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A Review on Improvement in Engine Performance by Application of Controlled Cooling Method

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Abstract

The temperature and cooling effect plays a major role in deciding the performance factors in Engines.In liquid cooled engines there is a option for controlled cooling by controlling the circulation of coolant around the cylinder.But in the air cooled engines,there is no such option on cooling and which is operated always in open air. During cold condition when the engine starts it looses heat even when before it reached the optimal temperature. This delay results in higher fuel consumption and lower thermal efficiency. In this paper attempt was made to review the effect of adopting Controlled cooling method for Air cooled engines by maintaining optimal temperature of an engine always with a option to cool it only when the engine overheats beyond the optimal temperature limit.

Keywords: Heat Transfer,Air cooled Engines,Controlled Cooling Method,Engine performance,Forced Convection

Introduction

Air cooled motorcycle engines release heat to the atmosphere through forced convection. The rate of heat transfer depends upon the wind velocity, geometry of engine surface, external surface area and the ambient temperature. Motorbikes engines are normally designed for operating at a particular atmospheric temperature. There is an optimal cooling rate of an engine for its efficient operation. If the cooling rate decreases, it results in overheating leading to seizure of the engine. At the same time, an increase in cooling rate affects the starting of the engine and reduces efficiency[1]

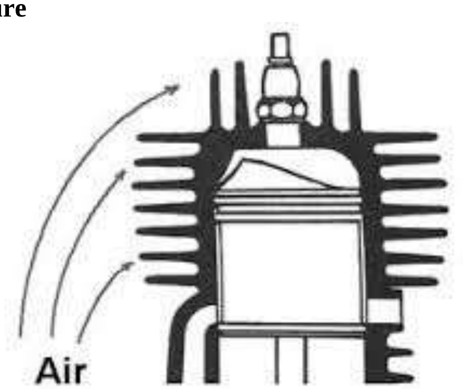
Heat transfer have a major influence on engine efficiency, performance and emissions for a given mass of fuel within the cylinder. Higher heat transfer to the combustion chamber walls will lower the average combustion gas temperature and pressure and reduces the work per cycle transferred to the piston. Thus specific power and efficiency are affected by the magnitude of engine heat transfer. Although the heat losses are such a substantial part of the fuel energy input, elimination of heat losses would only allow a fraction of heat transfer to combustion chamber walls to be converted to useful work[2]

The improvement in efficiency of air cooled engine in motorbike is the major area of study in this paper. The maximum efficiency closely depends upon the rate at which the cooling occurs, during starting period. Due to various operating conditions and environmental factors there is a fluctuation in the engine optimum temperature which causes loss in fuel efficiency and power output.[1-12]

Air Cooled Engine

Air-cooled engines have fins extending out from the engine to pull heat away. Cool air is then forced over the fins. For Motorcycles the speed alone moves enough cool air over the fins to keep the engine cool.

Figure



Air Cooled Engine

The number of fins,material,fin design,location all effects the cooling effect in engines. [3]

Heat Transfer

Heat transfer describes the exchange of thermal energy, between physical systems depending on the temperature and pressure,by dissipating heat. Forced

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convection is a mechanism in which fluid motion is generated by an external source like a pump, fan, suction device, etc During the engine warm-up phase, there are effectively three thermal masses interacting with each other, namely the main engine block, the lubricant and coolant. Of the three, the coolant is the fastest to respond owing to its temperature being closely coupled to that of the combustion gases.

Problem Definition & Objectives

The engine cylinder temperature should be maintained at optimum level for efficient combustion and high thermal efficiency. The engine temperature must be maintained within a precise range of, not too cold or not too hot for complete fuel burning and smooth engine functioning. To achieve that temperature some extra heat is used up in heating the engine cylinder (obtained by fuel burning). If the engine does not make and retain enough heat then it will run too cold and hence performance, economy and emission control may suffer. In motorbike continuous cooling of engine occurs from the very starting of the engine thus makinit difficult to achieve the optimum temperature very early. A method of preventing this excessive heat loss is to use a diffuser in the path of air before it strikes the engine surface. This will help in reducing the air velocity and help in improving the efficiency of the engine[1].

Objective

The main aim is to prevent the air flow until the engine cylinder temperature reaches its optimum level, after engine starts.

Development of a system to monitor and maintain the engine temperature requirements conditions.

Study of Engine performance based on results obtained during various temperature conditions of controlled cooling.

Feasibilty study of Controlled cooling method for air cooled engines.

Components

The components used are Thermocouple, Linear actuator,Transducer with digital display,Baffle and Mileageometer

Engine

A 4-stroke Petrol 150CC Honda Made is used for experiment.

Flow Directing Panel

This is made up of aluminium material, frame thickness of 2mm, rod diameter 11mm, baffle thickness of 2mm, ball bearing of internal diameter 8 mm and outer diameter 22 mm

Process Parameters

1. Stroke: 21mm
2. Voltage: 12VDC +/-2V
3. Working temperature: -40 to +80 C

Methodology

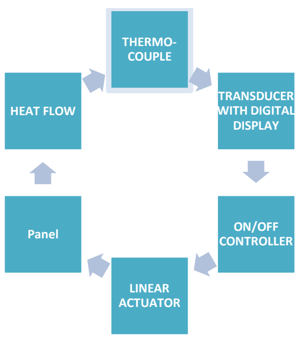
In order to have a controlled cooling method in air cooled engine our main aim is to prevent the flow of air around the engine until cylinder temperature reaches its optimum level, after starting engine. To achieving the same, a panel is provided in front of the engine which operates accordingly with the temperature. The Panel remains in the closed position till the engine reaches its optimum temperature.and opens fully only after reaching the optimum temperature and the air flow starts past the fins and the cooling begins.

Figure

Panel Mounted front of engine

When the engine is started the panel remains in closed position which avoid air entry over the engine.When the temperature of the engine reaches to the set optimum temperature through the input sensor and thermocouple and temperature range .It compares the actual temperature to the desired control temperature and provides an output to a control element. An on-off controller will switch the output only when the temperature crosses the set point and the output required is sensed by electromechanical relay analog output and the panel opens due to the signal received by the transducer.

Figure



System actuating process

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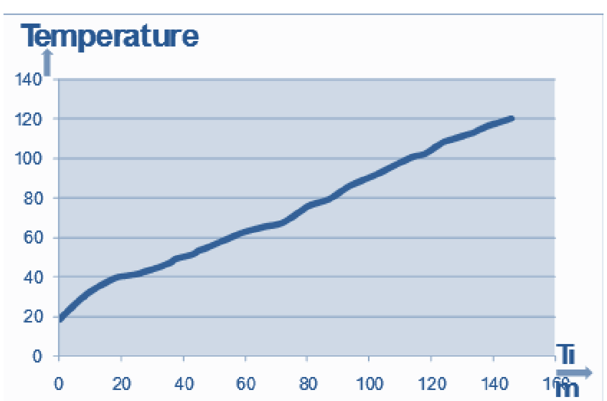
This opening of the panel leads to air cooling of the engine so that engine temperature does not reach to a maximum temperature. In this way the panel helps in providing the maximum efficiency of the fuel by maintaining the optimum temperature of the engine. Finally by using milegometere fuel saved is analyzed.

Results and discussion

During running the engine at normal range it has been found that the optimum engine temperature near the exhaust valve is 105°C. Hence, for the engine used runs smoothly and efficiently at an optimum outside surface temperature of 105°C. The controller is also earlier set to this 105°C temperature. Initially the panel is in closed position. As the engine is started,after few minutes the outside surface temperature near the exhaust valve reaches its maximum value.On achieving this temperature the controller sends a relay signal to actuate the linear actuator. The actuator's piston will move forward and open the panels. So the cooling will begin and will avoide overheating. The controller has a hysteresis loss of 5°C. So when the outside temperature near the exhaust valve comes down to 100°C, the piston of the actuator would move back and closes the panel. By this we get a temperature diffrence of 5°C between 100°C and 105°C making the system not too sensible. The panel continues to opening and closing with their dwell period based upon the optimum outside surface temperature near the exhaust valve. The graph shown below is rise in temperature versus time graph plotted when the motorbike runs with panel. On observing the graph, it can be clearly said that the temperature increase is nearly linear with time. This is because here the cooling is of natural convection since the panels are in closed position until the temperature of the engine reaches its optimum value.

Graph



Temperature with Time(With Panel)

It has been found that the mileage of the motorbike running at an average speed of 45Km/hr is 45.3 Km/lit.with enhancement in milage compared to 43.8Km/lit without panel.

Conclusion

The air cooling system in motor-bike can be effectively controlled by application of air flow controlling panel in front of engine.The mileage of the motor bike increased with flow controlling panel system..It shows that a some amount of heat lost in cooling is converted into useful work. The panel does not affect the engine operation.

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