –

Material	Composition Weight %	Thermal Conductivity W/m K	Density Kg/m^3	Specific Heat KJ/Kg K	Ultimate Tensile Strength MPa	Melting Point (Celsius)
Aluminum Alloy 6061	Al -(95.8-98.6) Mg-(0.2-0.8) Si-(0.4-0.8) Cu-(0.15-0.4) Other max 0.005	167	2700	1.25	310	582
Aluminum AlloyA204	Al-(94.6- 97.8) Mg-(0.17-0.74) Si-(0.37-0.67) Other max 0.005	125	2850	1.68	280	510
Aluminum Alloy6082	Al-(97.3-98.5) Mg-(0.6-1.2) Si-(0.7-1.3) Mn-(0.4-1.0) Cr-(0.1-0.25) Other max 0.00025	180	2700	1.5	295	555
Aluminum Alloy6063	Al-(97.5-98) Mg- (0.45-0.90) Si-(0.2-0.6) Fe-(max 0.35) Cr-(maxo.1) Zn-(max 0.1)	200	2700	1.0	241	616

RESULT ANALYSIS

These are the following result we obtained from the Analysis

Categories	FIN – 1		FIN – 2		FIN – 3		FIN – 4	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Temperature (C)	600	520.09	600	520.13	600	520.92	600	544.02
Total Heat Flux	1.6338e5	2100.5	1.615e5	3014.1	1.6392e5	1288.4	77934	3022.9
Directional Heat Flux	77156	- 5737.3	1.4063e5	- 7694.3	1.3319e5	- 3810.2	77156	- 5737.3

CONCLUSION:-

From the above result we came to the conclusion that Fin – 1 is more effective than all of the other because its heat transfer rate is more as compare to another. Since we can see from the above result that all the three fins (FIN -1, FIN – 2, FIN – 3) having the value of heat transfer is nearly equal to each other. So we can say that the above three fin is more effective as compare to FIN – 4.

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