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RESEARCH COMMUNICATION

EXHAUST ENERGY RECOVERY WITH HEAT PIPE IN 4-STROKE DIESEL ENGINE TEST-RIG

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ABSTRACT

In this paper comparative engine performance is analysed. Performance parameter such as brake thermal efficiency, sound pressure level without heat pipe (without inlet-air-preheating) and with heat pipe (with inlet air preheating) is observed. Exhaust gases energy is used to preheat the inlet air supplied to diesel engine with the help of heat pipe. A heat pipe without bend is used in which working fluid is water. As a result there is an increase in brake thermal efficiency and reduction in sound pressure level.

Keywords: Test Rig, Heat Pipe and Diesel Engine.

1. INTRODUCTION

Total energy is supplied to the engine in the form of heat energy from the fuel. A large amount of energy is expelled to environment through engine cooling system and exhaust gases. Increasing energy problem, economic development and energy crises over the world have caused the automotive world researcher's attention on saving of IC engine exhaust gases energy. The effort is focused on improving overall vehicle energy efficiency. For waste energy can be converted in to useful work by various means. One way to use this energy is to supply the exhaust gas energy into inlet air by means of Heat pipe.

This research work will make use of preheating of inlet air using heat pipe as shown in fig 2. In the heat pipe one end is connected to exhaust gas (Higher temperature) i.e. evaporator heats up and vaporizes the heat pipe fluid, and then rises to the condenser where it is condensed and working fluid return to evaporator, condenser is attached to inlet air (Low temperature) take the heat and condense heat pipe fluid i.e. water.

2. HEAT PIPE OPERATION

A heat pipe is essentially a passive heat transfer device with an extremely high effective thermal conductivity. The two-phase heat transfer mechanism results in heat transfer capabilities from one hundred to several thousand times that of an equivalent piece of copper.

As shown in Figure 1, the heat pipe in its simplest configuration is a closed, evacuated cylindrical vessel with the internal walls lined with a capillary structure or wick that is saturated with a working fluid. Since the heat pipe is evacuated and then charged with the working fluid prior to being sealed, the internal pressure is set by the vapor pressure of the fluid.

As heat is input at the evaporator, fluid is vaporized, creating a pressure gradient in the pipe. This pressure gradient forces the vapor to flow along the pipe to a cooler section where it condenses giving up its latent heat of vaporization. The working fluid is then returned to the evaporator by the capillary forces developed in the wick structure.

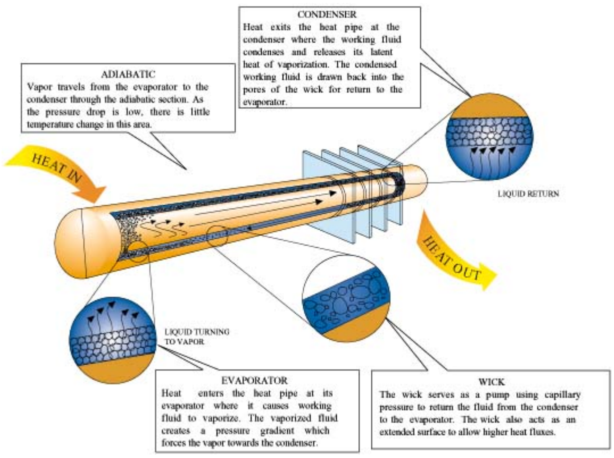

Fig. 1: Heat Pipe Operation. Source[1]

Heat pipes can be designed to operate over a very broad range of temperatures from cryogenic (< -243°C) applications utilizing titanium alloy / nitrogen heat pipes, to high temperature applications (>2000°C)using tungsten/silver heat pipes. In electronic cooling applications where it is desirable to maintain junction temperatures below 125-150°C, copper/water heat pipes are typically used. Copper/methanol heat pipes are used if the application requires heat pipe operation below 0°C. [1]

3. OBJECTIVE

The objective of proposed work is:

- To emphasis on comparative study of brake thermal efficiency at various rpm with and without heat pipe
- To concentrate on comparative study of sound pressure level at various rpm with and without heat pipe.

4. EXPERIMENT SETUP AND PROCEDURE

The experiment was conducted in a four stroke diesel engine. The specification of tested engine has been shown in table

Items	Specification
Type	1-Cylender, 4 Stroke
Bore stroke	80X110 mm
Compression ratio	16.5:1
Type of cooling	Water cooled
Company	Kirloskar

The rpm was measured proximity sensor is attached with dynamometer.

The outlet temperature of cooling water and exhaust gas temperature was measured directly by using thermocouple attached to these lines.

Engine noise was measured at a constant distance from the engine by a sound level meter (Model SL-4010)

- Fill up sufficient diesel in diesel tank
- Check the level of lubricant oil in the sump by oil dip stick. It should be up to top edge of the flat
- Portion provided over the dip stick
- Fill up water in manometer up to half of manometer height
- (iv)Start the water supply and see water is flowing through engine jacket, brake drum and exhaust
- Gas calorimeter
- Release the loading screws, so that there is no tension in the rope.
- Start the engine with the help of auto ignition key
- Load the engine with loading screw and set the balance difference to say 2 Kgs
- Open the burette filling cock, take sufficient diesel in burette and close the cock
- Now turn the selector cock to engine and note down the time required for 20 ml fuel consumption
- Note down the brake drum speed with tachometer
- Note down difference in two limbs of manometer
- Note the following temperatures from digital thermometer
- Note down jacket cooling water and calorimeter water flow rates
- Take 2 sets of reading for different load

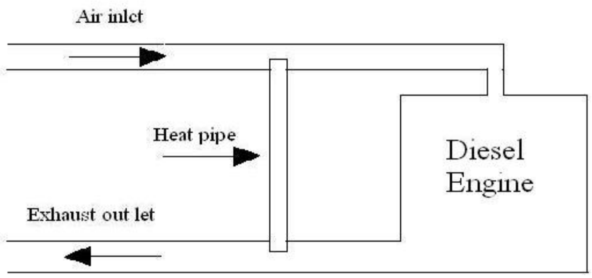

Fig. 2 Experiment Setup

5. RESULT

- Preparing a test rig. Suggest modification that may be desired for our experience.
- After conducting experiment, evaluate the brake thermal efficiency for system.
- Evaluate sound pressure level for system at constant distance.

6. CONCLUSION

In this work an air preheating system has been designed and fabricated and its effect has been tested on diesel combustion and exhaust emissions. The results of this work may be summarized as follows:

Heat energy is recovered from the exhaust gases, which causes lower heat addition, thus improving engine thermal efficiency

Sound pressure level is also decrease with inlet air heating with heat pipe.

7. FUTURE SCOPE

Test conducted for comparison between brake thermal efficiency of engine w/o heat pipe and heat pipe used for air preheating, heat pipe reduce maintenance and operating cost.

This test rig is important for automobile purpose.

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